

IJCSIS Vol. 15 No. 8 (II), August 2017
ISSN 1947-5500

International Journal of Computer Science & Information Security

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Bibliographic Information

ISSN: 1947-5500

Monthly publication (Regular Special Issues)

Commenced Publication since May 2009

Editorial / Paper Submissions:

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47. PaperID 31071782: Proactive Approach to Estimate the Re-crawl Period for Resource Minimization in Information Retrieval (pp. 362-366)

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48. PaperID 31071783: Gene Based Software Refactoring Location Identification and Rectification for Software Code Quality Maintenance (pp. 367-383)

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49. PaperID 30061731: Analysis of Cholesterol Quantity Detection and ANN Classification (pp. 384-390)

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50. PaperID 30061791: A Comparison of Artificial Neural Network and Multiple Regression Analysis in Modeling GDP in Nigeria (pp. 391-405)

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A Comparative Study to Removal Salt & Pepper Noise from Satellite Image

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Abstract-- This paper attempts to undertake study of remove the Salt and Pepper Noise (SPN) from satellite Image in Different Noise densities have been removed between 10% to 60% by using Two types of software programming such as MatLab Programming , ENVI software, they are compared with one another. The comparative study is conducted with the help of Mean Square Errors (MSE) and Peak-Signal to Noise Ratio (PSNR). So as to choose the base software for removal of the SPN noise from satellite image.

Keywords: *Satellite Image, Image noise, Software Programming, Environment Visualizing Images (ENVI) program.*

I. INTRODUCTION

Images obtained from satellite are often used for land records, to see effect of earthquake, etc. these images may be distorted or corrupted by artifacts errors such noise because sending across space, transferred from computer to another or as result storage which affects the accuracy and clarity of the images, these reasons may let sending an image or re-imagine again was very costly and don't logical then many studies to solve this problem we will put some of this studies in brief:

He is defined Salt and Pepper Noise is typically caused by errors in the data transmission malfunctioning pixel elements in camera sensors, faulty memory locations, or timing errors in the digitization process[1]. Wavelet transforms are often used to separate noise from satellite image [2]. They proposed two new algorithms for adaptive median filters. These have variable window size for removal of impulses while preserving sharpness. The first one, called the Ranked-order based Adaptive Median Filter (RAMF), is based on a test for the presence of impulses in the center pixel itself followed by the test for the presence of residual impulses in the median filter output. The second one, called the impulse Size based Adaptive Median Filter (SAMF), is based on the detection of the size of the impulse noise [3].they are defined Two common types of impulse noise are the salt-and-pepper noise and the random-valued noise. For

images corrupted by salt-and-pepper noise (respectively random-valued noise), the noisy pixels can take only the maximum and the minimum [4]. MatLab areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, image processing and many others. Image processing tool box has extensive functions for many operations for image restoration, enhancement and information extraction. Some of the basic features of the image processing tool box are explained and demonstrated with the help of a satellite imagery obtained from IRS(Indian Remote Sensing Satellite) [5]. Convolution filters produce output images in which the brightness value at a given pixel is a function of some weighted average of the brightness of the surrounding pixels. Convolution of a user-selected kernel with the image array returns a new, spatially filtered image. You can select the kernel size and values, producing different types of filters. Standard convolution filters include:

Median — Smooth an image, while preserving edges larger than the kernel dimensions (good for removing salt and pepper noise or speckle). ENVI's Median Filter replaces each center pixel with the median value (not to be confused average) within the neighborhood specified by the filter size. The default is a 3x3 kernel.

Several image enhancement techniques can contribute to manual interpretation the surface geology such as lineament extraction [6 7 8 9].

II. SATELLIE IMAGE

Satellite image is used to obtain information about a target or an area or a phenomenon through the analysis of certain information which is obtained by the remote sensor. It does not touch these objects to verify. Images obtained by satellites are useful in many environmental applications such as tracking of earth resources, geographical mapping, prediction of agricultural crops, urban growth, weather, flood and fire control etc. Space image application includes recognition and analysis of

objects in the images, obtained from deep space-probe missions.

III. MAGE NOISE

Satellite image, containing the noise signals and lead to a distorted image and not being able to understand and study it properly, requires the use of appropriate filters to limit or reduce much of the noise. It helps the possibility of better interpretation of the content of the image this paper is discuss the salt & pepper noise.

A. Salt & Pepper Noise (SPN)

This type contains random occurrences of both black and white intensity values, and often caused by threshold of noise image.

Salt & pepper distribution noise can be expressed by:

$$p(x) = \begin{cases} p_1, & x = A \\ p_2, & x = B \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

Where: p_1, p_2 are the Probabilities Density Function (PDF), $p(x)$ is distribution salt and pepper noise in image and A, B are the arrays size image.

IV. SOFTWARE PROGRAAMMING

This paper is discusses Two type of software programs used to remove the noise from satellite image such as MatLab program and ENVI software.

A. MatLab Program

MATLAB stands for "Matrix Laboratory" which is an interactive, matrix-based computer program for scientific and engineering numeric computation and visualization. It intended to provide easy access to the matrix libraries developed by LINPAC and Eispack projects MatLab is a common computer program using in image processing techniques by using many filters to reduce the artifacts errors in digital image such as noise.

This paper using one filter to reduce the salt & pepper Noise called Adaptive Median Filter (AMF).

I) Adaptive Median Filter (AMF)

Adaptive Filter (AMF) changes its behavior based on the statistical characteristics of the image inside the filter window. Adaptive filter performance is usually superior to non-adaptive counterparts. The improved performance is at the cost of added filter complexity. Mean and

variance are two important statistical measures using which adaptive filters can be designed. Adaptive Median Filter (AMF) is designed to eliminate the problems faced by the Standard Median Filter.

Adaptive median filter works in two levels denotes Level A and Level B as follows:

$$\begin{aligned} \text{Level A: } & A_1 = Z_{\text{med}} - Z_{\text{min}} \\ & A_2 = Z_{\text{med}} - Z_{\text{max}} \end{aligned}$$

If $A_1 > 0$ AND $A_2 < 0$, Go to level B

Else increase the window size

If window size $\leq S_{\text{max}}$ repeat level A

Else output Z_{xy} .

$$\begin{aligned} \text{Level B: } & B_1 = Z_{xy} - Z_{\text{min}} \\ & B_2 = Z_{xy} - Z_{\text{max}} \end{aligned}$$

If $B_1 > 0$ And $B_2 < 0$ output Z_{xy}

Else output Z_{med} -

Where,

Z_{min} = Minimum gray level value in S_{xy}

Z_{max} = Maximum gray level value in S_{xy}

Z_{med} = Median of gray levels in S_{xy}

Z_{xy} = gray level at coordinates (x,y)

S_{max} = Maximum allowed size of S_{xy}

B. ENVI Software

Is the Environment Visualizing Images (ENVI) program software. Today's imagery analysts, scientists, and GIS professionals in a wide variety of disciplines choose products from the ENVI® line of premier software solutions for extracting information from geospatial imagery. ENVI provides advanced, user-friendly tools to read, explore, prepare, analyze and share information extracted from all types of imagery. ENVI is a software application currently marketed by ITT Visual Information Solutions used to process and analyze geospatial imagery. It is commonly used by remote sensing professionals, scientists, researchers, and image analysts. ENVI software makes scientifically advanced image processing and analysis capabilities accessible to all levels of geospatial imagery users. The software uses an automated, wizard-based approach that walks users through complex tasks [10].in this paper we use on filter from ENVI Called Median Filter to removal salt & pepper Noise.

1. Median Filter (MF)

Median—Smoothest an image, while preserving edges larger than the kernel dimensions (good for removing salt and pepper noise or speckle). ENVI's Median filter replaces each center pixel with the median value (not to be confused with the average) within the neighborhood specified by the filter size. The default is a 3x3 kernel [11].

A comparative study was implemented using (MATLAB R2007a, 7.4a) and **ENVI** tested to remove salt & Pepper Noise (SPN) on the image illustrated in the Fig. 1.

V. EXPERIMENS VERIFICATIONS

A. Testing Procedure

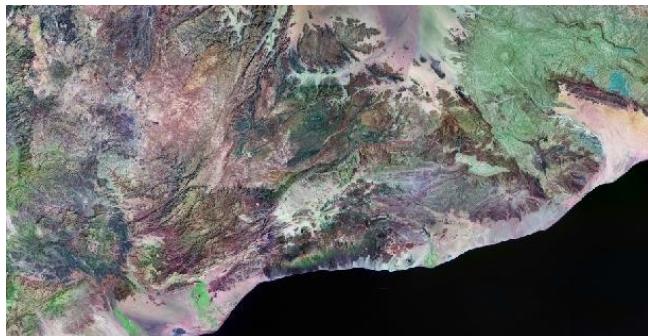


Figure.1 – Original Image

This image, its performance for (SPN) with probabilities densities from 10% to 60%.

B. Simulation Results

Intensive simulations were carried out using one monochromes stillate images are chosen for demonstration. The performance evaluation of the filtering operation is quantified by the PSNR (Peak Signal to Noise Ratio) and MSE (Mean Square Error) calculated using formula:

$$PSNR = 10 \log_{10} \left(\frac{255^2}{MSE} \right) \quad (3)$$

Where,

$$MSE = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N [g(i,j) - f(i,j)]^2 \quad (4)$$

Where, M and N are the total number of pixels in the horizontal and the vertical dimensions of image. g denotes the Noise image and f denotes the filtered image.

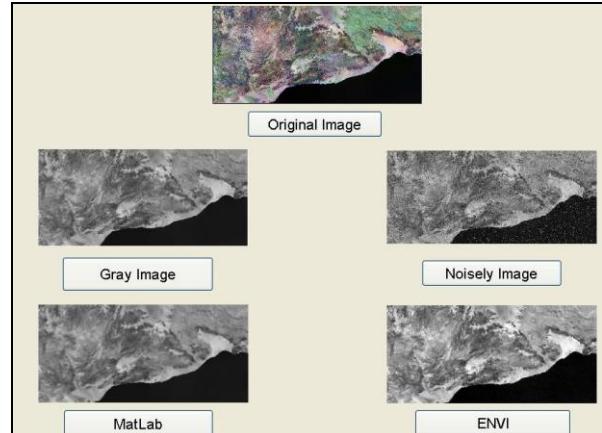


Figure.2: Removal Noise from Image corrupted by 30% intensity salt & pepper Noise

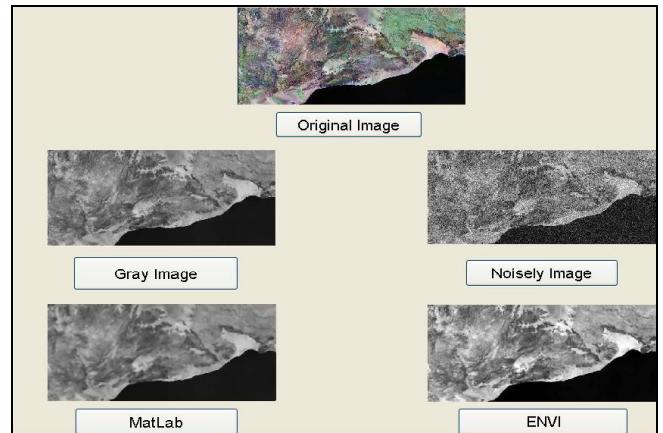


Figure.3: Removal Noise from Image corrupted by 40% intensity salt & pepper Noise

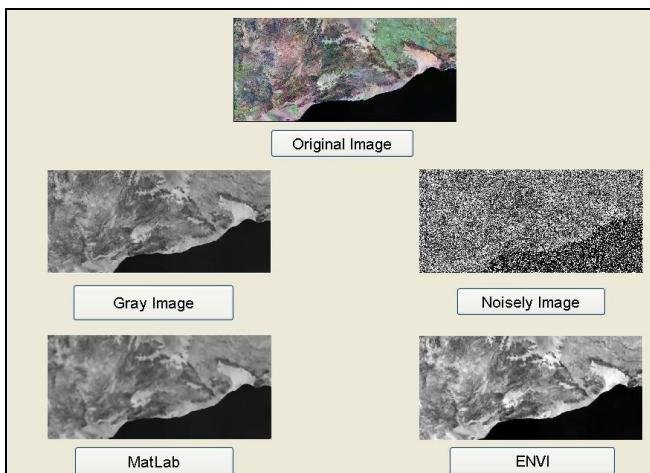


Figure.4: Removal Noise from Image corrupted by 60% intensity salt & pepper Noise

Table. 1: Restoration Result PSNR for Salt and Pepper Noise

Software Name& Filter Type	10%	20%	30%	40%	50%	60%
Matlab AMF	75.24	89.51	100.59	108.52	114.73	119.32
ENVI MF	70.01	88.5	98.30	108.50	114.73	119.32

Table 2: Restoration Result MSE for Salt & Pepper Noise

Software Name& Filter Type	10%	20%	30%	40%	50%	60%
ENVI MF	29.36	28.61	28.10	27.77	27.53	27.36
MatLab AMF	27.81	2853	2800	27.77	27.53	27.36

Figure.5 – PSNR and MSE Analyses for (SPN)

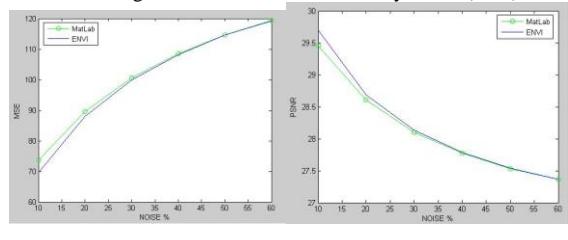


Table 4: Comparative MatLab & ENVI

Types of Software	Time taken for process	Cost of software	Application	Efficiency
MatLab	Less Time	Less Cost	Many Application	83% for noise Density more than 40% and 70% for density less than 40%
ENVI	High Time	High Cost	Only In the GIS	88% for noise Density more than 40% and 75% for density less than 40%

VI. CONCLUSION

In this paper, the comparative studies are explained & experiments are carried out for two software are the best programming to remove SPN noise of satellite image is Matlab see this in the figure(2), figure (3) and figure(4) and also can be see that in table(1)and (2) from MSE ,SPNR respectively and also can be see analyses studies in Fig.5 and a comparative studies results can be shown in table.3.

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Linked List vs. AVL Tree in Modulo Ten Search

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Abstract—There are various kinds of searching algorithms such as Modulo Ten Search, which has been used to find a certain key. This searching algorithm searches a key first by checking the values of modulo ten, and then it follows a linear search. We have used an AVL tree instead of a linked list. The result shows that using an AVL tree in Modulo Ten search improves the searching process.

Keywords- *Modulo Ten; AVL Tree; Linked List.*

I. INTRODUCTION

The most fundamental problems in computing are searching problems; many algorithms have been developed to tackle this problem. Searching is the process used for finding a specific item in a group of items. The most basic search algorithm that can be found is the linear search. This algorithm checks every input sequentially until finding the element. It is suitable for minimum inputs [1]. A binary search algorithm, on the other hand, searches for items inside a sorted array. The item is compared with the middle element in the array. If the item is greater than the middle element, it should be in the upper half of the array ; otherwise, it lies in the lower half [1]. A binary search deals with half an array in the worst case, which is medium for a linear search[2]. However, a binary search tree is a binary search that is modified to deal with information rather than values [3]. It is suitable to organize large files because it is “efficient with both random and sequential access of records, and for modification of a file” [4]. Each node in a binary tree keeps the smaller elements on the right and the greater ones on the left. This leads to an easy search since the comparison with the root will decide the direction (right/left) that should be followed to find the element[5]. It is faster than linear search; however, searching a binary tree can be as slow as linear search if all nodes lie on one side, which depends on the sequences of the input [6]. A balanced binary search tree overcomes the previous problem with binary search trees by having a parameter that can be varied to maintain the balance of the tree[7].

There are many data structures that have been used to store information; one of the basic structures is a link list[8], which is a sequence of elements each of which has a pointer to the next sequential element in the list with the ability to add and remove elements from the list [9]. The searching in a linked list is sequential and time consuming[8]. AVL (a highly balanced

binary search tree) is another technique of data structure which is first introduced by Adel'son-Vel'skii and Landis [10] and it is named after them. The binary tree is called an AVL tree if the heights of the right subtree differ from those of the left subtree by almost one for each node [11]. AVL is completely balanced, which leads to fast searching.

Modulo Ten Search is actually analogous to binary search in the case of small lists [12]. In our paper, we try to use the same technique that has been used by Francis [12] with another data structure, which is AVL tree and compare it with the previous one , which is a linked list in terms of time complexity. We found that using this technique with an AVL tree reduces the complexity of searching especially when we have a huge data base.

II. RELATED WORK

Most algorithms usually used for searching in databases include simple “linear search”, and a lot of other algorithms use a set of search data structures, for example, hash tables, heaps and binary search trees to accelerate various queries for the same database [3]. Besides, there are a lot of algorithms which are prepared practically for recall in very big databases like fingerprinting databases, electronic documents, and bank account records.

Modulo Ten Search is a searching algorithm used to find certain key inside the list using modulus ten of the number. Practically, automatically, the number is to be referred to one of the lists depending on the factor of modulo ten number. There are ten linked lists, each of which stores numbers depending on the values of modulo ten. Linked list one includes numbers whose values of modulo ten are one. Linked list two, on the other hand, includes numbers whose values of modulo ten are two and so on. Therefore, number 95 is to be stored in linked list five because the value of modulo ten of 95 is 5. At last, a consecutive search is to be utilized to establish whether the item is explicit in the linked list or not.

When Modulo Ten Search is used, at first the value of modulo ten of the number is calculated. Based on the modulo

ten value, the corresponding linked list uses a linear search method to check the existence of this item in the linked list [12]. In this paper we replaced the linked list with an AVL tree. The

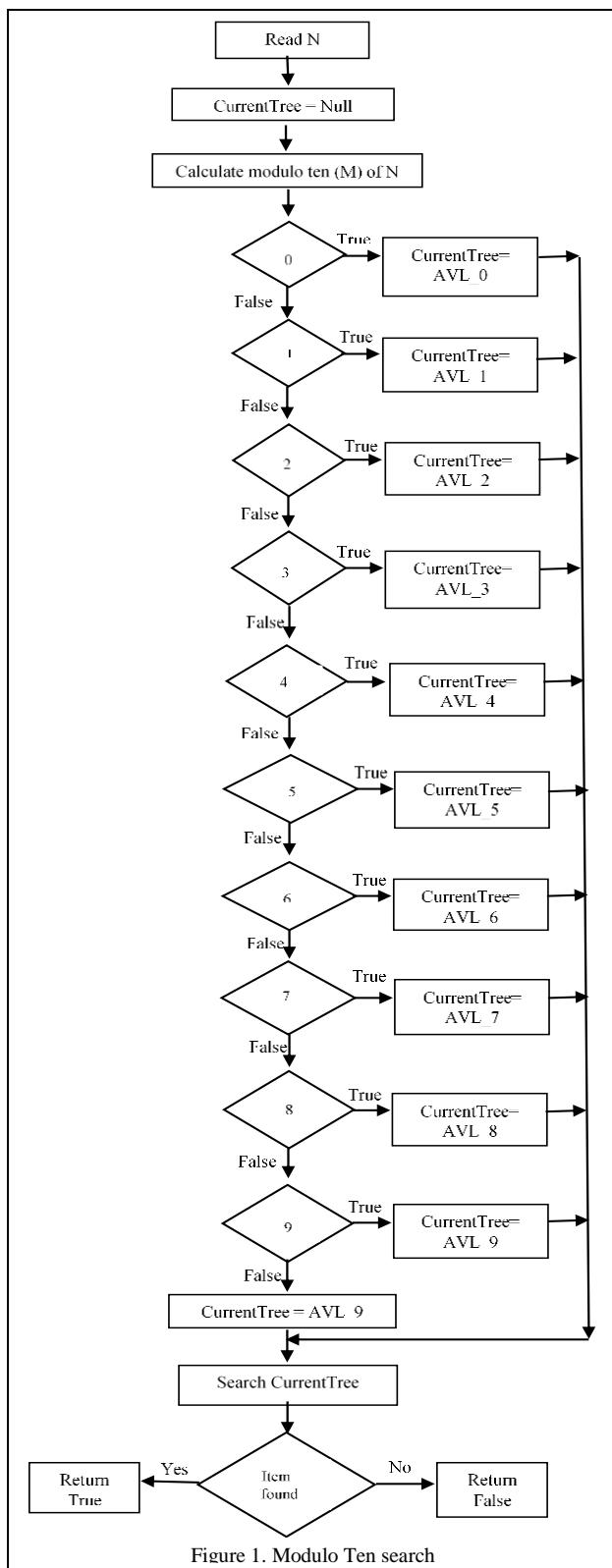


Figure 1. Modulo Ten search

same Modulo Ten has been used by computing the modulo ten for the number. After that we used this number to determine the tree that we are going to search in. Each AVL tree contains all the numbers with the same modulo. Fig.1 shows the pictorial implementation of the AVLS.

III. METHODOLOGY

In Modulo Ten Search we will have ten AVL trees; each tree will store numbers depending on their values of modulo ten. For instance, tree nine will include numbers whose values of modulo ten are nine and tree eight will include numbers whose values of modulo ten are eight and so on.

A. AVL Modulo Ten Search

Our experiment is based on the Modulo Ten Search algorithm {AVL_0 to AVL_9 includes the items}

Firstly: Starts All AVL equal to Null

Secondly: Read the key entered (X) // that X is the element to be found.

Thirdly: Check M which represents the modulo ten value of X.

Fourthly: Check (M) parameter with switch/ case statement,
case 0: AVL_0

case 1: AVL_1

case 2: AVL_2

case 3: AVL_3

case 4: AVL_4

case 5: AVL_5

case 6: AVL_6

case 7: AVL_7

case 8: AVL_8

case 9: AVL_9

Fifthly: Perform search for AVL tree.

Sixthly: End of Modulo Ten AVL Search.

An AVL-tree uses the binary tree as its backbone. This is a powerful structure that supports a large number of operations on an ordered set efficiently. AVL is a binary search tree with the difference in height between the left and right children of any node is at most 1. If at any time they differ by more than one, rebalancing is done to restore this property [13].

B. Implementation

In our experiment we assume to have two-digit numbers, and it will contain a hundred numbers as maximum: from zero to ninety-nine. By applying modulo ten, all AVL trees will have at most ten elements (numbers).

Let us assume that we have these numbers, which are thirty eight numbers as follows:

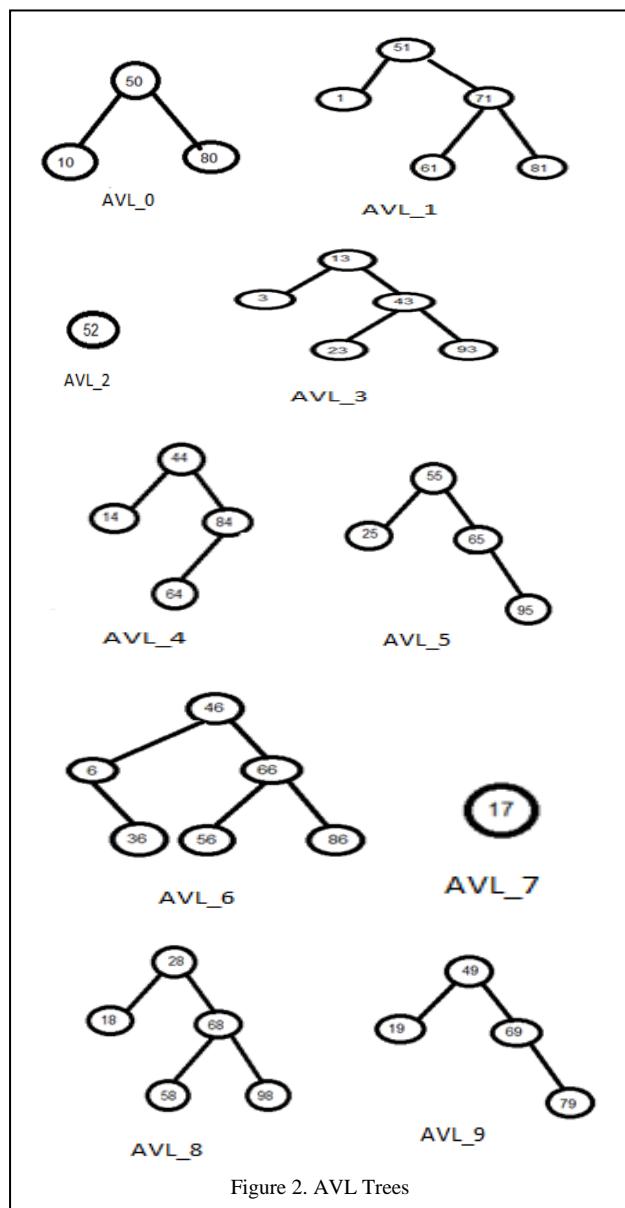
71,23,66,17,98,18,28,68,58,49,84,44,14,64,55,25,81,52,3,13,9

3,43,65,95,6,86,46,10,50,80,61,1,51,36,56,19,69,79

At the beginning the AVL trees do not have any items. Later on, they are inserted inside the AVL trees as in Fig. 2

Assume that a search for the item 86 is applied. Firstly the modulo ten of 86 is to be found, which is actually 6. After that we search the AVL_6. The result of this example will be obtained in three comparisons instead of six comparisons in a linked list.

Assuming that we need to add a new item to the AVL tree, firstly, modulo ten of the number is to be found and then to be added to the identical tree. Assume now that we need to add 87, the modulo ten of 87 is to be calculated, which is 7. Therefore, the number 87 is added to AVL_7.



IV. RESULT AND DISCUSSION

Starting comparisons in Modulo Ten Search is going to reduce the whole linked list to 10 % of Linear Search. Therefore, the complexity of time for Modulo Ten Search is much better than Linear Search [12]. The complexity of time for Modulo Ten Search by using linked list is not better than when we use the AVL tree.

Operations to access an item by position (add ,retrieve, remove) in linked Lists are O(n) in the worst case and O(1) in best case [14] when the item that we are looking for is at the beginning of the Linked List. An AVL tree, however, is a binary search tree with excellent performance guarantees. AVL trees guarantee fast lookup (O(log n)) on each operation [14]. In multithreading, AVL trees are more useful with lots of lookups because of parallel lookups in AVL tree [15].

V. CONCLUSION

The Modulo Ten Search is usually used as another method for the linear search. Further, it can be well-performed if the list appears to be as an AVL tree. The comparison number can be reduced by putting the item which is indicated frequently at the beginning of the list; however; implementing Modulo Ten search with an AVL tree can give faster results especially with bushy applications.

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Optimised Kd-Tree Approach with Dimension Reduction for Efficient Indexing and Retrieval from Multibiometric Database

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Abstract— Biometric retrieval is a challenging task as the size of the databases have increased considerably. In this work, a novel optimized kd-tree algorithm is implemented to enhance the efficiency of indexing and retrieving for a multibiometric database comprising of iris and fingerprints. To improve the retrieval performance, fingerprint image is represented by minutiae features and iris image is represented by texture features and the features are fused together by feature level fusion. Dimension reduction of the feature vector is carried out using Principal Component Analysis to reduce the storage space and increase retrieval rate. The proposed optimized kd-tree indexing technique with dimension reduction aims to overcome the limitations of the existing nearest kd-tree. From the experimental results, it is concluded that the proposed optimized kd-tree indexing algorithm with dimension reduction has reduced False Acceptance Rate and False Rejection Rate and has improved Hit rate to 95% at 60% penetration rate compared to existing nearest kd-tree technique for a multibiometric database.

Keywords- *Indexing; Multibiometrics; Nearest kd-tree indexing; Optimised kd-tree indexing; PCA;*

I. INTRODUCTION

Biometrics is the science of uniquely recognizing humans based upon one or more intrinsic physical or behavioral traits. The number of biometric systems deployed on an international scale is increasing and the size of the underlying databases also increases manifold. As these databases are used extensively for many applications, efficient ways for searching and retrieving relevant identities becomes imperative. Indexing is a process of providing a means for uniquely classifying data which in turn makes items easier to retrieve. Several Indexing techniques for biometric databases have been proposed. But existing systems have drawbacks such as search

time and accuracy [1-3]. Compared to other methods, indexing using multibiometric is an area which is rapidly growing because of its great benefits like accuracy, reliability and provides relatively good performance [4]. Fingerprints and iris are the most widely used parameters for personal identification amongst all biometrics. Most of the finger-scan technologies are based on Minutiae [5], while the eye-scan technologies are based on Iris [6]. Minutia-based techniques represent the fingerprint by its local features, like terminations and bifurcations and Iris-based techniques represent the eye by its texture features that are unique complex random patterns. This approach has been intensively studied, and is also the backbone of the current available multibiometric recognition products [7-8].

Many biometric feature techniques have been proposed in the literature but still there is need for more accurate, fast and efficient algorithms [9]. Many of the existing techniques use single identity or multiple identity features [19]. These features are computationally expensive to compute and there is no standard definition of these features since these features are not defined in the standard template [10-11]. In addition, template size has to be kept as minimum as possible so that the algorithm works efficiently. It has been suggested [12-13] that if the statistical feature of fused biometric information is used for the purpose of multibiometric indexing, it will be more tolerant and robust against global transformations and non-linear distortions. It will also give better results than using global information [14]. Hence a statistical feature extracted from the fused template has been used in this work.

In this paper, an efficient indexing technique which can be used in an identification system with large biometric database has been proposed. To make the indexing algorithm fast and robust, attention is focused on a good indexing technique. This

paper proposes to exploit the merits of the optimised kd-tree indexing technique [15] coupled with high dimensional index selectivity for indexing the multibiomeric database. The paper focuses on the choice of statistical index features, such that it is invariant to distortion. Dimension reduction of the fused feature vector is carried out to reduce the storage space for large databases and reduce the time required for matching. To show the improvements of the proposed optimized kd-tree indexing technique, existing nearest kd-tree indexing is considered as the reference technique. The performance of the proposed technique is analyzed using MATLAB simulation and various performance metrics are computed to demonstrate its superior performance.

The paper is organized as follows. The present section gives the need for efficient indexing technique and related works. In Section 2, the existing nearest kd-tree indexing and proposed optimized kd-tree indexing are discussed. Section 3 explains the dimension reduction technique and its implementation. The simulation results are discussed in Section 4. Finally conclusion is made in Section 5.

II. PROPOSED SYSTEM MODEL

Traditional databases are indexed numerically or alphabetically to reduce the retrieval time of records from the database. In biometric databases, biometric templates do not possess any natural or alphabetical order. Hence, there is a need for an efficient indexing technique which stores the

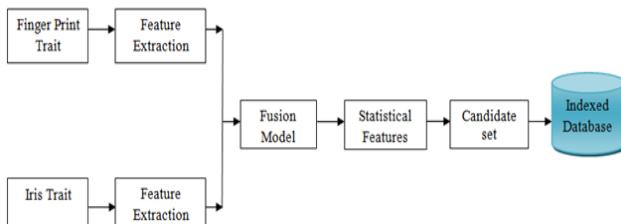


Fig 1. Enrollment stage

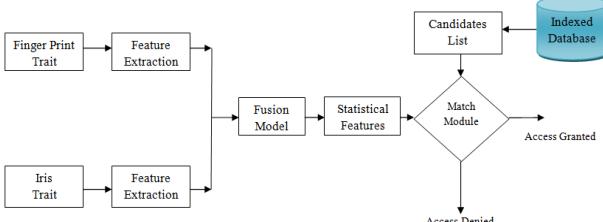


Fig. 2 Recognition stage

templates in some predefined manner so that an efficient retrieval strategy can be achieved. In this work, a multibiomeric database comprising of fingerprint and iris has been used.

The proposed biometric recognition system consists of two

subsystems; one for enrollment and second one for recognition. In the enrollment stage, the biometrics namely, fingerprint and iris are acquired from the individuals, feature sets are extracted from the acquired data and the features are fused together by feature level fusion. From the fused feature set, the statistical feature $f(x,y)$ such as mean and standard deviation are computed and stored in the database as shown in figure 1(a).

Statistical features are more tolerant and robust against global transformations and non-linear distortions and are hence used in this work. Multiple templates per individual are typically used to compute the statistical features for accuracy considerations.

In the recognition stage, biometric data, i.e, fingerprint and iris of the individual is captured, a feature set is computed (query template) and then it is compared with the templates stored during enrollment in the database, as shown in figure 1(b). Thus biometric acquisition, preprocessing and feature extraction stages are required to create a template. To reduce storage space and increase retrieval rate, the reduced dimensional feature vectors are fused at feature level and the fused feature vectors are used to index the database by forming optimized Kd-tree for efficient retrieval. During the retrieval phase, the query template of the user is compared with other dimension reduced indexed templates, estimating the similarity between them. Based on the matching result, the user is authenticated.

A. Nearest kd tree indexing algorithm

kd-tree is a binary tree that represents hierarchical subdivision of space using splitting planes as shown in Figure 2. It is a space partitioning data structure for organizing points in a k dimensional space and useful for searches involving multi-dimensional search key. k denotes the dimensionality of the template and the number of nodes in a kd-tree is equal to the number of templates in the gallery set. Each node in a kd-tree consists of information field, discriminator field, value field and two pointer fields. Information field contains descriptive information about the node, value field contains feature vector values, discriminator field takes a value from 1 to k and pointer fields has pointer value of left and right subtree of the node. At the root, data points are split into two halves by a partition hyper plane and each half is assigned to one child node. Each of the two halves is recursively split in the same way to create a balanced binary tree.

To find the nearest neighbor for a query template, a top down searching procedure is performed from root of kd-tree to a leaf node. According to the nearest neighbor problem, given a point set P of n objects, search the nearest point in P for given query point q.

This problem can be called as nearest kd-tree search, if k points in P which are nearest to q are required as the result. It is called as R-near neighbors, if all points within distance R

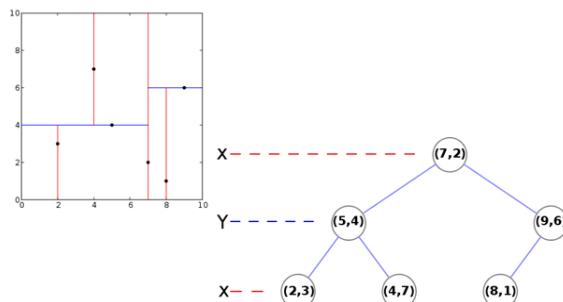
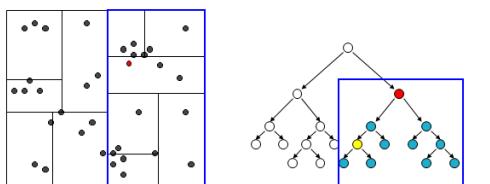


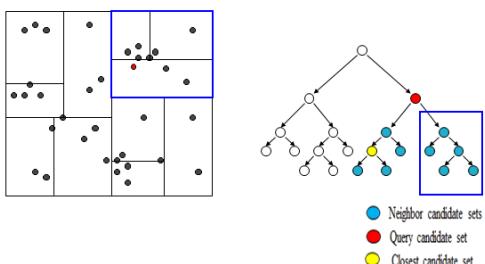
Fig. 2 Pictorial representation of kd-tree structure

from point q are required as the result. In approximation based nearest search algorithm, a point is returned as result if, its distance from the query is at most c times the distance from the query to its nearest neighbor where c is the approximation factor. This is known as c-approximate nearest neighbor's problem. This can also be generalized to c-approximate kd-tree closest point neighbor problem and c-approximate R-nearest neighbor problem.

The kd-tree algorithm has better performance compared to other indexing techniques such as k-nearest neighbour algorithm [16]. However, the drawback of nearest kd-tree algorithm is that it performs poorly if the training set is large. In kd-trees, the partition hyper plane is limited to be orthogonal to the coordinate axis. This results in the space not being well partitioned. Hence more leaf nodes are to be searched to get the nearest neighbors instead of considering only one node.

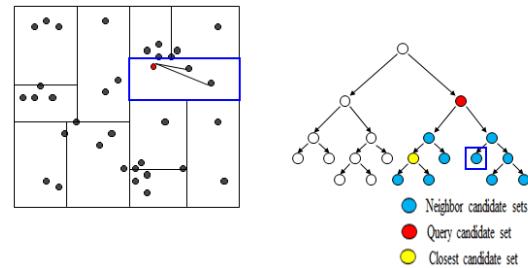


(a) Nearest neighbors on kd-tree

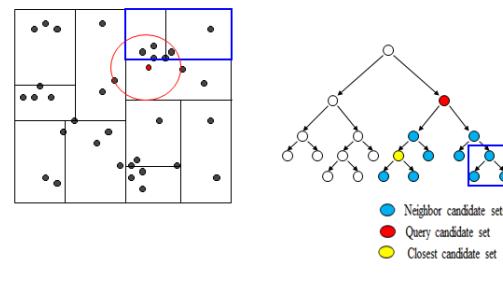


(b) Left subtree on nearest kd-tree

In addition, it is very sensitive to irrelevant or redundant features because all features contribute to the similarity matching. Backtracking is also a challenging issue in nearest kd-tree indexing algorithm.



(c) Right leaf node on left subtree



(d) Left leaf node on nearest kd-tree

Fig. 3 Illustration of Nearest kd-tree algorithm

To understand the drawbacks of kd-tree indexing algorithm, consider the following example of searching the set of samples shown in figure 3(a). The query candidate set is indicated in red, the closest candidate set in yellow and the nearest neighbors in blue. At first, the branch of the tree that is closest to the query point (left subtree) is explored as shown in figure 3(b). At the next stage, the leaf nodes of the subtree are traversed. (Fig. 3(c)). When a leaf is reached, the distance to each point in the node is computed to check for a match. If it is large, as in figure 3(d), then, backtracking is done and the other branch at each node visited are tried. This backtracking results in more search and retrieval time limiting the performance of the kd-tree indexing algorithm.

One of the main reasons that nearest search on kd-tree perform poorly is when there are more number of candidate sets and the best candidate point can be either far from the query point q or else close to the query point q. Hence, the objective of optimising the kd-tree is to reduce the expected number of visited leaves so as to improve the performance. The main advantage of the optimised kd-tree [15] is parameter adjustability, that is, the direction and position of the split axis as well as the maximal number of points.

B. Proposed Optimised kd-tree indexing algorithm for fused biometric database

This paper proposes an approach which tries to exploit the

optimisedkd-tree indexing technique combined with judicious choice of index features for a multibiometric database. To address the issues of the nearest kd-tree algorithm, extended priority search is used where the priority search is implemented among multiple trees to overcome the problem of backtrack significantly. In the existing kd-tree algorithm, searching may require that each data vector be examined. To find the nearest neighbor of each point in a data set of N vectors requires the comparison of $N(N-1)/2$ distances when using a brute force method.

To optimize the kd-tree using extended priority search, the priority level based on radius of hyper plane is fixed. Figure 4 shows the proposed optimisedkd-tree structure.

The innermost red circle indicates level 1 priority and outermost green circle indicates level 2 priority. If the best candidate falls on red hyper sphere then search is stopped else it will move to outermost circle based on radius threshold computation.

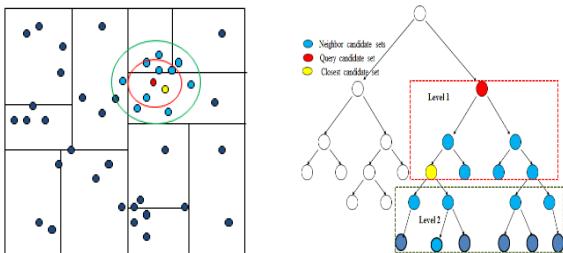
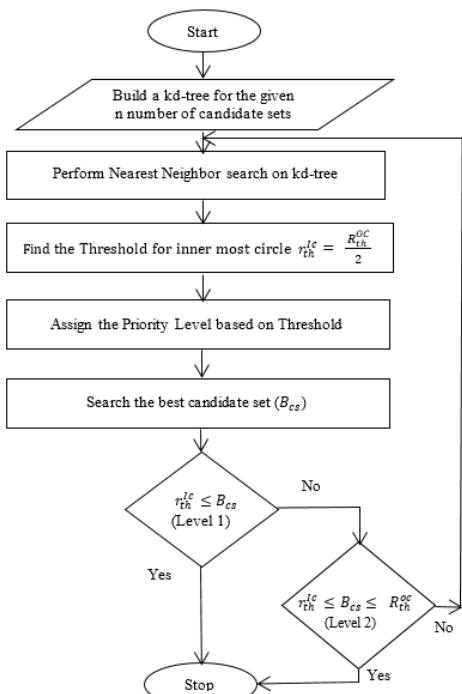


Fig. 4 Optimised kd-tree structure

The radius threshold for query candidate set q and neighbor candidate set p (leaf node) is given by

$$R_{th}^{oc} = \max(\sqrt{q^2 + p^2}) \quad (1)$$

Where, R_{th}^{oc} is outermost circle radius threshold, q is query candidate set, p is end node (leaf) from nearest neighbors and r_{th}^{ic} is inner most circle radius threshold.



C. Algorithm for optimized kd tree

Fig. 5 Flowchart for optimized kd-tree

The optimized kd-tree indexing algorithm involves the following steps:

- 1: Build a kd-tree for given templates from multibiometric database.
- 2: For the given query q, perform nearest neighbor search on kd-tree.
- 3: A nearest search first descends the tree and finds the node that contains the query point as the first candidate. Then it will find the nearest candidate p based on the Euclidean distance limit which will be in the outermost circle.
- 4: A point contained in this outermost circle is often not the closest neighbor.
- 5: A priority search proceeds through other nodes of the tree in order of their distance from the query.
- 6: The priority search is bounded by a hyper sphere (innermost circle) of radius r_{th}^{ic}
- 7: The radius r_{th}^{ic} is adjusted when a better candidate is found. When there are no more nodes within this radius, the search terminates.

The flow chart of the optimized kd-tree algorithm is shown in Fig 5.

III. PROPOSED OPTIMISED KD-TREE INDEXING ALGORITHM WITH DIMENSION REDUCTION

To improve the efficiency of the proposed system model, dimension reduction of the feature vectors is done. This provides the advantages of lesser storage space and faster retrieval from the large database. The dimension reduction of the extracted features is achieved in this paper with the help of popular Principal Component Analysis (PCA) algorithm.[18]. The main advantage of this reduction is to reduce the storage space of template and also to ease the matching algorithm.

A multidimensional feature vector of each trait is first normalized and then, it is projected to a lower dimensional feature space. The reduced dimensional feature vectors are fused at feature level and the fused feature vectors are used to index the database by forming optimised Kd-tree. The proposed method reduces the data retrieval time along with possible error rates compared to optimised kd-tree without dimension reduction using PCA.

A. Dimension reduction with PCA

The given two feature vectors F_I and F_F of d dimension that belongs to Iris and Fingerprint respectively are reduced to s dimension using the PCA. The features extracted from two

traits are of very high dimensions. Since all the features generated are not equally important, proposed technique uses PCA to reduce the dimensions which represents the compact information. In the proposed technique, the two traits features of finger print and iris are reduced from f_{dF} and i_{dI} to f_{sF} and i_{sI} dimensions respectively.

The reduced s dimension features are fused to yield a new feature vector V_{Nt} to represent an individual. The vector V_{Nt} of dimensionality $2s$, ($2s \leq (f_{dF}+i_{dI})$) can be generated by augmenting vectors F_F and F_I of Fingerprint and iris respectively. The fused feature values are then indexed using the Optimised kd-tree.

B. Algorithm for Optimised kd-tree with PCA

The enhanced Optimised kd-tree indexing algorithm including the dimension reduction stage involves the following steps:

- 1: Normalize the feature vectors of each trait
- 2: Reduce the feature vectors using PCA.
- 3: Fuse the feature vectors at feature level fusion.
- 4: Form the Optimised kd-tree with the fused feature vectors for indexing.
- 5: Invoke this indexing technique through multimodal identification system.

In this technique, reduction makes use of Optimised kd-tree structure for organizing the data in such a way that each node can store one biometric template.

IV. SIMULATION RESULTS AND DISCUSSION

Simulation of the proposed model has been carried out using 250 fingerprint images from the FVC database. The fingerprint images were first subjected to preprocessing techniques which include, selecting the region of interest, histogram equalization and normalization. Finally the minutiae features are extracted as per [16-17] and stored. The extracted features for given image is shown in figure 6.

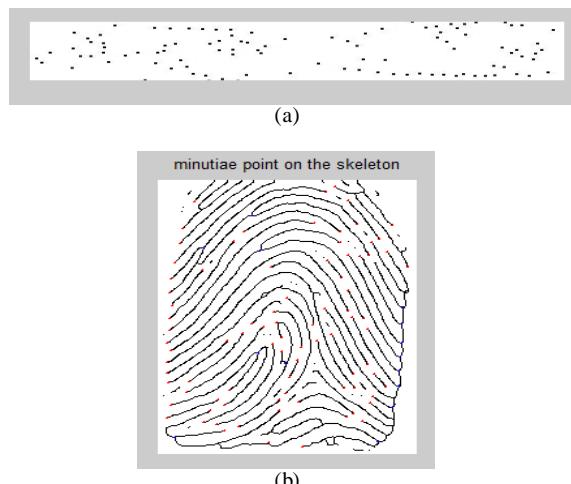


Fig. 6 Minutiae Extraction (a) Skelton image (b) Minutiae points

The iris image is loaded from casia iris V4 database and subjected to preprocessing to remove noise. Iris recognition system comprises of four stages, iris segmentation, iris normalization, and feature extraction and matching.

Iris segmentation separates an iris region from the entire captured eye image by using circular Hough transform and Canny edge detection. Iris normalization is performed to fix the dimensions of segmented iris region to allow for accurate comparisons by using Daugman's Rubber Sheet Model. (Fig.7)

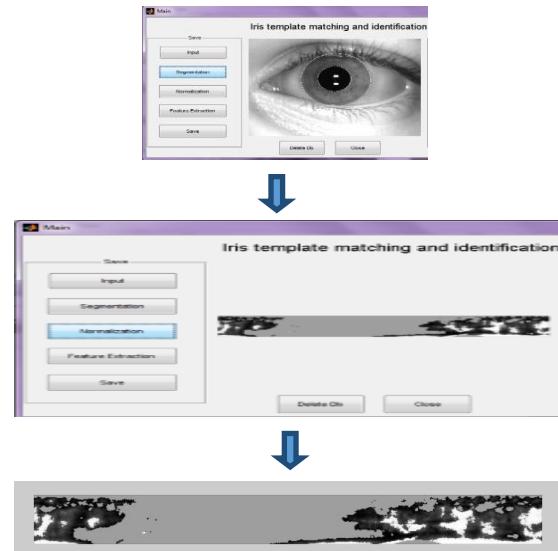


Fig. 7 Iris Texture Feature

The features extracted individually from the two biometric traits namely Fingerprint and Iris are fused using Feature level fusion technique as shown in Figure 8(a).

The feature level fusion is advantageous over other fusion techniques because of its better performance [18]. Figure 8(b) shows the fused feature obtained by applying PCA for the individual features.



Figure 8(a). Fusion of Fingerprint and Iris Features

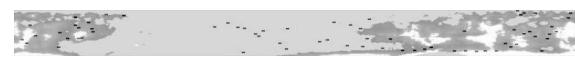


Figure 8(b). Fusion of Fingerprint and Iris features after PCA reduction by 54%

Next, the statistical feature of a fused image namely, mean and standard deviation are computed and this is used as the two dimensional key $f(x,y)$ for improving the retrieval performance for the multibiometric database.

A. Nearest kd-tree indexing algorithm

For the given set of samples, the traditional kd-tree structure is implemented which searches N closest point based on input of query biometric image.

This query image has two dimensional key $f(x,y)$. As shown in figure 9, the blue line indicates x axis tree splitting and red line indicates y axis tree splitting and this is mainly based on depth of the tree (i.e level) in x or y in alteration fashion. The points within the circle indicate the candidate set for the given query indicated by blue star.

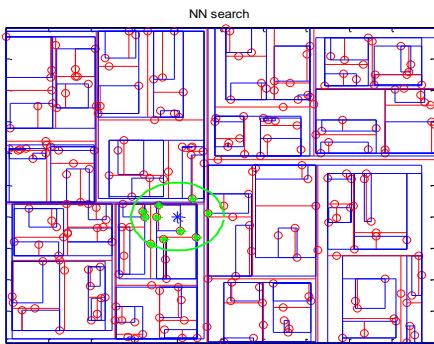


Fig. 9. Nearest kd-tree search

B. Optimised kd-tree algorithm



Fig. 10 Optimised kd-tree search

For the given set of samples, the optimized kd-tree structure is implemented which searches N closest point based on distance between input of query candidate set and neighbor candidate set (leaf node). Here once again, the blue line indicates x axis tree splitting and red line indicates y axis tree splitting. The innermost blue circle indicate level 1 priority and outermost black circle indicate level 2 priority as shown in figure 10. As explained in section 2.2 the priority is set based on the radius threshold. For the given query q, a nearest search first descends the tree and finds the node that contains the query point as the first candidate.

Then it will find the nearest candidate p based on the Euclidean distance limit which will be in the outermost circle.

A priority search proceeds through other nodes of the tree in order of their distance from the query. If the best candidate falls on innermost circle (blue) then search is stopped else it will move to outermost circle based on threshold computation.

C. Performance Analysis

The performance of the proposed system is analysed by testing the accuracy of matching between enrolment module and verification module for a query template to identify an individual for authorization. False Acceptance Rate and False Rejection Rate are calculated based on genuine and imposter authentication during verification. False Acceptance Rate (FAR) is defined the number of times an imposter is authenticated as genuine, as the criteria of reference threshold is fulfilled. It is given by

$$FAR = \frac{\text{Successful fraudulent attempts made for identity } n}{\text{All fraudulent attempts made for identity } n} \quad (2)$$

False Rejection Rate (FRR) is defined as the number of times a genuine person is rejected because the criteria of reference threshold are not fulfilled. It is given by

$$FRR = \frac{\text{Rejected genuine attempts made for identity } n}{\text{All genuine attempts made for identity } n} \quad (3)$$

The unibiometric (fingerprint and iris as individual biometrics) and fused multibiometric indexing methods are compared in terms of FAR and FRR. Typically, FAR and FRR should be low which means imposter is not allowed to authenticate and only genuine user is allowed access.

From the simulated results it is inferred that multibiometric indexing has less FAR when compared to unibiometric and FRR is comparatively reduced to 62.5% as shown in figure 11.

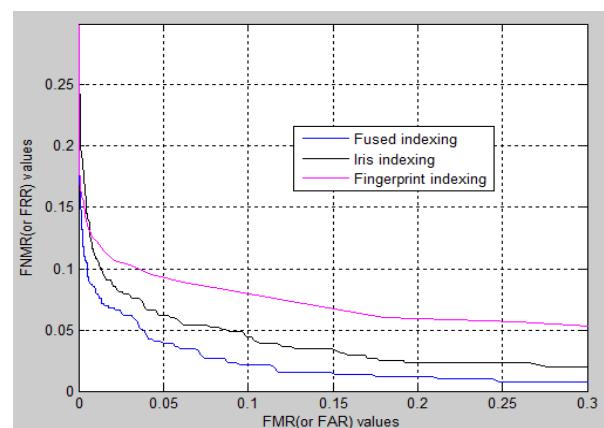


Fig. 11 Comparison of Unibiometric and Multibiometric Indexing

This indicates the advantage of using fused multibiometric template in comparison to a single biometric system. The FAR

is also known as False Matching Ratio and FRR also known as False Non-Matching Ratio. Thus, these two metrics help to measure the accuracy of identification and security level of the system.

D. Hit Rate and Penetration Rate

The nearest kd-tree and optimised kd-tree indexing technique are compared in terms of penetration rate and hit rate. A query image is said to be correctly identified, if one of the retrieved identities corresponds to the correct identity. Hit rate is defined as

$$\text{Hit rate} = \frac{C}{P} \quad (4)$$

Where C is the number of query images correctly identified and P is the number of query images in the probe set.

The Penetration rate is the percentage of entries that have to be retrieved by the indexing scheme for identification of probe entries

$$\text{Penetration rate} = \frac{1}{N} \sum_{i=1}^N \frac{L_i}{M} \quad (5)$$

Where N is the number of tests, L_i is the number of images in the candidate set of i^{th} input image and M is the number of identities in the database.

From the simulated results it is inferred that optimised kd-tree indexing has more hit rate when compared to nearest kd-tree and penetration rate is comparatively reduced as shown in figure 12.

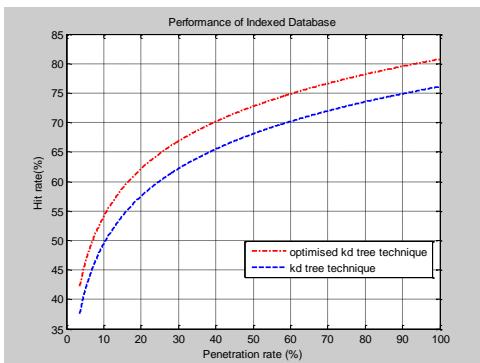


Fig. 12 Hit rate versus Penetration rate

Table 1 shows the comparison between nearest kd-tree and optimized kd-tree and dimension reduced features in optimized kd-tree algorithms for the multibiometric database. If retrieving process take penetration rate of 20%, 40%, 60%, and 80%, the hit rate of the proposed technique is improved by nearly 6% compared to the nearest kd-tree indexing technique with less penetration rate and it also reduces search time compared to nearest kd-tree indexing algorithm.

Thus the proposed optimisedkd-tree indexing technique achieves 75% of reduction in False Acceptance Rate and 62.5 % of reduction in False Rejection Rate which outperforms nearest kd-tree indexing technique in terms of accuracy of identification and security. When the feature vectors of reduced dimension after PCA is used to form the optimized kd tree, the hit rate performance is still better.

TABLE 1.
COMPARISON OF HIT RATE AND PENETRATION RATE

Penetration rate (%)	20	40	60	80
Hit rate (Nearest kd-tree indexing)	57.5	65.5	70.5	74.0
Hit rate (Optimisedkd-tree indexing)	63.0	70.0	75.0	78.5
Hitrate (optimized kd-tree indexing with PCA)	76.4	80	85.9	89.6

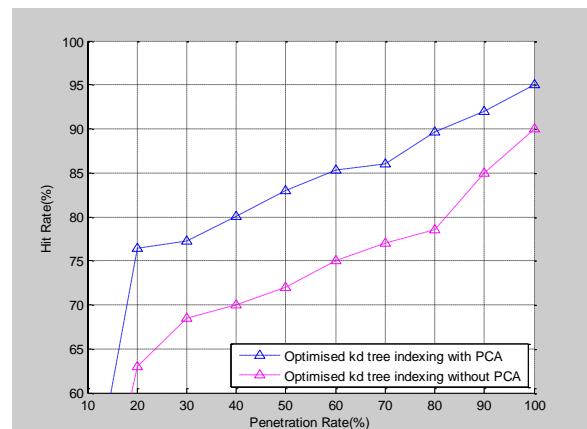


Fig. 13 Comparison of performance with and without PCA

Figure 13 reveals that the hit rate of multibiometric optimised kd-tree indexing with dimension reduction using PCA increased at approximately 20% at different penetration rates compared to the optimised kd-tree indexing without dimension reduction using PCA. This shows the merit of the proposed work.

V. CONCLUSIONS

In this paper, an efficient indexing and retrieving technique based on optimisedkd-tree with dimension reduction using PCA has been proposed for multibiometric identification.

Multibiometric databases require large storage due to huge amount of templates (for example Aadhar database, ATM database and other biometric databases). These types of databases require efficient indexing to improve retrieval efficiency. The experimental results obtained indicates that the proposed indexing technique not only reduces the search space and time but also gives good identification accuracy in terms of hit rate and penetration rate when compared to identification accuracies obtained by conventional database search. The performance results is improved after use of PCA as it reduces the memory space and reduces time required for matching. Future research can also be done to analyze the indexing performance where the database contains multiple samples of a user from different types of sensors.

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Object Oriented Modeling of Space Efficient LSB based Steganography including Compression in Transmission of e-Learning Documents

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Abstract: e-Learning is an application of Information and Communication Technology (ICT). In an e-learning system, transmissions of documents should be kept in secret. Since, the total system is dependent on Internet and Internet is publicly accessible, so there is a great chance of the document, sending between the participants of e-learning system, to be hacked by hackers and may be changed or damaged. So, before transmitting documents, more specifically digitally signed images, if the sender uses the Least Significant Bit based steganography technique including compression algorithms, then secrecy and authenticity can be achieved. Object oriented design is one of the current trends in software engineering and it has several advantages over the traditional design procedure. In this paper, we have wrapped this LSB technique in object oriented models to achieve the benefits of object oriented analysis and design.

Keywords: Haar wavelet transform, LSB based steganography, PackBits algorithm, Unified Modeling Language

I. INTRODUCTION

E-Learning provides the opportunity to learn anytime and anywhere and it is also cost effective and time saving process of learning. In e-learning all the communications between the participants of e-learning- administrator, teacher and learner are done through internet^[1]. All the transmissions of documents like registration certificate, identity card, login-id, password, study material, admit card, mark sheet, certificates are transmitted via internet. Internet is publicly accessible and there is always a great threat of hackers in any kind of communication through internet and due to this, security plays a vital role in e-learning.

In this paper, we will represent our proposed model using the diagrams of Unified Modeling Language (UML), which is compatible with the leading software development methods^[2]. The object oriented modeling of any system assure improved software development quality, improved software maintainability, faster development and lower cost of development by using classes^[3], code reusability, encapsulation, inheritance and polymorphism which are the properties of any object oriented design^[4,5]. Here we use some of the UML diagrams, both from the structural UML diagram and behavioral UML diagram, for the object oriented design of our proposed model.

In our proposed model, we consider the transmission of e-learning documents, most likely images like scanned copy of watermarked admit card, registration certificate, mark sheet etc. between the administrator to learner. Administrator has to choose an image as cover image to embed the secret image and the cover image must be two times in size of the secret image, which he/she wants to send secretly. For the compression of the secret image, we have used Haar wavelet transform and PackBits algorithm. Haar sequence is recognized as the first known wavelet basis, use efficiently in teaching method and also easy to implement^[6]. PackBits is also a fast, lossless compression algorithm for run-length encoding of data^[7] and it is also easy to implement. Here we use it because after the use of Haar wavelet transform, the number of 0's in the digital image become huge in number and PackBits helps to decrease this number. For the encoding purpose, we have used Least Significant Bit technique which is also easy to implement and the bits of the cover image can be easily embedded into the cover image. LSB replacement technique is very secure against attack s such as cropping and compression and the resulting color change is imperceptible^[8]. Here we don't consider the JPG or JPEG type of images, since they are always in compressed form and the compression is done by various compression algorithms. If the administrator use this way of transmission, if the hackers may be able to reach the documents cannot be able to understand about the secret image. Here we consider only color images and the secret images can also be compressed by Haar wavelet transform and to reduce the number of zeros, we also use PackBits algorithm before sending the secret image. If the administrator applies these transforms, then the size of the cover image and the stego image (secret image embedded into cover image) will not differ so much.

In section-II, we will discuss about the algorithm of our proposed model. Section-III.(a) contains some of the behavioral UML diagrams like activity diagram, sequence diagram, use case diagram and in section III(b) we will discuss about one of the structural UML diagrams-class diagram in brief. Finally, we have concluded in section V by citing some future scopes.

II. ALGORITHM OF PROPOSED MODEL

Here we will discuss about the algorithm of our proposed model, which will help to make understand about the way through which we design it. Based on this algorithm, we will prepare the object oriented designs later. In this system, the administrator will choose the secret image and the appropriate cover image to embed the cover image into it and prepare the stego image using LSB based steganography^[9] encoding technique and learner will decode the stego image to get the secret image. The following algorithm is divided into steps due to the secret image and for cover image.

Step1.1: Select the secret image

Step1.2: Convert the secret image into grayscale and divide it in 8x8 sub images.

Step1.3: Create an 8x8 Haar transform matrix H.

Step1.4: For i=1 to 8

Multiply H with the transpose of the i-th row of the current 8x8 sub images to get 8x1 column matrix C(i).

Concatenate all C(i) to get the 8x8 compressed image.

Step1.5: concatenate all 8x8 compressed matrices to get the total compressed image data

Step1.6: Apply PackBits algorithm on the compressed image data.

Step2.1: Choose the cover image

Step2.2: Convert it into binary RGB format and compare the size of cover image with the secret image. The size of secret image should be half of the cover image.

Step3: Retrieve one bit B from the compressed data and one bit P from the cover image. Separate P into 3 channels (RGB) and encodes the bit B using LSB by keeping one channel unchanged. This step will be repeated until the last bit of the compressed data.

III. (a) UML DIAGRAMS

In this section, we will discuss on some of the behavioral UML diagrams like use case diagrams, activity diagram and sequence diagram^[10].

Use Case Diagram: Our proposed model is designed based on the transmission of the scanned images from the administrator to the learner. So, this use case diagram contains two types of objects- Administrator and Learner. The use case diagrams are shown in fig1.1 and in fig1.2.

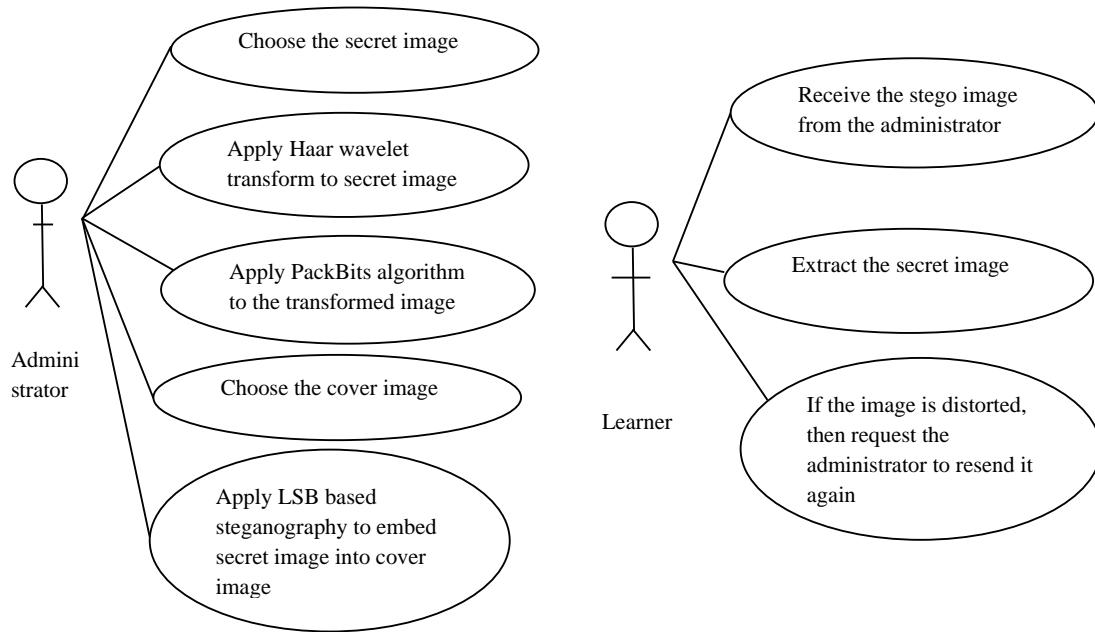


Fig1.1: Use case diagram for administrator

Fig1.2: Use case diagram for administrator

In the above use case model, shown in fig1.1, we discussed about the LSB based encoding of the compressed secret image with the cover image at the administrator's end. Here, administrator will select the secret image and also the cover image and the secret image after being compressed with the help of Haar wavelet transform and PackBits algorithm, will be embedded into the cover image by using LSB based steganography encoding technique.

In the next use case model, shown I fig1.2, we have discussed about the decoding section, which will be done at the learner's end. The learner will decode and extract the secret image from the embedded image, sect by the

administrator. During transmission, if the sego image is distorted due to noise or any other kinds of attacks, then the cover image as well as the secret image will also be affected and the extracted image will be of no use and the learner will ask the administrator to send the document again.

Activity diagram: It is another tool of Unified Modeling Language. It shows the relationship between the activities of the different components of a system which helps in better understanding^[11]. In our proposed model, the numbers of components are two: administrator and learner. All the relationships between these two different components of our system are shown by using activity diagram shown in fig2, in the annexure.

Sequence diagram: A sequence diagram is a tool of UML used to show the interaction among the objects of a design^[12,13]. The sequence diagram of our proposed model is shown in fig3, in annexure. All the scanned documents are stored in the database of the administrator. When the learner requests or when necessary, the administrator sends these documents to the learner. Before sending, due to space efficiency and secrecy the administrator will first apply the compression techniques and then encode it using LSB based steganography and sends the same to the learner. After receiving the learner will decode it and extract the secret image.

III. (b) CLASS DIAGRAM OF PROPOSED MODEL

The class diagram, another tool of structural UML diagram^[14], of our proposed model, is shown in fig4, in the annexure, which is used to show the classes of our model and its attributes and methods and also relations between these objects.

Here we use six classes^[15]: HaarTransform, HaarTransformImage, PackBits, LSBSteganography, Admin and Learner. We will shortly discuss on these classes we have used in sending e-learning documents after compression from administrator to learner.

Class HaarTransform is used as the base class. It contains nine private data members, five public data members and seven private member functions and two public member functions. This class is used to prepare the secret image for Haar wavelet transform.

Class HaarTransformImage is privately derived from the class HaarTransform. It is used to complete the transformation of the secret image by the administrator. It contains five private data members, three public data members and four private member functions and two public member functions.

Class PackBits is used to apply the compression on the transformed image. It contains ten public attributes and two public member functions and one private member function.

Class LSBSteganography is publicly derived from the classes HaarTransform and HaarTransformImage, which contains 20 attributes and 3 methods and all are publicly defined. It is used to embed the secret image into the cover image and send it to the learner.

Class Admin contains nine public attributes and four public methods. The attributes serves the purpose of the methods, which are used to mainly compress the secret image using Haar wavelet transform and PackBits algorithm and encode this secret image into the cover image and send the same to the learner.

Class Learner includes four attributes and three member functions. The member functions are used to receive the buffered image from the administrator and then decode it to extract the secret image.

IV. CONCLUSION

All the advantages of object oriented modeling of any system like data redundancy, data hiding etc. are achieved by implementing the object oriented modeling of the propped system. Secure transmission of any documents also provides privacy and authenticity. Here, the administrator while sending the documents will send it after making it in compressed form, which is very important for sending a large number of documents specifically in case of sending study material to the learner. Other than e-learning system, this proposed model is also applicable for the other online systems, like e-commerce, e-baking, e-governance etc. in case of transmitting scanned documents. If the administrator sends the documents after digitally signed by the certificate authority, then authenticity will be more efficient, which is out of scope of this paper.

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Annexure

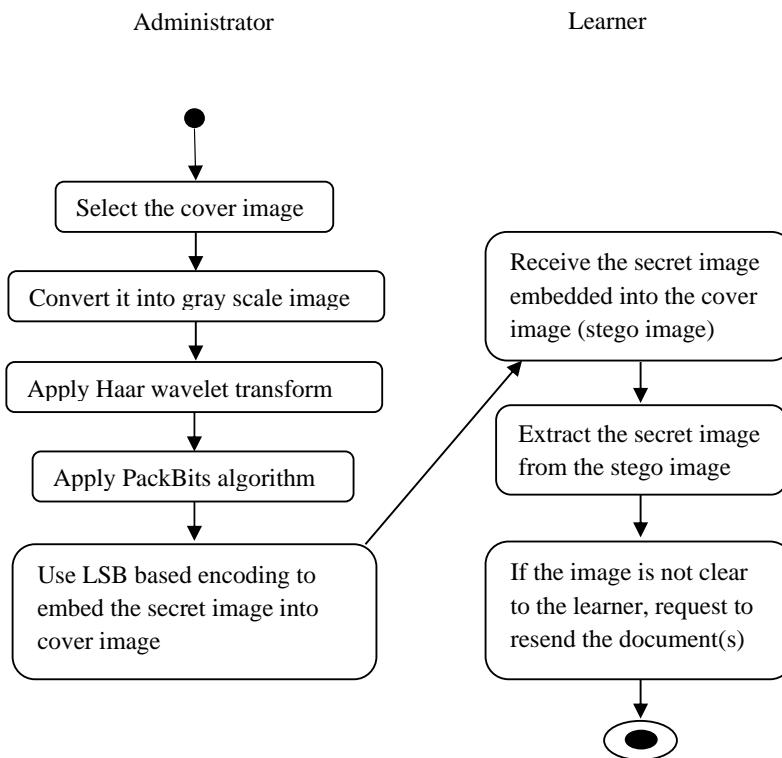


Fig2: Activity diagram for sending image documents from administrator to learner applying LSB based seganography

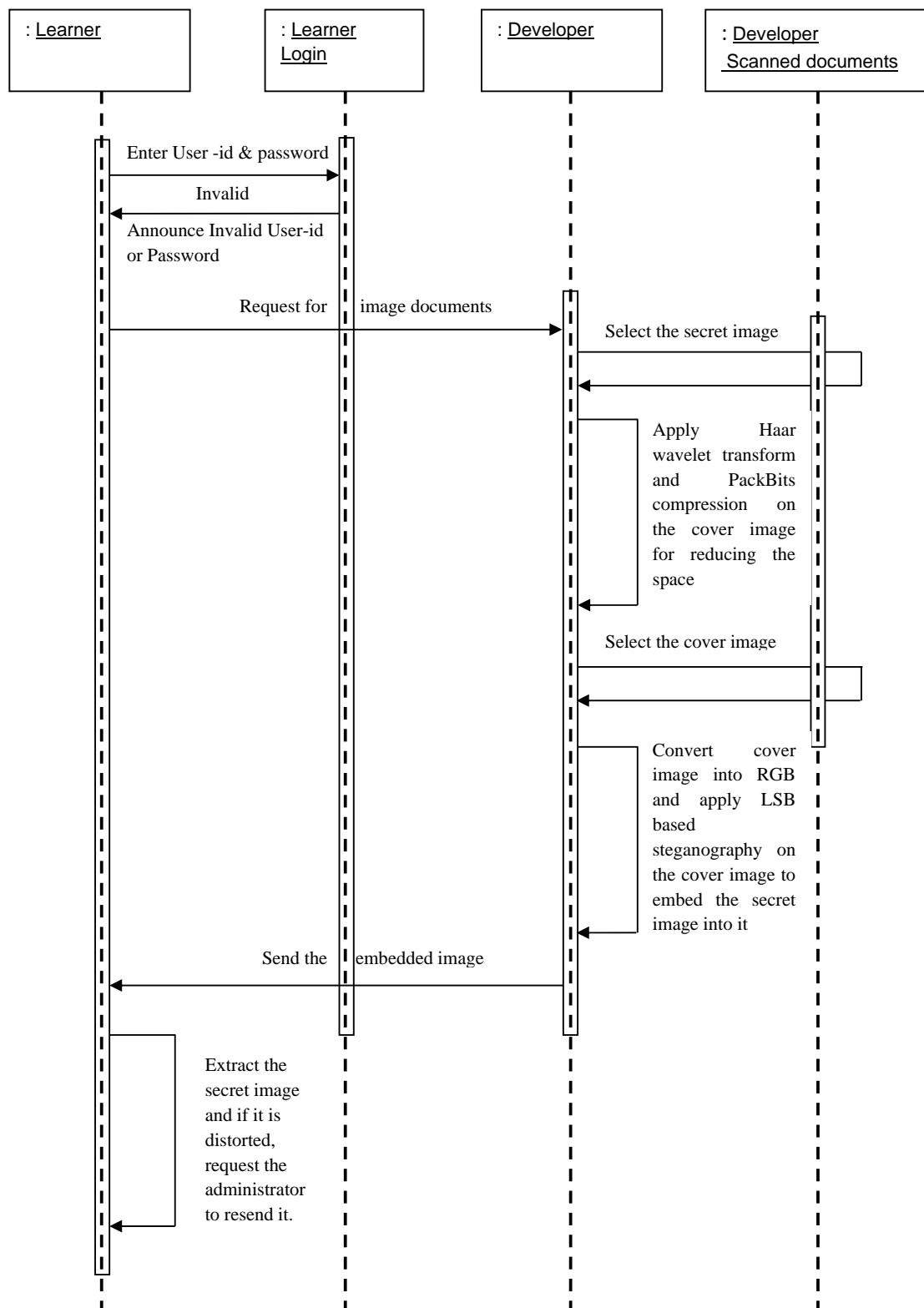


Fig3: Sequence diagram for secure transmission of scanned images in e-learning system

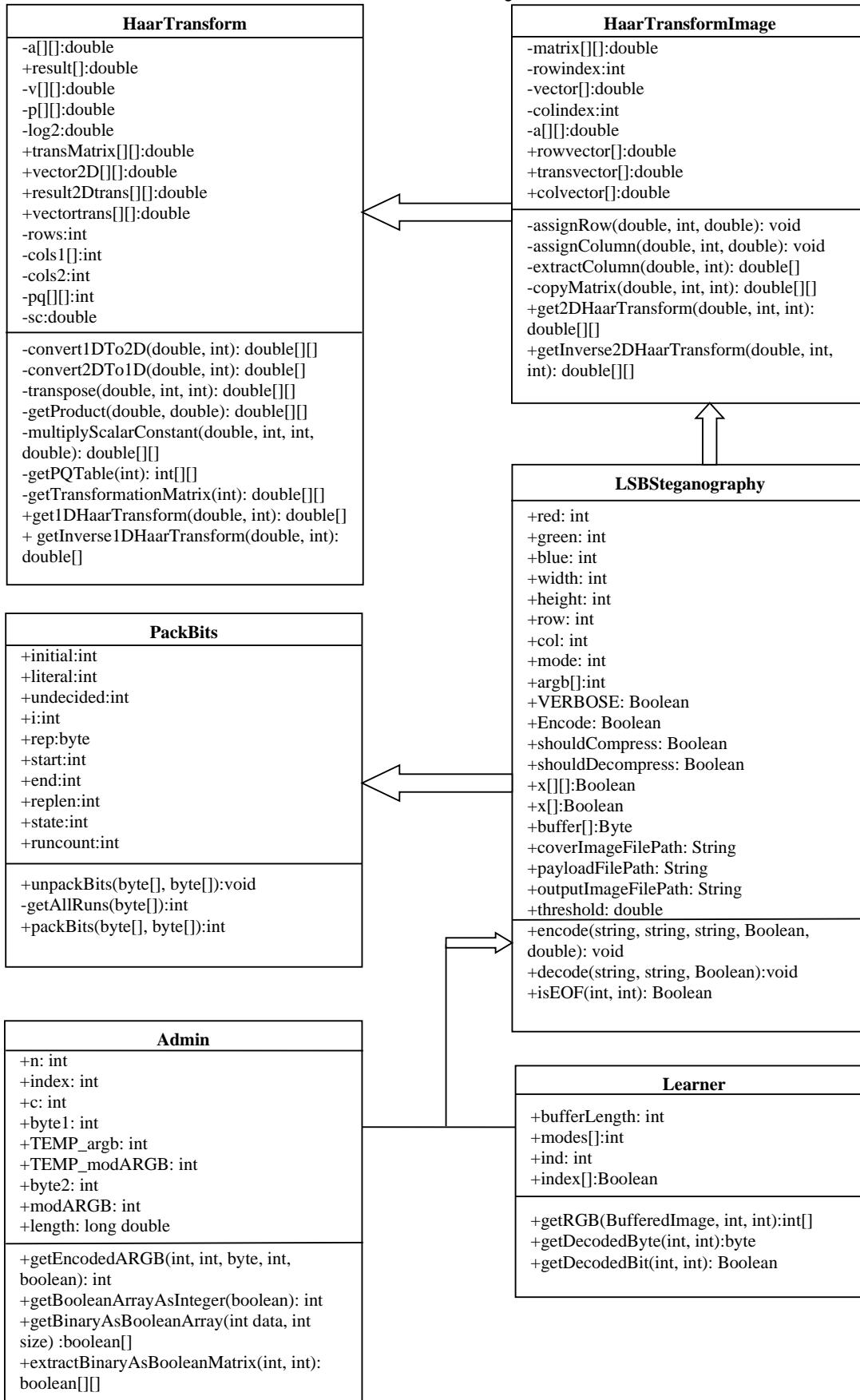


Fig4: Class diagram of proposed model

Performance Enhancement for quality inter- layer Scalable Video Coding

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Abstract: One of advanced video coding standard is scalable video coding (SVC) extension of H.264/AVC, SVC provides multimedia service within variable transport environments. SVC is a large computation complexity in encoding processing, through using the exhaustive search technique. The encoding processing included the select macroblock mode and motion vector layer. This paper introduces a new proposed algorithm to reduce this complexity with saving quality. Scalable quality inter-layer performance enhancement (SQILPE) proposed algorithm depends on analysis amount of change in intensity value of pixels in the MB and video statistics. Experimental results show that the proposed fast mode decision algorithm can achieve computational savings up to 77.6% with almost no loss in quality.

Keywords: motion vector, motion estimation, Quality SVC, SNR SVC, macroblocks.

1. INTRODUCTION

Many heterogenous demands required this day for a video sequence. SVC is one of

recent video coding standards based on H.264/AVC [1] [2], Which provided more resilience in dealing with multiy different requierments of video sequance ensursnce efficient video coding Performance. Through high compression ratio and saving the quality[3].

The SVC/H.264 take considerable time in coding processing for computation the best mode of macroblock and motion estimation through using the exhaustive search techniques [4]. There are eight macroblock models for inter prediction (SKIP, MODE_16x16, MODE_16x8, MODE_8x16, MODE_8x8, MODE_8x4, MODE_4x8, and MODE_4x4) [5] [6] , and two intra modes (INTRA_4x4 and INTRA_16x16 [7] [8].

For the monition vector estimation, there are three-layers full pixel, subpixel (half pixel and quarter pixel) [9] [10].

The reasons for using subpixel come from difference reasons; Sampling: converting, Lighting condition, Noise, Camera shaking: camera shaking can bring motion effect to stationary objects[11] [12].

The Sub-pixel refinement can greatly improve the performance of ME regarding both compression ratio and decoded image quality[13] [14].

Many fast modes decision schemes have been proposed to solve the problem that resulted from using exhaustive search technique. Tae-Jung Kim and et al in [15] introduced fast mode decision algorithm based on coded block pattern (CBP) of 16×16 mode in the current frame and a reference block of best CBP. Seon-Tae Kim and et al. in [16] suggested a method, depends on using information of collocated macroblock and a neighboring block in the base layer to encode enhancement layer. He Li, Z. G. Li and et al. in [17] developed an algorithm based on the relation between a base layer (BL) and enhancement layer (EL) number of candidate mode.

This paper introduced proposed an algorithm to enhancement the problem of encoding complexity in two phases. First one for the select the MB modes and the second phase for select motion layer depends on many

characteristics as video statistics [18] [19], change of pixel value intensity [20] [21], object belong to background or foreground. All details will be discussed in the following sections.

The rest of the paper is organized as follows: Section 2 gives the description of the proposed algorithm. The proposed Algorithm experiments and results; are introduced in section 3. Finally, section 4 represents the conclusion.

2. Scalable Quality Interlayer Performance Enhancement(SQILPE)

Scalable Quality Inter-layer Performance Enhancement (SQILPE) proposed algorithm Outlined in fig.1. This algorithm depandes on many charatrisctics; analyisis the change in the pixels intistiy vlaue, stady the video statstics, and extract back ground objects and for ground objects, relation bettwen the size of blocks and the quaity of the encoded MB. Links these flages with others to achive our targets from this proposed algorithm

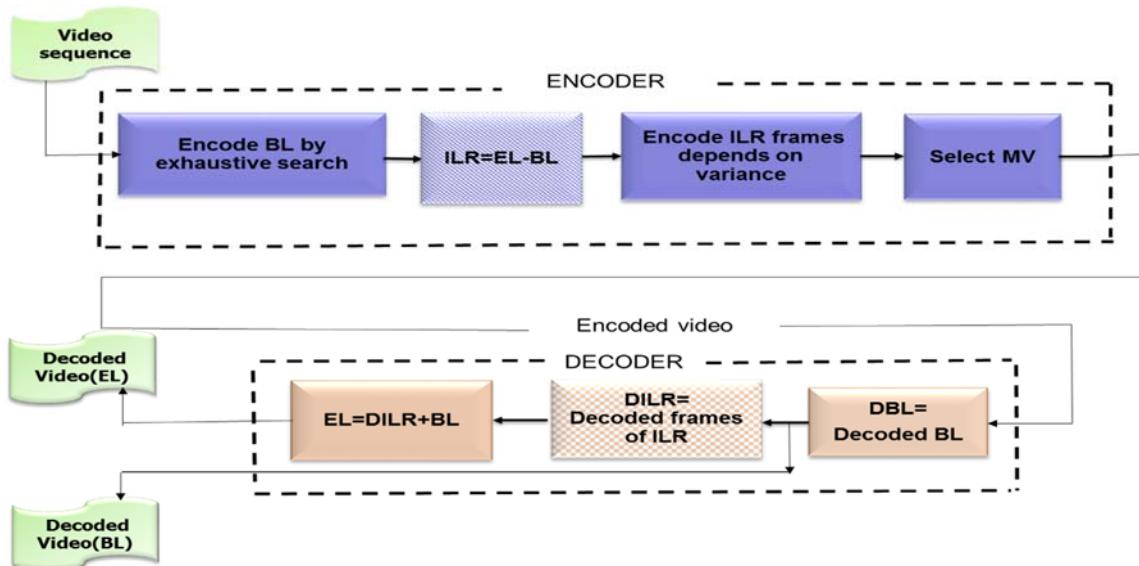


Figure 1: Scalable Quality Inter-Layer Performance Enhancement proposed algorithm

The proposed algorithm work on two phases as follows :

First phase: select the best macrblocks depandes on the the change in the intinisty pixels value for MB and the vido statistics. And tradeoff between blocks size and mode where blocks are bigear as MB16*16 This achive good and fast encoding processing at the expense of quality on the other hand side the smaller block size saving the quality with incrasing unmrber of bits and incrasing the encoding time[22]. SQLPE proposed algorithm illustrated in fig.2 start by divid frame the block as MB 16*16 and analysis intinity value in the MB using varianc [23] [24].using the following equation :

$$\sigma^2 = \frac{\sum(x-\mu)^2}{n} \dots\dots\dots (1)$$

$$\mu = \frac{\sum x}{n} \dots\dots\dots (2)$$

Where σ^2 an μ represent variance, and mean respectively.

IF $\sigma^2_{MB16*16} < TH1$; Which means the low variance; in this case the MB 16*16 is the best choice .now the proposed algorithm select the mode (inter or intra)of the selected size of MB depends on analysis the video statistics using zero mean normalized Crosse correlation [25] [26] according the following equation:

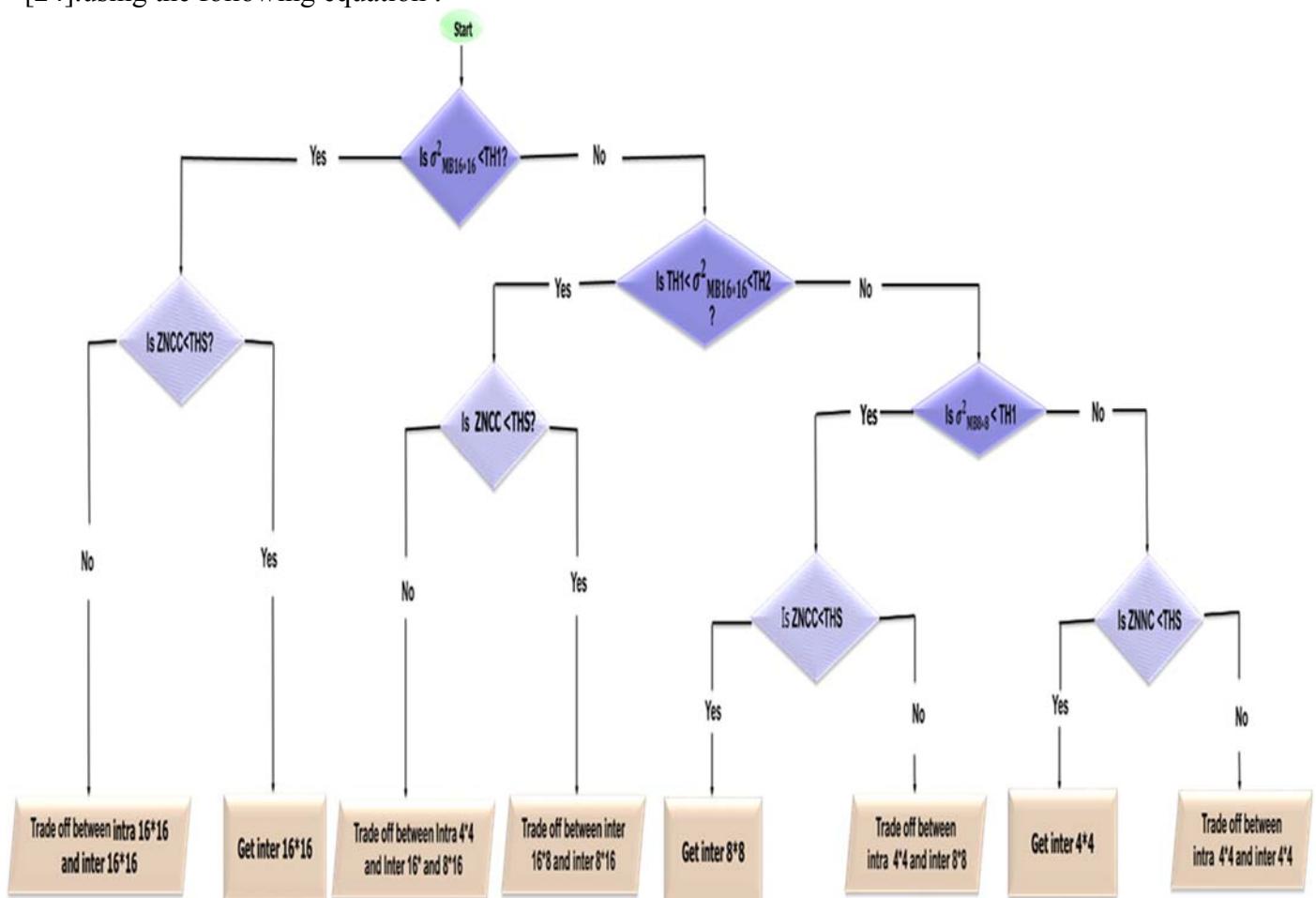


Figure 2: select MB mode in SQLPE

$$\text{ZNCC}(F_{t1}, F_{t2}) = \sum_{F=1}^{N-1} \frac{\sum_i ((H_F^i - \bar{H}_F) \times (H_{F+1}^i - \bar{H}_{F+1}))}{\sqrt{\sum_i (H_F^i - \bar{H}_F)^2 \times \sum_i (H_{F+1}^i - \bar{H}_{F+1})^2}}. \quad (3)$$

$$F1 = \sum_{i=0}^{n-1} \sum_{j=0}^{m-1} (x_i, y_j),$$

$$F2 = \sum_{i=0}^{n-1} \sum_{j=0}^{m-1} (x_i, y_j)$$

- If $\text{ZNCC} < \text{THS}$: Which mean the low video statistics; Get inter mode of MB16*16 Whereas the propopilaity to find the same MB in search window is vary high as knowing the inter mode using lower bit s than intra mode
 - Else if Tradeoff between inter MB16*16 and intra MB16*16 using (Sum absolute transformer difference) SATD [10].

Else if $\sigma^2_{MB16*16} < TH2$: Which means the medium variance and select MB size and modes depends on video statistics as following:

- If $ZNCC < THS$ Tradeoff
between inter MB16*8 and , inter
MB 8*16
 - Else if $ZNCC > THS$ Tradeoff
between: inter MB 16*8, inter
MB 8*16 and intra MB16*16

Else Excludes the MB 16*16 size for inter and intra mode and test MB 8*8 as following:

$\sigma^2_{MB8*8} < TH1$ the MB

- $ZNCC < THS$ Get inter MB
8*8

- $ZNCC > THS$ Tradeoff between: inter MB 8*8 and intra

Is $\sigma^2_{MB\ 8*8}$ > TH1?

- $ZNCC < THS$ Get intra MB
4*4

- $ZNCC > THS$ Tradeoff
between: inter MB 4*4 and intra
MB 4*4

The second phase in SQFM: utilized to select the best layer of MV with low complexity. As mentioned before there are many reasons for using the different layer in selecting the MV -full pixel and sub motion pixel (quarter and half). The way of selecting the MV layer in this proposed algorithm depends on the frame of video contains the different objects with different statistics from this point the proposed algorithm will start. Classified the objectives on the frame to background and foreground object[27] -here the background object represents the object with nearly fixed. As illustrated in fig.3 Star by calculating the video statistics using the ZNCC equation which already calculated from phase one of proposed algorithm (1):

If $ZCNN < TH1$ Which mean the low video statistics; here the applied of full MV and disparity subpixel MV, and the mv calculate as the following equation:

$$(MF_{x,k}, MF_{y,k}) = \sum_{N=0}^{N-1} \sum_{G=0}^{G-1} B(N, G) \dots \quad (4)$$

$$B \equiv SATD \equiv H F H^T \quad \dots \dots \dots \quad (5)$$

$$(H_m)_{N,G} = \frac{1}{2^m/2} (-1)^{\sum j^N j^G} \dots \dots \dots \quad (6)$$

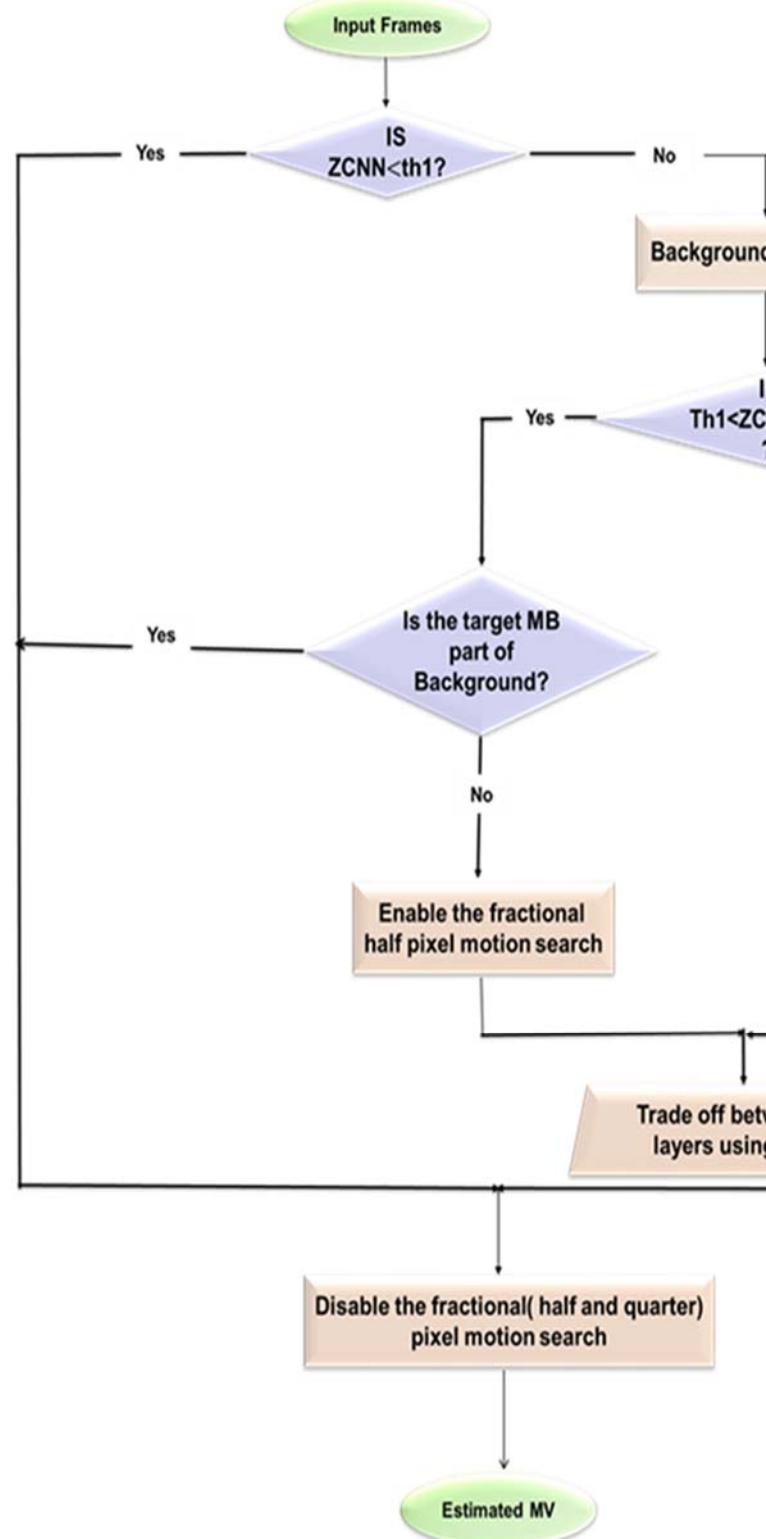


Figure 3: select MV layer

If TH1<ZCNN< TH2 which mean the medium video statistics, here sparated the objects in frame to background and for ground objects using Median approximation median filter[28] as equations (7),(8) in case of the target MB belong to the background applied of full MV .

$$MB = \sum_{i=0}^{k-1} \sum_{j=0}^{l-1} |I(i, j, t) - Med(i, j, t - 1)| < Th \dots \dots \dots (7)$$

$$\text{Median} = \{(n + 1) \div 2\}^{\text{the value}} \dots \dots \dots (8)$$

If MB belongs to the foreground which meaning:

$$MB = \sum_{i=0}^{k-1} \sum_{j=0}^{l-1} |I(i, j, t) - Med(i, j, t - 1)| > Th \dots \dots \dots (9)$$

In this case applied full motion vector and half pixel MV and bilinear interpolation to interpolate macroblocks for sub motion vector.

ZCNN>TH2 Which mean video statistics is high.

If the MB belongs to the foreground object. Test: MV1=full motion vector and sub motion vector (half and quarter) with utilising the bicubic interpolation to interpolate macroblock. Else if MB belongs to background objects using full MV.

3. Experiments and Results

The results of the proposed algorithm - experimental results- where be compared to JSVM 9.17 reference software, Seon-2

algorithm [29]All the results were be referred to reference algorithms as a percentage value.

This work evaluates the proposed algorithms on three standard test sequences. The test sequences are "Forman" as low motion, "Bus" as medium motion, and "Football" as fast motion. Four parameters are used to evaluating the performance. These parameters are; saving in several sending bits (ΔNSB), saving in ET (ΔET), saving in TT across the network (ΔTT), and degradation in peak signal to noise ratio (Y-PSNR). The equations of the three parameters are shown in equations [10-12].

The results show in table 1

$$\Delta NSB = \frac{NSB(JSVC) - NSB(\text{proposed})}{NSB(JSVC)} * 100 \dots \dots \dots (10)$$

$$\Delta ET = \frac{ET(JSVC) - ET(\text{proposed})}{ET(JSVC)} * 100 \dots \dots \dots (11)$$

$$Y-PSNR = PSNR(\text{proposed}) - PSNR(JSVC) \dots \dots \dots (12)$$

First: “Foreman” test video:

By applying the **SQILPE** algorithm; in this case, the highest significant reduction in encoding time can be obtained up to 77.58%, with negligible decreasing in quality 0.002 dB and increasing in Number of sending bits up to -0.13% compared with JSVM 9.17.

Comparing “Foreman” test video with Seon-2, the results become 12.29%, -0.126%, 1.025 dB for, ΔET , ΔNSB and the increased value in Y-PSNR respectively.

Second: “Bus” video sequence:

SQILPE algorithm; achieve 74.68% reduction in encoding time, 0.54% increasing in numbers of sending bits with negligible decreasing in quality with 0.002dB compared with JSVM 9.17.

Table 1: Results of SQILPE proposed algorithm

Video Sequence Test	Measurement Parameter	SQILPE	
		.SQILPE Vs JSVM 9.17	SQILPE Vs. Seon-2
Foreman	$\Delta \text{NSB } \%$	-0.13	-0.126
	$\Delta \text{ET}\%$	77.58	12.29
	Y-PSNR dB	-0.002	1.025
Bus	$\Delta \text{ NSB } \%$	-0.54	-0.486
	$\Delta \text{ET}\%$	74. 68	11.75
	Y-PSNR dB	-0.004	1.008
Football	$\Delta \text{NSB } \%$	0.98	-0.92
	$\Delta \text{ET}\%$	70.54	21.31
	Y-PSNR dB	-0.006	1.013

Comparing “Bus” test video with Seon-2, the results become 11.75%, -0.486%, 1.008 dB for, ΔET , ΔNSB and increase in Y-PSNR respectively.

Third: “Football” video sequence: SQILPE algorithm; achieve 70.54% reduction in encoding time, a negligible number of sending bits 0.98 with decreasing in quality 0.006dB compared with JSVM 9.17.

Comparing “Football” test video with Seon-2, the results become 21.99%, -0.92%, -1.006 dB for, ΔET , ΔNSB and Y-PSNR respectively.

4. CONCLUSION

This new proposed algorithm paper introduced for quality Inter-layer residual SVC. SQILPE proposed algorithm achieve significant saving in encoding time with small decreasing in quality and small

increasing in number of sending bits comparing with JSVM 9.17. moreover,

comparing with other proposed algorithms as Seon-2 the SQFM algorithm improving the

quality and the encoding time with negligible increasing with NSB.

Acknowledgment

The paper in the core technical gives opportunity to express my profound gratitude and deep regard for Eng. Gamal Saleh Chairman of Systems Design Company, for his great support and honest consultation specialisation for valuable feedback and constant encouragement.

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A New Pairing Free ID Based Certificate Less Digital Signature (CL-DS) Scheme Using Elliptic Curve Cryptography

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Abstract— Certificate less public key cryptography is a design that is secure against key escrow issue and remove loopholes of ID based cryptography. Lots of work has been done on CL -DS yet they depend on bilinear pairing that required more time to perform pairing operations. Bilinear pairing is executed with super-singular EC group which is tedious. In this paper we propose a pairing free ID based Certificate Less Digital Signature (CL-DS) scheme utilizing elliptic curve cryptography, which maintain a strategic distance from tedious operations required in bilinear matching. We improve the security of the previously proposed scheme with less computation time with time stamp.

Keywords- Certificate Less, Elliptic curve, Bilinear pairing, Digital Signature, Security

I. INTRODUCTION

IBE evacuates the requirement for a PKI, by supplanting it with PKG that process user's private key. IBE is more efficient, yet it experiences key escrow issue. Key escrow means that PKG who is trusted third party register the private keys for the users it implies PKG can read the messages of users in the framework. In IBE, there is a significant practical problems associated with it is to handle key revocation of users. Al-Riyami and Paterson [25] in 2003, proposed new scheme for public key encryption that removes the disadvantages of both public key encryption and IBE keeping in mind the end goal to determine the key escrow issue. The new scheme is known as Certificate less –Public Key encryption (CL-PKE). CL-PKE is best among the two. The fundamental reason to utilize CL-PKE is to determine key escrow issue acquired from IBE without the use of certificates as in PKI. Today gadgets having constrained computational resources and communication bandwidth discover CL public key cryptography extremely appealing and imperative to reduce stack on the system. To wipe out the need of certificate Shamir proposed ID based cryptosystem in which PKG is responsible to take client's identity as input and process relating private key. However this method has two disadvantages – 1) If PKG is compromised, all messages and public private key pair protected with him also be compromised and 2) As PKG knows the private keys of users, he can use user's private key to decrypt messages on behalf of them. Thus it suffers major drawback of key escrow problem.

Subsequently to prevent from key escrow issue CL - DS came into light. In CL cryptography, PKG computes a partial private key d for each user using his master private key m_{sk} . The user combines this partial key with some user selected secret information to generate a complete private key. Thus PKG has not knowledge of user's private key. The private/ public key of user is computed from user's private key and PKG's public parameters $params$. The public key is made available by transmitted it with the message. Thus public key does not required any authentication mechanism. So, it is better than certificate based signature because public key can't be computed from user's identity alone.

Signer's public key is attached as part of digital signature in CL digital signature. It provides some benefits over ID based signature. There are many proposal on CL digital signature [5][14][16][17][18][19][20][21].

The rest of the paper is presented in the following sections: Motivation, Related work and security notations are explained in section 2. Section 3 explained the proposed approach followed by security analysis in section 4. Section 5 explains the conclusion of the paper.

II. MOTIVATION AND RELATED WORK

A. Motivation

Number of researchers working on CL digital signature. But they proposed schemes which are based on bilinear pairing. There are disadvantage of bilinear pairing as far as calculation overhead. Although the scheme proposed by Chen, Yu-Chi, et al [33] is secure but security level of this scheme can be increased and decrease the computation cost.

The motivation of this paper is to propose Certificate Less Digital Signature (CL-DS) scheme and prove its security.

B. Related Work

In PKI certificates are issued by Certificate Authority (CA). It depends on CA. A user can compute his private and public key, then submit certificate request to CA to issue a certificate. A user name and his public key are bind on a certificate signed by a CA. But there are two problems in PKE-(1) Certificate revocation is crucial and (2) Verification of certificate is costly to check whether certificate is valid or expired.

To avoid these problems, in 1984 Shamir proposed the idea of identity based cryptosystem based on inter factorization problem to simplify key management procedures of PKI [14]. ID based cryptosystem is advantageous over traditional PKI. It is a public key system where public key can be represented by an arbitrary string such as name, contact number, email address, network or IP address. Rather than creating arbitrary private/public key, Shamir proposed mathematically producing beneficiary public key from receiver's identity information. PKG has master public and private keys. Any user can generate a public key with reference to the identity ID by combining the identity attribute with master public key. He utilizes his master private key to produce the private key for the user [1][6].

The main motivation to propose this approach is to eliminate the need of the certificate and issues related to them such as whether certificate is valid or not, key/certificate revocation, trust on CA and maintenance of public key directory. As the public key is derived from the publicly available information then there is no need for public key directory and certificate management.

Ai-Riyani and Paterson [25] in 2003 proposed the concept of certificate less public key cryptosystem. Lots of work has been done on CL public key cryptosystems by [5][2][7][14][16][17][18][19][20][21].

C. Security Notions

- **Setup (1 k):** PKG randomly arbitrarily picks a secret value k and generates master secret key m_{sk} , master public key m_{pk} and generates public parameters $params$ of system required by signature schemes.
- **Set Secret Key:** User executes this algorithm on $(ID, params, m_{pk})$ to generate partial private key X_{ID} .
- **Partial Private Key Extract:** PKG runs this algorithm only once. The input of this algorithm is $m_{sk}, m_{pk}, params, ID$. It returns D_{ID} .
- **Set Private Key:** for given $(ID, params, m_{pk}, X_{ID}, D_{ID})$ return complete private key as sk_{ID} .
- **Set Public Key:** given $(ID_i, params, m_{pk}, X_{ID})$ return complete public key as pk_{ID} .
- **Certificate less Digital Signature:** for given $(ID, params, sk_{ID}, m)$ outputs signature σ on message m . It is run by signer or user.
- **Certificate less Digital Signature Verification:** for given $(ID, params, m_{pk}, S_{ID}, \sigma)$ returns *true* if the signature σ is valid, otherwise returns *false*.

D. Drawback of previous work

The schemes [2][5][6][14][33] are based on bilinear pairing and does not consider key escrow issue in ID based cryptography. We propose a new scheme that takes less time as compared to [2][6]. The security of our scheme is based on ECDLP assumptions. It could be efficient in terms of computation, communication cost and security [1].

III. PROPOSED CL DS SCHEME

In this section, we propose an efficient pairing free Certificate Less Digital Signature scheme based on ECC. The followings steps are required for CL-DS:-

Setup: For given security parameter $params$, PKG generates system's parameter in the following way:

- To determine the tuple $\{F_q, E/F_q, G_q, P\}$, PKG selects a k bitprime number q .
- Selects a secure random number $s \in RZ_q^*$ as the master private key and computes master public key $P_{pub} = sP$.
- Selects one way hash functions $H_0, H_1, H_2, H_3 : \{0,1\}^* \rightarrow \{0,1\}^k$.
- Publish system parameters $= \{F_q, E/F_q, G_q, P, P_{pub}, H_0, H_1, H_2, H_3\}$.

Set Secret Key: Let Alice is the sender and Bob is receiver. PKG computes private and public key pairs of the sender and the receiver with identities of $ID_a, ID_b \in \{0,1\}^*$.

The sender Alice with ID_a select a secure random number $x_a \in RZ_q^*$ as their secret key and computes the scalar multiplication $X_a = x_a P$ for mathematical related public key

Partial Private Key Extract: After computing X_a , Alice send (ID_a, X_a) to the PKG. PKG chooses a random number $r_a \in RZ_q^*$ and computes $R_a = r_a P$. PKG also computes secret key $d_a = r_a + sq_a \text{ mod } q$ where

$$\begin{aligned} q_a &= H_0(ID_a \parallel R_a \parallel X_a) \\ q_b &= H_0(ID_b \parallel R_b \parallel X_b) \end{aligned}$$

The private key d_a and R_a are send to the sender Alice with ID_a by PKG via secure channel. The corresponding ID based public key of Alice Q_a is computed $Q_a = R_a + q_a P_{pub}$. Now the private/public key (d_a, Q_a) pair can be verified by checking the equation $Q_a = R_a + q_a P_{pub} = d_a P$.

Set Private Key: The private key is set $sk_a = (d_a, x_a)$ for Alice with ID_a . Similarly Bob's private key with ID_b is set $sk_b = (d_b, x_b)$.

Set Public Key: The public key is set $pk_a = (X_a, R_a)$ for Alice with ID_a and for Bob with ID_b public key will be $pk_b = (X_b, R_b)$.

A. CL-DS-Sign

In order to generate the signature on the message m Alice performs the following steps:-

$Sign(m, X_a, ID_a, ID_b, d_a, t)$: The algorithm works as follows:-

- Alice sends $D = E_{PK_b}(t)$ to Bob.
- Alice selects a random number $y \in RZ_q^*$ and computes $Y = yP$.
- Alice Computes

$$h_1 = H_1(Y),$$

$$h_2 = H_2(ID_a, X_a, Y, ID_b, X_b, h_1)$$

$$h_3 = H_3(m, ID_a, X_a, Y, ID_b, X_b, t, h_2)$$
 where t is time when message signed.
- Computes $V = (y + h_2x_a + h_3d_a) \bmod q$
- Alice Computes

$$\begin{aligned} C &= (m \parallel V) \oplus h_2 \\ Z &= VP \end{aligned}$$

And returns signature $\sigma = (C, Y, Z)$ on message m .

B. CL-DMS Verification

To verify signature σ is (C, Y, Z) on message m , the verifier Bob performs the following steps:

- Bob decrypts $t = D_{SK_b}(D)$ to extract message signature time.
- Computes $h_1 = H_1(Y)$
- $C \oplus h_2 = (m \parallel V)$
- Before verification Bob first of all computes h_2, h_3, Q_a

$$\begin{aligned} h_2 &= H_2(ID_a, X_a, Y, ID_b, X_b, h_1) \\ h_3 &= H_3(m, ID_a, X_a, Y, ID_b, X_b, h_2) \\ Q_a &= R_a + q_a P_{Pub} \end{aligned}$$

where $q_a = H_0(ID_a \parallel R_a \parallel X_a)$

And then verifies the following equation

$$Z = Y + h_2X_a + h_3Q_a$$

Checks whether the equation $Z = VP$. If it verifies the verifier accepts the signature $\sigma = (C, Y, Z)$ otherwise rejects it.

IV SECURITY AND PERFORMANCE ANALYSIS

A. Security Analysis

Here we shall prove that the proposed scheme is secure against forgeability, key replacement and key escrow attack which shows how it full fill the security requirements confidentiality,

unforegeability. Verifier can verify $Z = VP$ and check the validity of the signature.

a. Correct and consistent

The proposed scheme is correct and consistent

$$\begin{aligned} VP \\ V &= (y + h_2x_a + h_3d_a)P \\ &= yP + h_2x_aP + h_3d_aP \\ &= Y + h_2X_a + h_3Q_a \end{aligned}$$

Hence the theorem is proved.

b. Origin Authentication

The proposed scheme consists of chain of digests in which ID of user is hashed e.g. $h_3 = H_3(m, ID_a, X_a, Y, ID_b, X_b, t, h_2)$. After receiving message receiver will compute h'_1, h'_2, h'_3 . If $h'_1 = h_1, h'_2 = h_2$ and $h'_3 = h_3$, then only be signature verified, which provides authentication for both parties.

c. Time Stamp

First of all receiver check when the message is signed by computing $t = D_{SK_b}(D)$. Then computes h'_3 which contains the time when message is signed, $h_3 = H_3(m, ID_a, X_a, Y, ID_b, X_b, t, h_2)$. If extracted t is same as calculated in h_3 , that will ensure message is new and is only sent by the sender.

d. Confidentiality

Although Adversary \mathcal{A} knows σ, Y, Z still he is not be able to get partial key information of the message m because adversary would have to know the receiver's private key as well as two prime number P and its factor q known only to PKG, signer and receiver. It is not feasible to derive a factorial from a large prime number [1].

A CL DS scheme is secure against attacks. Master secret key m_{sk} and complete private (Secret) key $sk_a = (d_a, x_a)$ will not be accessed by Adversary \mathcal{A} . Adversary is not allowed to extract secret key and public key $pk_a = (X_a, R_a)$.

e. Unforgeability

An adversary can be able to forge any DS only if he is in possession of sender's key $sk_a = (d_a, x_a)$ which is required to sign the message. He can only obtain the message m by decrypting it using corporate public key (Q_a, X_a) .

f. Key Replacement Attack

Private/public key pair can be replaced by adversary. But in this scheme he does know the user's partial private key issued by PKG. An adversary who knows only the public key P_{PKG} but not the corresponding secret key M_{sk} will not be able to forge a signature σ and message m . The identity based public key of the user ID_a is (X_a, Q_a) .

$$\begin{aligned} Q_a &= R_a + q_a P_{Pub} \\ &= R_a + q_a P_{Pub} \end{aligned}$$

$$\begin{aligned}
 &= r_a P + q_a s P \\
 &\quad [R_a = r_a P, P_{pub} = sP, d_a = r_a + \\
 &\quad sq_a] \\
 &= (r_a + q_a s) P \\
 &= d_a P
 \end{aligned}$$

Hence demonstrated that public key is derived from secret of the user e.g $Q_a = d_a P$. Thus this scheme secure against key replacement attack.

g. Key Escrow attack

PKG only knows the partial key but not the additional secret key generated by user. He is not able to do any cryptographic operations as the user [13].

h. Secure against Type-I attack

In Type -I attack the adversary \mathcal{A} knows the public keys of the PKG. To know the master secret key m_{sk} , adversary \mathcal{A} has to solve the Discrete Logarithm Problem (DLP) which is impossible as well as infeasible from DLA. The proposed scheme is secure against Type -1 attack.

i. Secure against Type-II attack

In Type -II attack adversary \mathcal{A} is dishonest PK. G, who knows the partial private and public key and can attempt to find user's private key. In proposed scheme user's private key x_a, d_a is generated from Z_q^* and can be known only if DLP can be solved. Thus proposed scheme is secure against Type-II attack.

B. Performance Analysis

In this section we compare the number of operation required in proposed scheme and existing schemes [2][6]. Table 2 shows how proposed scheme is more efficient in term of operations. It does not require bilinear pairing thus it reduce the operational cost required to perform exponential operations in bilinear pairing.

Notation	Description
T_{EXP}	Time required for executing modular exponentiation $T_{EXP} \approx 240 T_{MUL}$
T_{EM}	Time required for executing an elliptic curve scalar point multiplication, $T_{EM} \approx 29 T_{MUL}$
T_{BP}	Time required for executing bilinear pairing, $T_{BP} \approx 87 T_{MUL}$
T_{EA}	Time required for addition of two elliptic curve points, $T_{EA} \approx 0.12T_{MUL}$
T_{HASH}	Time required for executing one way hash function
T_{MUL}	Time required for executing modular multiplication

Table 1: Definition and conversion of various operation units

Operation	Proposed Scheme	Chen, Yu-Chi, et al [33]	He, Debiao et al.[2]	Harn' s Sche me [6]
Exponential	-	$3T_{Exp}$	$3T_{Exp}$	$7T_{Exp}$
Hash	$4T_H$	$4T_H$	$4T_H$	$3T_H$
Multiplicati on	$6T_{Mul}$	$4T_{Mul}$	$4T_{Mul}$	$3T_{Mul}$
Addition	$6T_{EA}$	$6T_{EA}$	$3T_{EA}$	-
Total time	$174.72T_{Mul}$	$836.72T_{Mul}$	$836.36T_{Mul}$	$1767T_M$

Table 2 : Comparison with existing CL-DS

V. CONCLUSION

In this paper, we have proposed secure and efficient CL-DS scheme which is secure against Type-I and Type -II attacks as well as other attacks [2][33]. Its computational cost and communication overhead is also less and can be used for limited communication and computational devices. Hence proved that proposed scheme is taking less time as compared to [2][6]. The proposed scheme uses t for the validity of the message which prevents the scheme from the replay attack.

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A stream authentication method over lossy networks using Optimized Butterfly Graph

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Abstract— In this work a method for video streaming authentication based on butterfly graphs is presented. As well as other methods variables such as the sender delay, receiver delay, computation overhead, communication overhead, robustness against packet loss, should be considered. The aim of this work is improvement of communication overhead as an important parameter, in networks which packet loss ratio is random and burst. For this purpose we develop butterfly graph to increase authentication probability.

Keywords- butterfly graph; authentication possibility, communication overhead; Hash chain; optimized butterfly graph

I. INTRODUCTION

Streaming of voice, video, slide show and etc is growing. One of most important issues in sending such real time data according to its sensitivity is security and authentication mechanism. Designing a proper authentication method for streams needs the balance between following parameters.

A. Computational overhead

Providing signature overhead on sender side and it's identifying on receiver side (it's important for networks with low ability of computing such as cellphones)

B. Communicational overhead

Adding bites to the packet and sending video streams increasing communication load. Adding MAC¹ or amount of signature, is essential for wireless networks with low bandwidth.

C. Sender delay

Time to packet is processed until the packet is really sent. In real time streaming high delay on sender side needs large buffers at the sender side.

D. Receiver delay

Time to packet is received and until the authentication operation is complete in receiver side. In this part also, the

delay needs large buffers on receiver side but high delay causes the loss of the “real-time” concept.

E. Resistance against packet loss

The authentication probability is defined as the probability that a delivered packet can be successfully authenticated [7].

On the other hand, because of the widespread use of smart phones, and memory limitation of these devices, some methods should be suggested to reduce the need of high space for buffers on sender and receiver sides [1].

In addition to the mentioned issues, some of the presented techniques, as well as reducing the overhead and ... try to maintain their efficiency against attacks on the network such as Dos², in order to assure the packet authentication during the attacks prevention [2].

Its clear that, resolution of all above issues is impossible at the same time, because some of them have collision with the another once. For instance, the sender delay conflicts the receiver delay, or communication overhead resistance against packet loss. Thus, designing an appropriate method should be considered based on the need of any applications separately. In this regard initial strategy is the use of digital signature per data packet. But this strategy, has very high communication overhead per packet. Also signature production on the sender side and its retrieval on the receiver side has high computation complexity per packet. Nowadays, current-methods focus on authentication of a group of packets instead of per packet. It means that a group of packets are considered as a block and only a signature will be assigned for it [1] in order to reduce the communication overhead. This strategy is based on using Hash chain.

But in these solutions, science the packets is dependent to each other, it is important to use a technique in which if some packets are lost, the other gotten packets could be verified.

II. RELATED WORKS

Gennaro and Rohatgi have presented the first simple Hash chain [4]. In this method Hash of each packet, is added to another packets and finally the last packet will be signed. This

¹ message authentication code

² denial-of-service

method reduces the number of bites of a signature in a data stream. But, if a packet is failed or lost in this chain, the next packets in chain won't be distinguishable.

Wong and et al [5] have presented a scheme based on authentication tree with a high communication overhead however it has supported high rate of data loss.

Perrig and et al [6] have presented a method called EMSS that each packets contained hashes of two to six other packets. These hash chains will be added with a vector. For instance [2,3,5] vector means that hash of P_i packet will be added to P_{i+1} , P_{i+3} and P_{i+5} packets. Although this method greatly resists against packet loss and authentication probability is high, makes a high communicational overhead (six hash chains per packet).

Zhang and et al [7] have proposed Butterfly hash based on hash chain. In butterfly scheme, packets are considered as a block which each block contains a signature. Each block is divided into a number of stages, each containing specific number of packets. The hash of packets in each stages, are added to the packets their next stage and signature packet at the end of the block contains the hash of packets of the final stage.

Total number of packets in a block is to $M=N(\log_2^{N+1})$. This method has low communication overhead and also shows high resistance against packet loss.

Zhang and et al then have done more investigation on butterfly graphs and called their new method as generalized butterfly graph (GBG) [8]. In this graph, they have changed their classification into the following order to get rid of putting the fixed number of whole packets in the formula.

It shows N packets in some rows N_R and columns N_C which $N_R=2^k$ and $N_C=N/N_R$. In this procedure if $N_R=1$, so $N_C=N$. In this case generalized scheme will be just like the simple hash chain. And if $N_R=N$, therefore GBG will have the quality as equal as tree chain method. On the other side, adding edges to the simple butterfly graph to change the authentication possibility, showed that if more edges are added to the middle nodes of the graph, the possibility of the authentication will be increased, Because there will be more paths to the signature packet.

Furthermore, Abuein and Shibusawa [9] have divided a data stream containing N messages into some blocks. In this method, each data block is divided into some Chains (C) and some slices (K). Then hash of each packets $H(P_i)$, in MC method, is added to another packet like P_{i+1} and P_{i+jc} so that $j=1,2,3,\dots,9-1$. For instance if hash of P_i packet becomes, $H(P_i)$ and $9=3$, then hash is added to the packets of P_{i+1} , P_{i+c} and P_{i+2c} .

As follows, some methods such as MLCC³, AMLCC⁴, RMLCC⁵ and ARMLCC⁶, were presented by H. Eltaief, H. Yousse which were modified forms of MC⁷ method. Although the collection of these methods have high resistance against

packet loss, due to the high computation complexity, inappropriate real time systems [10-13].

All of the strategies mentioned above will increase the authentication possibility, but they're inappropriate in realtime enviroment with low bandwidth, because of high computational overhead, high communication overhead and etc. Therefore, the optimized butterfly graph is presented.

III. PROPOSED WORK

Our proposed method is based on the butterfly graph, but some changes are applied to improve it in order to decrease communication overhead as for low network bandwidth. And on the other hand if the packet is lost, the authentication possibility will be raised again. That's why butterfly graph method is going to be described first and then, its changes will be explained in order to our proposed method to be completed.

In butterfly graph, the number of whole packets in a block are $M=N(\log_2^{N+1})$ and number of stages are \log_2^{N+1} . This makes the block size or the number of stages have limitation. According to this method, the signature packet contains the hash of whole packets at the final stage. The signature packet is exactly gotten by the receiver as an assumption. (For instance by resending the signature packet if it's lost, it can be guaranteed). The stages are numbered from 0 to $M-1$ and the packets in each stage are numbered from 0 to $N-1$. Packet $P_{S1,j1}$ has edge to $P_{S2,j2}$ if:

$$S_1=S_2+1, j_1=j_2 \quad (1)$$

$$S_1=S_2+1, j_1=j_2^S \quad (2)$$

That the difference because j_2^S and j_1 is just in one bit position at S_2 .

Figure 1 shows a butterfly graph with 4 steps and 8 packets in each stage. S is the signature packet of each block which is the result of the packet hash in final stage.

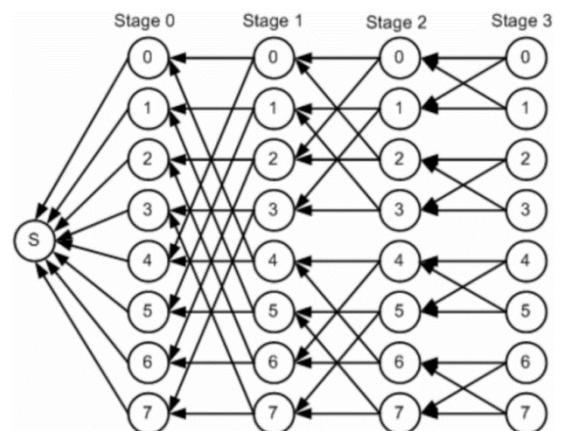


Figure 1. Butterfly graph

In our presented method, it is tried to implement data packets in blocks with the Number of $M=N(\log_2^{N+1})$ packets.

³ Multi-layers connected chains

⁴ Adaptive Multi-Layer Connected Chains

⁵ Recovery-Based Multi-Layer Connected Chain

⁶ Adaptive and recovery-based Multi-Layer Connected Chain

⁷ Multiple Connected Chains

Also to reduce communication overhead after taking the hash of each packet, The hashes of each packet are divided into two halves and the first hash half of each packet will be added to the equivalent packets of previous stage exactly similar to the simple butterfly graph and for adding the second half of each hash in a packet, it's done as below:

$$S_1=S_2+1, j_1=j''_{2^2}^{S_2} \quad (3)$$

That the difference between $j''_{2^2}^{S_2}$ and j_1 is just in one bit position at S_2-1 , except the stage 1(stage 1 in figure 2) which the difference is in bit position $M-1$. (figure 2)

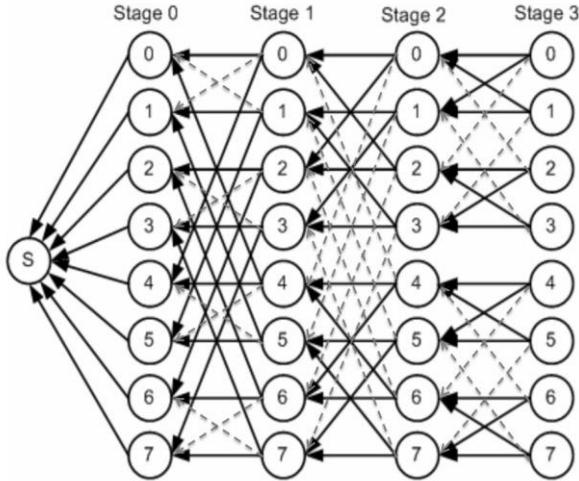


Figure 2. Optimized butterfly graph

According to the definition, $3/2$ hash is added to each packet. Therefore if the hash of each packet is considered as (h) bytes, the signature as (g) bytes and the number of whole packets $M=N(\log_2^{N+1})$, the communication overhead per packet will be as below:

$$O_{avg} = 3/2h - h/2(\log_2^{N+1}) + g/M \quad (4)$$

The communication overhead per packet in simple butterfly graph method, equals to $O_{avg} = (2h - h/\log_2^{N+1} + g/M)$ and the comparison of two formulas shows that the communication overhead is been reduced in the proposed method. In fact, if we use MD5 as hash funcation, 8 bytes are reduce from communication overhead per packet. Finally it can be inferred that in a block of 32 data, $8*32$ equals to 256 bytes are reduced from communication overhead and this is a considerable value in a high data stream.

On the other hand, the authentication possibility of whole packets increases by increasing in edges, because a new edge is added per packet in each stage. In fact, a packet will be authenticated, if there is a path from the packet to the signature packet. Thus increasing in edges makes the path increase.

Pay attention that, for a packet authentication, a half of a packet hash authentication is enough. On the other hand, because the signature packet is more sensitive, this packet

contains the complete hash of its previous stage just like the simple butterfly graph method.

IV. RESULT AND DISCUSSION

We simulate butterfly graph and our method (Optimized Butterfly Graph) in same condition. its referred that our proposed method eventuates better result of authentication probability. It means that by comparing different rates of packet loss and simulation of the method at this condition, our proposed method has lower communication overhead rather than the original butterfly graph and authenticates the receiver packets with more possibility despite of packet loss.

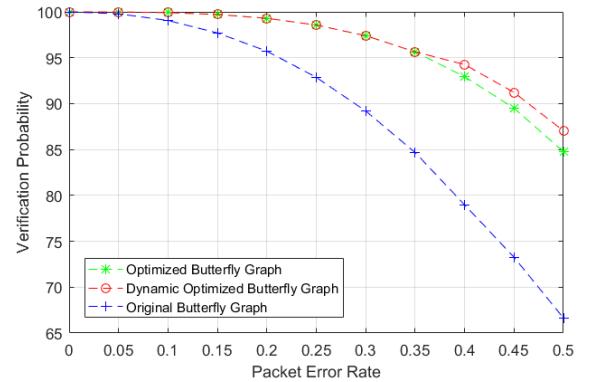


Figure 3. Authentication probability in different rates of packet loss

In the following, an acceptable threshold is considered for the packet loss and if the data loss rate is higher than our acceptable threshold, the second half of the packet hash will be added to more packets. In fact, according to the gotten feedback from the network, the data loss rate will be checked. If conditions are not suitable and the packets are more likely to be lost or corrupted, the second half of the packet hash will be added to more packets in order to authenticate more packets under conditions of burst loss rate. According to the results of the generalized butterfly graph, these new edges will be added to the packets in the middle stages.

Figure 3 shows simulation results of authentication probability in different rates of packet loss for original butterfly graph, optimized butterfly graph and dynamic optimized butterfly graph.

As it's clear, adding an edge to a packet, increases the authentication probability of both packet itself and packets which are related to the mentioned packet. So this mechanism can be used even when some packets are lost in order to protect received packet against authentication. Adding this ability to the considered method different rates of packet loss makes this method dynamic more intelligent.

V. CONCLUSION

In this paper, optimized butterfly graph is presented which according to the results, is more efficient in terms of communication overhead and authentication probability rather than the original butterfly graph. So it is suitable for networks with low bandwidth. This method is also more resistant against

random and burst packet loss rate rather than the original butterfly graph, because the number of the hash repetition in packets is increased and according to the definition, as a result the paths from a packet to the signature packet will be increased and this makes the authentication probability high. That is why it acts better in wireless networks.

In addition to the resistance against data loss, computational overhead of this method is low (the required time for hash computation and dividing it in two halves), but dividing the hash in two halves causes the reduction in the security range of this method, however this reduction doesn't mean the moiety in its security power and this security range it is acceptable.

In the following, it will be possible to have more divisions. For instance, dividing hashes into four or more parts instead of dividing into two halves, and also the formula of the edge addition can be changed.

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E-learning Information Technology Based on an Ontology Driven Learning Engine

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Abstract — Based on the experience of using the “Moodle”, the application of new ontology-based intelligent information technologies is proposed. In the article, proposed is a new e-learning information technology based on an ontology driven learning engine, which is matched with modern pedagogical technologies. With the help of proposed engine and developed question database we have conducted an experiment, where students were tested. The developed ontology driven system of e-learning facilitates the creation of favorable conditions for the development of personal qualities and creation of a holistic understanding of the subject area among students throughout the educational process.

Keywords: *e-learning, ontology, learning engine, educational content.*

I. INTRODUCTION

The use of new intellectual information technologies in the educational system allows to improve the learning process through introduction the new methods and approaches not only in education, but also through evaluation of acquired knowledge.

In the dawn days of WEB 2.0 development and social networks new forms of e-learning have emerged, which is owed to networked interaction between students and teachers, as well as so called collective knowledge [1].

Modern ontology-driven information systems are designed for conceptualization of ontological categories and improvement of hierarchical structures of entities on all levels. [2].

The shared use of a universal understanding of information structure by people and software agents is one of the most common goals behind the development of ontologies [3]. Lately, the OWL language is used as a standard of language for exchange between ontologies in Ontolingua, as proposed in the Semantic Web project. [4].

With the development of distance education as a form of organization of the learning process, which is characterized by provision of means for students to acquire knowledge on

their own through the use of advanced informational resources that are based on modern information technologies, an issue arises with application of an individual-oriented approach in electronic education and adaptation of distance education to the individual student.

The merging of information technologies and innovative pedagogical methods is able to increase the effectiveness and quality of educational programs, increase the adaptability and individual based orientation of the educational system towards the perception and knowledge levels of those who study. At the present stage of development of education, adaptive learning systems that are based on information technologies are what is most commonly used to achieve this goal.

An important direction in the development of e-learning is the construction of cross-subject ontologies [2] based on previously developed content.

Today, testing is one of the most commonly used forms of verification of student knowledge. The use of testing in the educational process allows for short-term verification of knowledge levels for large groups of students, control of achievement of educational results and shortens data processing times. At the same time, the creation of effective and verified tests is a relatively laborious process, which involves a lot of routine work.

II. THE CONCEPT OF THE ENGINE OF AN ONTOLOGY DRIVEN E-LEARNING SYSTEM

E-learning promotes the creation of conditions for the development of individual qualities among students during the education process. It is regarded as a means to increase the effectiveness of assimilation of learning material through audial, visual and kinesthetic types of perception. The simultaneous use of all three types of perception pushes the student towards stereoscopic perception. [5].

Therefore, the concept of an engine has to provide for the use of all three types of perception. At the same time, the problem of creation and integration of high quality content

still remains on the table, and has to be resolved through the use of ontologies [6].

The concept of the engine of an ontology driven e-learning system (ODELS) is proposed in [7] and is based on a “client-server” architecture. The structure of ODELS is presented on figure 1.

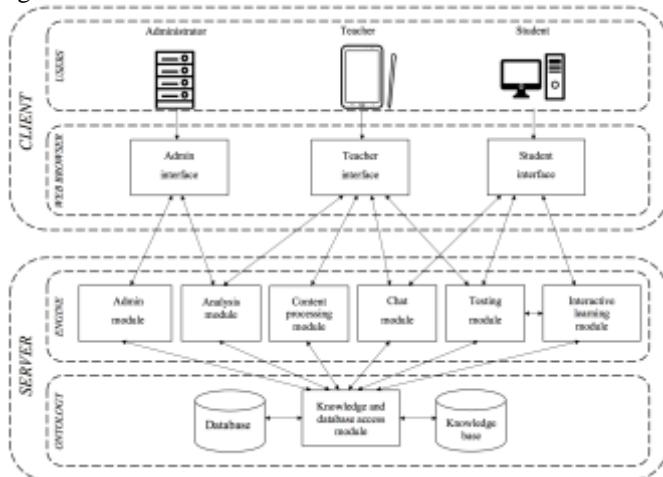


Figure 1. The structural plan of an ontology driven distance e-learning system

The proposed concept of an engine utilizes all of the advantages of e-learning systems and provides the ability to integrate developed discipline ontologies into the learning process.

III. THE MATCHING WITH MODERN PEDAGOGICAL TECHNOLOGIES

The didactic system is a constituent of the pedagogical system and includes the following components: targeted, semantic, technological, diagnostic [8]. A compulsory condition for the implementation of the learning process is consistency on all levels.

The most well-known model that describes the learning and thinking process is Bloom's taxonomy [9].

Bloom's taxonomy is a hierarchical system of educational goals, which encompass three levels of activity: cognitive, affective, and psychomotor. According to classification by Bloom's taxonomy of the six different levels of cognitive educational goals, it encompasses the thinking process beginning with the simplest forms and ranging up to the most complicated: knowledge, comprehension, application, analysis, synthesis, evaluation. [10].

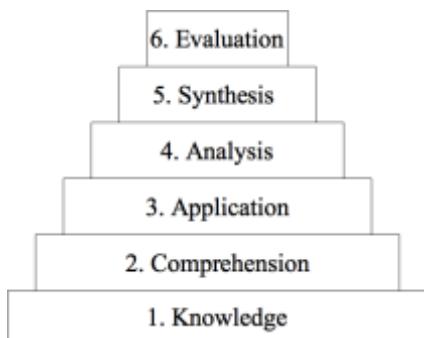


Figure 2. Levels of Bloom's taxonomy

In 2001, Lorin Anderson and his colleagues have proposed an updated version of Bloom's taxonomy, which accounts for a more wide range of factors, which influence the teaching and learning process. Just like Bloom's taxonomy, Anderson's taxonomy accounts for six levels of intellectual skills. They are arranged starting with the simplest, and ending with the most complicated: remembering, understanding, applying, analyzing, evaluating, and creating. However, the new taxonomy does not contain the synthesis level, and rather than analysis, the highest level is considered to be creating, which requires students to possess skills to generate, plan, and create something new [10, 11, 12].

The following levels have to be applied in order to facilitate the formation of higher thinking skills among students: analysis, synthesis, evaluation, and creating, which is not represented in Bloom's taxonomy, but is present in another taxonomy by L. Anderson and D. Krathwohl [10, 11].

Today, the learning system encompasses the different levels of taxonomy in the following manner:



Figure 3. The existing situation regarding coverage of taxonomy by the learning system

As seen on figure 3, the last levels of the taxonomy are completely dependent on unsupervised work by the student, while the “knowledge”, “comprehension”, and “application” levels are shared between traditional learning and e-learning.

The following situation in coverage of taxonomy is proposed with the goal of completely covering taxonomy and building of an individual-oriented learning space:

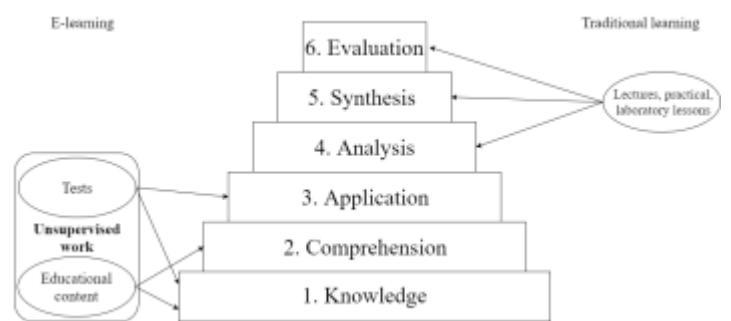


Figure 4. Desired situation regarding coverage of taxonomy by the learning system

The situation in taxonomy coverage proposed by the author of this article on figure 4, enables construction of the

learning process in such a way, where the teacher would create problematic situations for comprehension and perception by students, search for resolutions of various problems through constructive interaction during lectures, practical, and laboratory lessons. Students' unsupervised work on the other hand is based on e-learning, which consists of two components: learning content and monitoring of knowledge acquisition.

The proposed redistribution of structure and educational goals for the engine of the ontology driven e-learning system will elevate the level of education quality by means of coverage of more advanced levels of cognitive thinking during lessons.

As opposed to traditional learning, e-learning has its own peculiarities: it is built on a student's independent cognitive activity and is the most individually-oriented.

TABLE I. ANALYSIS OF LEARNING PROCESS COMPONENTS FOR TRADITIONAL AND E-LEARNING

Learning process component	Traditional learning	E-learning
Motivational	The motivation for learning is found in the contents of the discipline. Pursuit of good marks drives motivation.	Internal motivation to learn characteristic to each student. Improvement of motivation through interactive learning items.
Theoretical	Low level of thought development owed to teaching of predefined knowledge. Predominantly verbal form of teaching stimulates only auditory perception of information.	Active participation by students in the learning process. The ability to select learning topics independently accounts for individual qualities of the student. Simultaneous auditory and visual information feed, predominantly visual perception of information.
Practical	Template-restricted learning, practicing of skills under teacher supervision.	Independence and interactivity of the student during acquisition skills. Development of creative thinking.
Evaluational	Weak level of self-control. The teacher conducts the majority of evaluation and control.	High level of control. Computer software conducts the final evaluation, ruling out any bias.

Based on table 1 it is possible to highlight the major differences between organization of traditional and e-learning:

- E-learning attracts more attention to methods of stimulation of learning motivation, than traditional learning;
- Revitalization of students' cognitive processes during

e-learning is achieved through interactivity and active involvement in interaction with information technologies;

- The self-sufficiency of students while acquiring knowledge, skills and abilities is higher during e-learning as opposed to traditional learning.

This way, in order make the acquisition of learning information effective, it is necessary to account for pedagogical requirements to the introduction and use of information technologies in the modern learning process and modern educational purposes as well as psychological nuances of learning organization under the conditions of e-learning.

IV. CONSTRUCTION OF A DISCIPLINE ONTOLOGY AND GENERATION OF A QUESTION DATABASE

A. Discipline ontology

Based on analysis of ontological systems [4] and usage experience of the e-learning "Moodle" system [13] it is possible to resolve the highly relevant problem related to quality control of student knowledge, and in particular the development of a methodical framework for creation of ontologies of learning disciplines aimed at subsequent creation of high quality content based on the former and automation technologies for creation of test questions.

The proposed concept of meta-ontology consists two parts, content and didactic.

$$O^{Meta} = \langle O^{Didactic}, O^{Content} \rangle \quad (1)$$

Based on the studied experience we can conclude that the base element (entity) of the didactic part of the meta-ontology is a set of three elements – chunk, content mapping, and relation.

$$O^{Didactic} = \langle Ch, L, R \rangle, \quad (2)$$

where $Ch = \{ch_i\}$ – set of chunks which compose the didactic ontology;

$L_i = \{l_{1,i}, \dots, l_{m_i}\}$ – set of content mappings;

$R = \{r_j\}$ – set of relations.

Content mappings connect content blocks within the framework of one discipline and varying types of content, whether it is a text file, presentation, video file, or test. In addition to that, content mappings serve to connect chunks with content from other disciplines.

A chunk points to a certain part of the subject area, which is provided to the student for learning. The relation between the didactic order of chunks points to chunk sequential arrangement.

In this manner, for example, a chunk from the "Algebra and Geometry" discipline called "The system of linear equations" has to follow studying of chunks with smaller significance (figure 5).

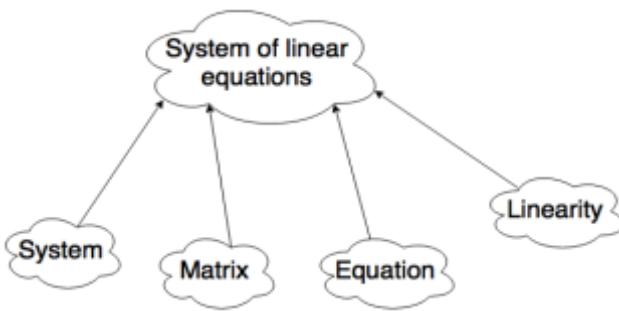


Figure 5. The “System of Linear Equations” chunk

On the other hand, the content model of meta-ontology of a learning discipline is represented with the following three items:

$$O^{Content} = \langle C, A, R \rangle, \quad (3)$$

where $C = \{c_i\}$ is a set of objects which compose the ontology of the $O^{Content}$ learning discipline;

$A_i = \{a_{1,i}, \dots, a_{n,i}\}$ is a set of properties of the c_i objects, n is the number of properties that describe the given object;

$R = \{r_k\}$ is the set of relations between objects and their properties.

In order to construct a content ontology it is necessary to highlight the main entities of the discipline. The given entities are matched with the following categories (figure 6). In its turn, each category has a set of certain properties [14].



Figure 6. The principle of learning discipline content ontology construction

The set of objects, which compose the ontology of the $O^{Content}$ learning discipline coupled with the properties of these objects and the relations between them, represent the knowledge of students in the area of a certain discipline.

B. Generation of a question database

With the help of the developed technology for generation of test questions based on ontologies and their software implementation [6,15], we have created a database of questions for disciplines such as “Data structure and Algorithms”, “Computer Graphics” and “Algebra and Geometry”, which are taught at the faculty of applied math of the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” by the authors of the given article.

Analysis of work techniques with test questions has shown that in the case of a low quantity of questions in the database it is advisable to utilize tests only for final control of acquired knowledge in the form of exams.

C. Cross discipline referencing

The ability for cross discipline referencing of objects in electronic learning courses is one of the main features of the developed model of meta-ontology.

Due to the didactic part, the ontologies of different disciplines that are build according to a common pattern allow for automatic detection of cross discipline references, and thus creation of new cross discipline ontologies.

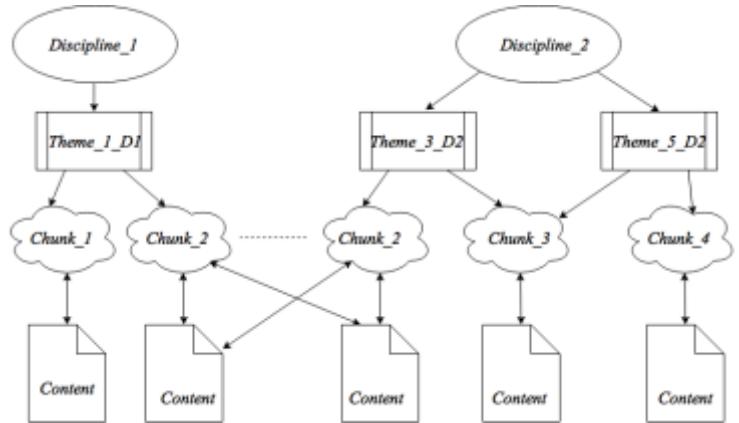


Figure 7. Cross subject referencing

For example, course tests for “Computer Graphics” include the use of mathematical chunks such as “Vector” and “Coordinate System”.

If a student is unable to pass this test successfully, with the help of the didactic ontology it will be clear that the given student has not learned those chunks, and therefore has to be urged to repeat not only lectures on vector graphics, but also certain lectures on vector algebra. The said example clearly demonstrates cross subject referencing between the “Algebra and Geometry” and “Computer Graphics” courses with the help of chunks from the subject areas of “Vector” and “Coordinate System”. The example that is described above is represented on figure 8.

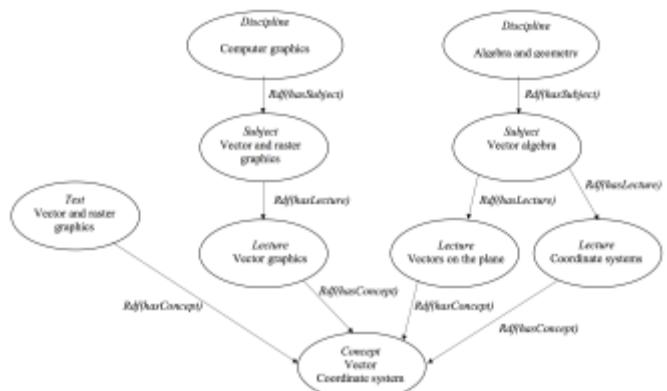


Figure 8. Cross subject connection between courses

The connection between course subjects and concepts of subject areas allows to indirectly connect lectures, tests and methodic materials between each other.

In this manner, the task for formation of a structure of the learning material in the subject area of the discipline is achieved through determination of educational content properties (theoretical and practical fragments, test question), which are based on concepts.

V. STUDENT KNOWLEDGE TESTING AND RESULT ANALYSIS

In order for the developed automation technologies of test question and calculation task creation [6, 15] to implement the principles of individualization and differentiation of the learning process, we have matched test question types to the corresponding competences in Bloom's taxonomy (table 2).

TABLE II. COMPETENCES – QUESTION TYPE

Competences	Test question type	Differentiation		
Knowledge	TF - True/False questions; SA - Single answer questions	I level of difficulty	On the other hand, while testing in “exam” mode, students have increased their knowledge levels by at least 10% as compared to testing before ODELS implementation. This is due to higher motivation and attentiveness, as well as an individual approach to discipline learning in ODELS.	
Comprehension	MA - Multiple Answer questions	II level of difficulty		
Application	M, Mapping the question to its appropriate answer	III level of difficulty		

If a student submits answers to each question from level I correctly, he is eligible for a mark up to Satisfactory (E or D). This indicates that the student has acquired base skills in this discipline, and is able to resolve typical tasks that consist of one or two steps (actions).

If a student submits answers to each question from level II correctly, he is eligible for a mark up to Good (B or C). This indicates that the student is able to perform tasks correctly, which consist of two-three steps (actions), with sufficient explanation.

If a student submits answers to each question from level III correctly, he is eligible for a mark up to Excellent (A). This indicates that the student is able to perform tasks correctly, which consist of three-four steps (actions), with sufficient explanation.

With the help of the developed question database and ODELS we have conducted an experiment, where three groups of students were presented with three tests for a single topic:

- Traditional testing before ODELS use;
- Testing with ODELS in “learning” mode;
- Testing with ODELS in “exam” mode.

After the conduction of the said experiment the results of the students were analyzed as represented on figure 9.

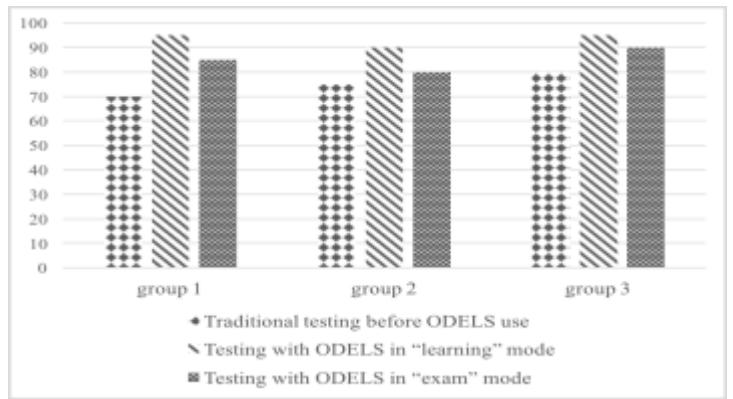


Figure 9. Results of three tests

As seen on figure 9, while testing in “learning” mode students indicate the best result, due to the system allowing reviewing information about concepts in a different window.

On the other hand, while testing in “exam” mode, students have increased their knowledge levels by at least 10% as compared to testing before ODELS implementation. This is due to higher motivation and attentiveness, as well as an individual approach to discipline learning in ODELS.

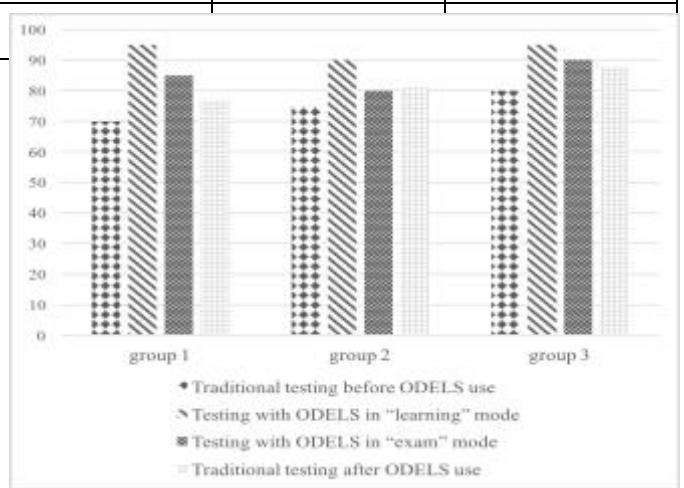


Figure 10. Additional testing results

As seen on figure 10, during repeated traditional testing after application of ODELS students have also increased their level of knowledge by at least 7% as compared to initial testing.

During analysis of the acquired testing results, we have determined that students which were proposed to undergo testing assisted by ODELS dealt with the tasks at hand with more success due to learning while working on tests. Additionally, during result analysis students that underwent level of knowledge control assisted by ODELS were easier to indicate blank spots thanks to use of the DCI (Digital concept index), which is proposed in [14].

Traditionally, while evaluating test results, any points assign for correct replies are summarized, while in the case of using DCI, points for correct replies are annulled if a student replies incorrectly to another question with the same DCI.

Such a technique allows us to rule out the possibility of a positive mark in cases of random answer guessing. During evaluation of testing results, an entry threshold is established for each DCI group, which represents course sections. For example, answers to question Q for each DCI are distributed as per table 3.

TABLE III. EXAMPLE OF EVALUATION OF A STUDENTS' WORK WITH USE OF THE DCI

	Q_1	Q_2	...	Q_m	
DCI_1.1	+1	+1	...	+1	60
DCI_1.2	+1	-1	...	+1	15
...	
DCI_n	+1	-1	...	-1	-10
Total					65

It is evident, that in the case of usage of a simple total of points, the student has achieved 65, which is a passing mark, but the entry threshold will not allow him to pass the course without additional processing by DCI_n.

Such an approach to student knowledge evaluation allows detecting of weaker points (topics) for the individual student, provide him with recommendations for repeated learning of certain sections of the discipline in the e-learning system, and stimulate him to acquiring deeper knowledge.

VI. CONCLUSION

The developed ontology driven system of e-learning facilitates the creation of favorable conditions for the development of personal qualities and creation of a holistic understanding of the subject area among students throughout the educational process. Thanks to ODELS it is possible to increase the effectiveness of assimilation of learning material through audial, visual and kinesthetic types of perception which in turn pushes the student towards stereoscopic perception.

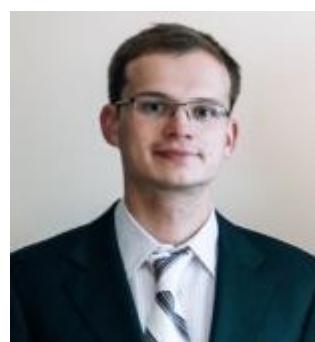
The results of application of the developed ontology driven system of e-learning and created database of test questions to test groups of students while teaching three disciplines, in particular "Data structure and Algorithms", "Computer Graphics" and "Algebra and Geometry", has shown that the knowledge, skills and abilities have increased by 8% on average, which brings e-learning to a new level of quality.

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Fusion Approach for Robust Speaker Identification system

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Abstract— The performance of speaker identification systems decreases significantly under noisy conditions and especially when there is a difference between the recognition and the learning sessions. To improve robustness, we have proposed in the previous study an auditory features and a robust speaker recognition system using a front-end based on the combination of MFCC and RASTA-PLP methods. In this paper, we further study the auditory features by exploring the combination of GFCC and RASTA-PLP. We find that the method performs substantially better than all previous studied methods. Furthermore, our current identification system achieves significant performance improvements of 5.92% in a wide range of signal-to-noise conditions compared with the last studied front-end based on MFCC combined to RASTA-PLP. Experimental results show an average accuracy improvement of 10.11% in case of GFCC combined with RASTA-PLP over the base line MFCC technique across various SNR. This fusion approach allow a highly and appreciable enhancement in the higher noisy conditions.

Keywords—Robust Speaker Identification; Gammatone Frequency Cepstral Coefficients GFCC; Relative Spectral Transform Perceptual Linear Prediction RASTA-PLP; Gaussian Mixture Model GMM.

I. INTRODUCTION

The most accepted form of biometric identification for human is his speech signal. The speaker recognition process based on a speech signal is treated as one of the most exciting technologies of human recognition [1,2,3]. Audio signal features can be classified either in the perceptual mode or in the physical mode. In the previous work, we have studied the perceptual features towards the speaker identification activities [4,5]. In the current work we intend to study furthermore the conceptual mode based on the auditory techniques mainly GFCC and RASTA-PLP. Most published works in the areas of speaker recognition focus on speech under the noiseless environments and few published works focus on speech under noisy conditions [6,7,8,9]. In this study we added the white Gaussian noise with different level to our signal test to simulate the real used environment for these systems. Learning systems in speaker identification that employ hybrid strategies can potentially offer significant

advantages over single-strategy systems. In this proposed system, an hybrid algorithm based on GFCC combined to RASTA-PLP has been used to improve the performance of the text independent speaker identification system under noisy environment. Our system is implemented and simulated under Matlab environment based toolbox such as signal processing Toolbox, Voicebox and HMM Toolbox.

The Speaker identification task is typically achieved by two-stage signal processing: training and testing. The training process calculates speaker-specific feature parameters from the speech. The features are used to generate speaker models. In the testing phase, speech samples from unknown speakers are compared with the models and classified. The following figure 1 shows the block diagram of the standard structure of an automatic speaker recognition system.

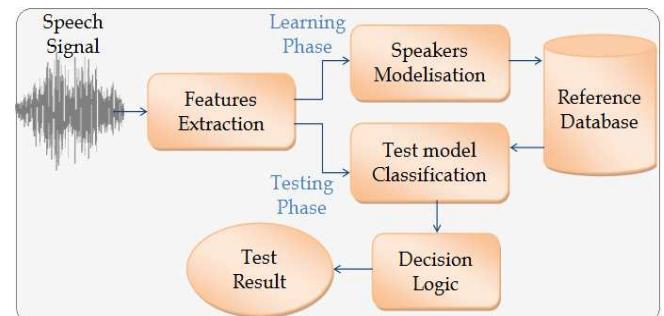


Fig.1 Block diagram of an ASR system

The rest of this paper is organized as follows: Section 2 describes the used GFCC and RASTA-PLP feature extraction techniques, followed by a description of Gaussian Mixture Modeling and expectation maximization classification in Section 3. In section 4 we give the experimental results and finally a conclusion and perspective work at the last section 5.

II. FEATURE EXTRACTION METHODS

Front-End Analysis or features extraction is the first step in automatic speaker recognition task. It aims to extract features from the speech waveform that are compact and efficient to represent the speaker's voice imprint. Since speech is a non-stationary signal. The feature parameters should be estimated

over short-term intervals from 16 ms to 32 ms, in which speech is considered to be stationary. The major types of front-end processing techniques used in the field of ASR are: Linear Predictive Coding (LPC), Perceptual Linear Prediction (PLP), Mel Frequency cepstral coefficients (MFCC), Gammatone Frequency cepstral coefficients (GFCC) and RASTA-PLP. In this study we have studied the RASTA-PLP combined with the auditory GFCC method to characterize the speaker's voices. The conventional MFCC method is usually used as a base line system serving for comparison and evaluation with other feature extraction methods. Many study show that this last technique gives the best result in the quiet environment but its performance is exceeded in very noisy environments [10,11,12,13]

A. GFCC METHOD

The GFCC (Gammatone Frequency Cepstral Coefficients) is a feature method based on Gammatone filterBank. The filters in the bank are designed to simulate the auditory process of human ear [14,15] that are formulated as follows :

$$g(t) = at^{n-1}e^{-\pi b t} \cos(2\pi f_c t + \varphi) \quad (1)$$

Where a is a constant which is generally equal to 1.

N is the filter order which is set less or equal 4

Φ is the phase shift between filters

Fc and b are respectively the center frequency and the bandwidth of the filter in Hz which is related by:

$$b = 1.019 * ERB = 1.019 * 24.7 \left(4.37 * \frac{f_c}{1000} + 1 \right) \quad (2)$$

The extraction of the best parametric representation of acoustic signals is an important task to produce a better identification performance. The efficiency of this phase is important for the next phase since it affects its behavior. The overall process of the GFCC algorithm is shown in the block diagram at the following figure 2.

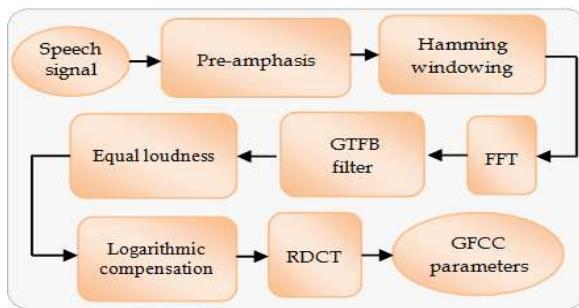


Fig.2 Block diagram of GFCC method

The GFCC algorithm is another FFT-based feature extraction technique in speaker recognition field. The technique is based on the Gammatone Filter Bank (GTFB), which attempts to model the human auditory system as a series of overlapping band-pass filters [16,17]. The following figure 3 shows the shape of the used gammatone filter-bank with 16 KHz sampling frequency.

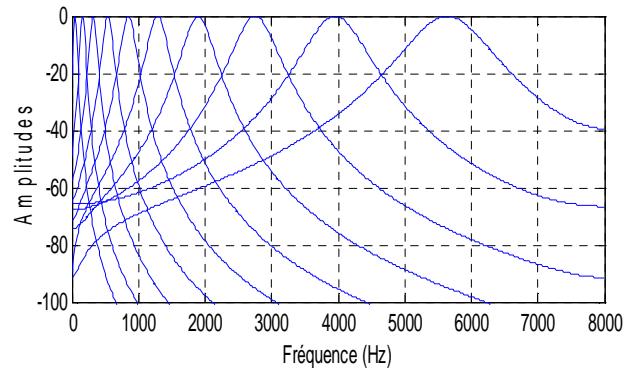


Fig.3 Impulse response of a set of 10 Gammatone filters

As in the conventional MFCC the robust GFCC technique are calculated from the spectra of a series of windowed speech frames of 32ms and overlapping by 16ms. First, the spectrum of a speech frame is obtained by applying the Fast Fourier Transformation (FFT), 512 point. Then the speech spectrum is passed through 20 gammatone filterbank GTFB. Equal-loudness is applied to each of the filter output, according to the centre frequency of the filter. After that, the logarithm is taken to each of the filter outputs. Finally we applied the Reverse Discrete Cosine Transform (RDCT) to the gammatone filter-Bank outputs in order to transit from spectral domain to cepstral domain. The following figure 4 and figure 5 show respectively an example of the 10 gammatone filter-Bank outputs behavior and a gammatonegram of a speech signal frame of 32ms applied in input.

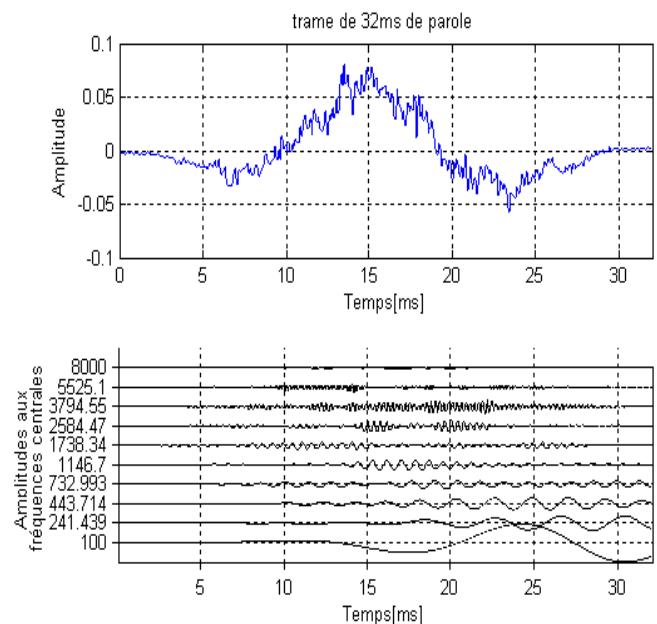


Fig.4 Example of a 10 gammatone filterbank outputs behavior

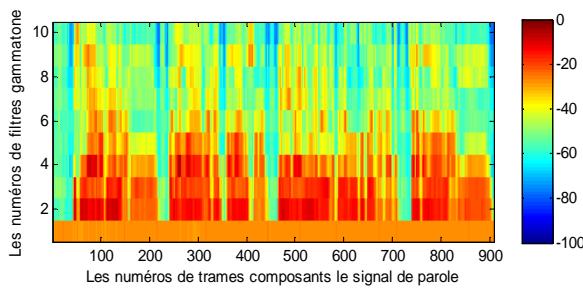


Fig. 5 Example of a gammatonegram of a speech signal

According to this gammatonegram, we can be said that most of the energy of the speech signal is concentrated only at the outputs of the first five gammatone filters.

B. RASTA-PLP Method

The RASTA-PLP (RelAtive SpecTrAI-PLP) analysis is a variant of the PLP analysis, which is designed to eliminate time-related variations that are too slow or too fast for noise. It is inspired by the fact that human perception responds to relative values rather than to absolute values [18,19,20].

This method, which is based on the famous PLP analysis, consists firstly of performing the discrete Fourier transform in the short term and then calculating the amplitude spectrum in critical bands. Then, the logarithm is applied to extract the spectral envelope of the speech signal. Pass-band filtering is then carried out in order to eliminate any eventual offset or slow components of the signal. After this, the amplitude is compressed by the application of a cubic root in order to simulate the power law of the human ear. Finally, the coefficients are calculated according to the classical LPC method. The following figure 6 shows the overall process of the RASTA-PLP analysis [21,22,23]

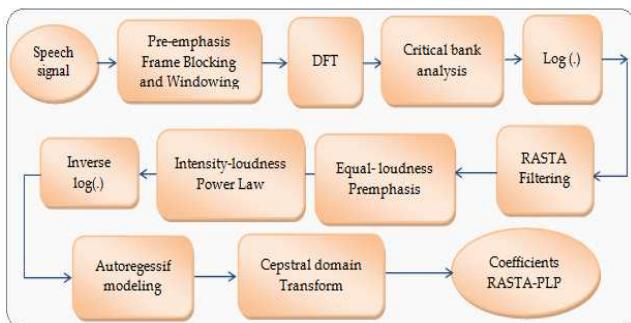


Fig.6 Block diagram of RASTA-PLP method

C. Hybrid Front-End Feature Extraction

In order to design a new robust feature extraction technique, we used a hybrid algorithm based on a combination of the previous described feature extraction methods GFCC and RASTA-PLP. Each of these method is first used separately and then concatenated together in order to obtain a new feature representation vector. The following block diagram at

figure 7 show the principle of the proposed hybrid front-end extractor.

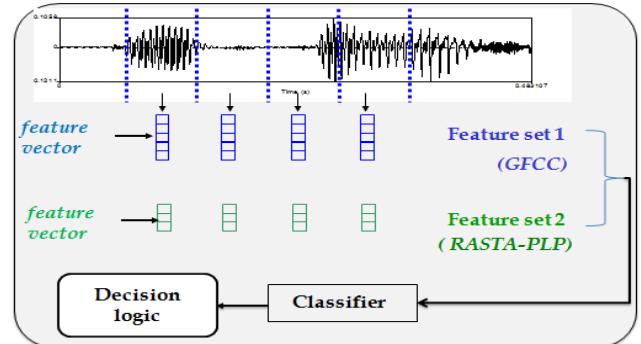


Fig.7 Structure of the proposed feature extraction method

III. PATTERN RECOGNITION

A. GMM Method

There are many methods for pattern recognition in the field of speaker recognition: Template approach, Statistical approach, Neural Network approach and multiple Hybrid models. In this study we have used the probabilistic method GMM that is the state of the art in this field [24]. The Gaussian mixture model assumes all the data points are generated from a mixture of a finite number of Gaussian distributions with unknown parameters. The probability density functions (PDF) of many random processes, such as speech, are non-Gaussian. A non-Gaussian PDF may be approximated by a weighted sum mixture of a number of Gaussian densities of appropriate mean vectors and covariance matrices according to (3)

$$f_i(x) = \frac{1}{(2\pi)^{\frac{d}{2}} \sqrt{\Sigma_i}} \exp \left[-\frac{1}{2} (x - \mu_i)' \Sigma_i^{-1} (x - \mu_i) \right] \quad (3)$$

Where: $f_i(x)$ is the probability density functions, μ_i and Σ_i , $i \in \{1 \dots M\}$ are respectively the mean vectors and the covariance matrices of each component and finally d is the dimension of vectors.

GMM is a conventional method for speaker recognition, known for its effectiveness and scalability in this field [25]. GMM is simple, easy and faster to compute models also in training and testing phases. The limitation of GMM that it requires a sufficient amount of training data to ensure good performance which increase the training time. GMM works well in terms of accuracy compared to other classification and recognition methods. We have used GMM in our hybrid system because we need to combine fast and accurate approaches in order to have an acceptable computational time of the derived system from our fusion approach. The decision of the identity of the speaker is based on the similarity measure between the test speaker model and all of the speakers models in the reference database. For the similarity measure we have used the maximum likelihood estimation (MLLE). To maximize the classification process for a given

set of feature vectors the Expectation Maximization (EM) algorithm is used.

B. The Expectation Maximization Algorithm

In this study, the maximum likelihood ML method using Gaussian mixtures model is used to design our speaker identification system. The EM algorithm is based on an efficient iterative procedure for calculating the maximum likelihood estimate in the presence of missing data. In the ML estimation, we first compute the parameters of the model for which the observed data are most likely. The EM algorithm consists of two steps for each iteration: estimation and maximization [26]. In the estimation step the missing data are computed based on the observed data and the actual estimated parameters. In the maximization step, the likelihood function is optimized by assuming that the missing data are known. Estimates of missing data from the estimation step are used as actual missing data. The convergence of the EM algorithm shown in the following figure 8, is satisfied by the fact that it increases the probability at almost every iteration [27].

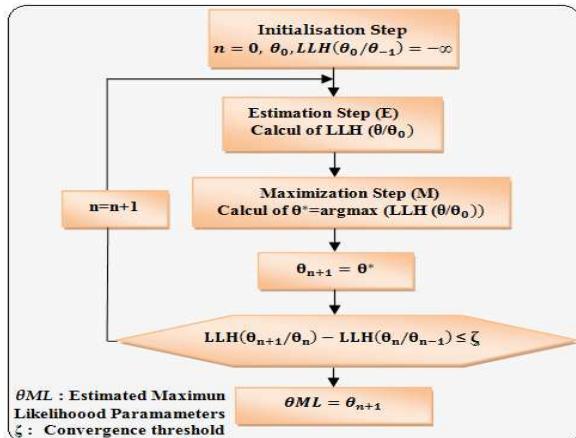


Fig.8 Expectation Maximization algorithm

IV. EXPERIMENTATION AND RESULTS

A. Effect of the pre-emphasis stage

The pre-processing of speech signal is a very important stage in the design of any speech/speaker recognition system because it has a direct influence on its robustness and efficiency. The pre-emphasis of the speech signal intend to give more energy to the high frequencies. This is obtained by using a high-pass filter having the following transfer function:

$$H(z) = 1 - \alpha \cdot z^{-1} \quad (4)$$

In this study we fixed α equal 0.95

The next figures 9a and 9b show the benefit of the pre-emphasis preprocessing that make uniform display of the energy over all the frequencies of the speech signal. This new frequency distribution will consequently lead to an

improvement in the characterization of the speech signal and an increase in the accuracy of the speaker recognition system. The obtained result justifies the use of this technique.

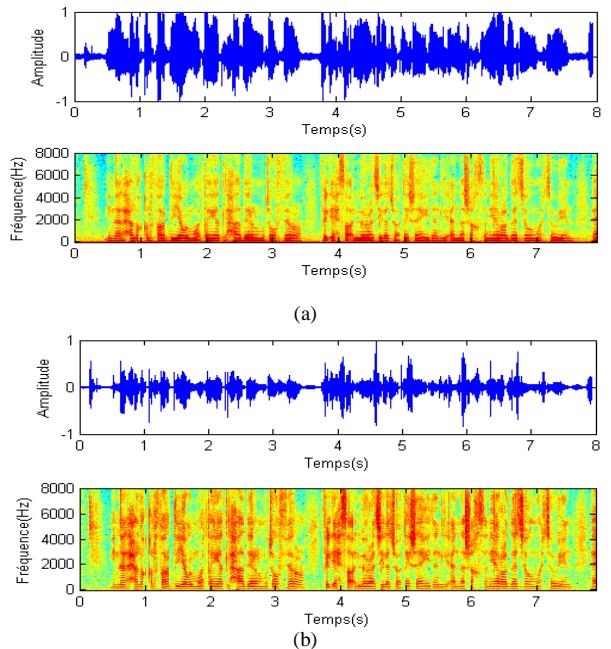
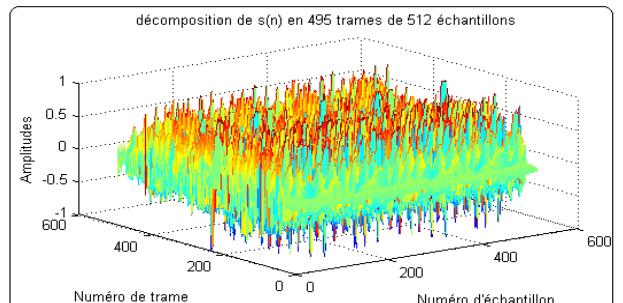
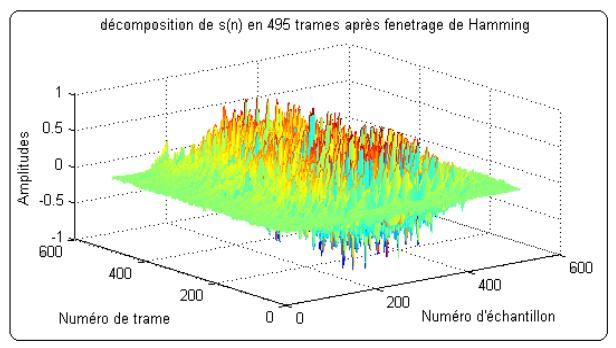


Fig.9 The spectrogram (a) before and (b) after the pre-emphasis

The pre-emphasis processing contributes to reduce the edge effect between successive frames as illustrated by the following figure 10.



(a)



(b)

Fig.10 Edge effect interframes (a) before and (b) after pre-emphasis

B. Experimental conditions

In this study, we recorded a database of 51 speakers (35 male and 16 female). For each speaker we acquired two records: one of about 20 seconds for the training phase, the other of about 10 seconds which will serve later for the recognition phase. All speech signals were acquired in .wav format with a sampling frequency of 16 kHz and 16 bits monophonic quantization using the Wavesurfer software tool [28]. A Gaussian white Noise of zero mean and unit variance with a various level was added only to the test signals in order to evaluate the robustness of our system under conditions similar to reality. The noise has been added only to the test records because generally the learning speech signal are carried out in a controlled environment whereas the test speech signals is taken in most practices cases in noisy and uncontrolled environments. The feature extractors that will be considered in this study are MFCC, GFCC, RASTA-PLP and the combination of GFCC and RASTA-PLP. The entire system is implemented under the MATLAB environment. The following table I gives a detailed description of the experimental conditions of our study.

TABLE I
EXPERIMENTAL CONDITIONS OF THE STUDY

Task system	Text independent automatic speaker identification
Feature set	MFCC, GFCC, RASTA-PLP, GFCC+RASTA-PLP
Back-end	Gaussian mixtures model with NG=4 mixtures
Nb. of coeff. in a feature vector	12 MFCC, 12 GFCC and 12 RASTA-PLP 24 for GFCC&RASTA-PLP
Window size	32 ms
Step size	16 ms
Sampling rate	16 kHz
Training set	51 speakers (one record of 20s for each speaker)
Test set	51 speakers (one record of 10s for each speaker)
Noise Type	White Gaussian Noise (zero mean and unit variance)
SNR range	From 40 db to 0db with a step of 5db
Platform	HP Elite book core i5 2.4Ghz
Prog. environnement	MATLAB®7

C. Performance measure

In this paragraph we will present the performance results corresponding to our recognition tests experiments which we have conducted on four sets features extractors: MFCC, GFCC, RASTA-PLP and GFCC combined to RASTA-PLP. All tests were conducted in the presence of an additive white Gaussian noise having a variable signal par noise ratio changing from 40 dB to 0 dB. The total accuracies of recognition are presented in Table II and figure 11. The results show that the performance obtained by the fusion of the feature parameters GFCC and RASTA-PLP is better than that by using separately the feature parameters MFCC, GFCC or RASTA-PLP.

TABLE II
THE ACCURACY RECOGNITION OF USED METHODS

RSB (dB)	MFCC	GFCC	RASTA-PLP	GFCC + RASTA-PLP
40	100	100	100	100
35	100	98.37	98.37	100
30	91.18	98.37	88.67	98.37
25	82.37	94.15	80.37	94.15
20	58.75	80.37	60.12	80.37
15	25.32	58.75	27.65	60.12
10	20.91	25.32	20.91	25.32
5	16.45	20.91	16.45	20.91
0	10.85	10.85	10.85	16.45
Av. Acc.	56,09%	65.23%	55.95%	66.20%

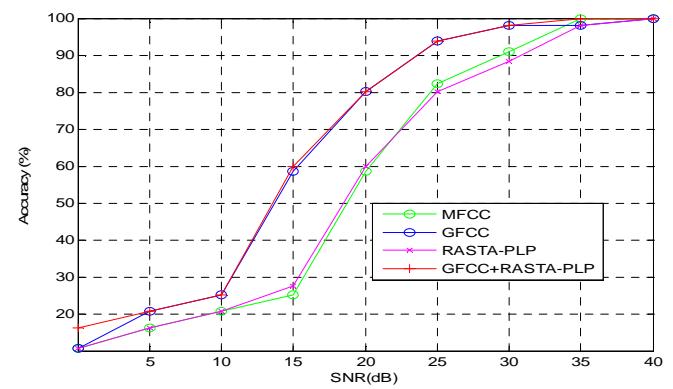


Fig.7 The performance results of studied methods

V. CONCLUSION

In this paper a fusion approach based on the combination of two auditory models GFCC and RASTA-PLP have been explored for feature extraction process. We have chosen these methods to build our front-end because it simulates the spectral and temporal aspects of the peripheral auditory system. The GMM classifier is used as a back-end for speaker modeling. The main objective of this study is to explore the new feature representation and evaluate the robustness of the implemented speaker identification system. It is therefore necessary to analyze the strengths and weaknesses of each set of parameters and to compare their performance in terms of identification rate (accuracy) under noisy conditions but also in terms of response time (efficiency). The ultimate objective of all these analyzes is to identify the strengths of each method in order to exploit them when they are combined or used separately according to the requirements of the intended application. Based on the results of tests carried out on our database, we can conclude that all methods MFCC, GFCC and RASTA-PLP used separately give a good accuracy result 100% with the speech is recorded in quiet environments and when there is a similar condition for recognition test and learning phases. But when we added a highly level of white Gaussian noise to the test speech, the performance result decreases considerably. However, the hybrid method RASTA-

PLP combined to GFCC gives the best performance of with a relative improvement of average accuracy of 10% compared to the conventional MFCC method when SNR changes from 40 db to 0db.

Finally, a multiple combination of features may be deployed to implement a robust and efficient parametric representation for speaker identification system. However different features may be complementary and can be combined to enhance accuracy.

Multiple combinations of features can be used to implement robust systems. However, despite the fact that these different features are complementary and can be combined to improve the accuracy, the computational load of the implemented system may increase with the consequent number of parameters to be processed, which may be unacceptable in terms of system efficiency. Future work will extend the study to other scenarios to improve noise robustness but also the efficiency of the system.

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The ontology of the competency-based approach and the perspectives of implementation

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Abstract— This article is a continuation of our researches on the competency-based approach (CBA). It presents the ways that can facilitate and generalize the understanding of CBA, its adoption and its implementation in the educational system of Morocco. The work described in this paper aims of the final stages of an ontology's development, when consensus is reached. More precisely, the stage of operationalization: the process that allows the transforming from the conceptual representation of knowledge in an ontology regardless of use, to one operational representation appropriate to its use. This article gives an overview of the constraints that characterize this stage and opportunities that can be offered by the ontology's implementation. It outlines a functional draft of a learning platform architecture based on CBA, in order to guide the choices made in the operationalization phase of CBA ontology.

Keywords: *Ontology, Competency Based Approach, Modeling.*

I. INTRODUCTION (HEADING 1)

As part of our research about e-learning, education systems and modeling of information systems, we are interested in the problems being experienced by the teaching in Morocco, especially when adopting the Competency-Based Approach (CBA). We are devoted to the study of this approach and the diagnosis of problems that hinder its adoption in the educational environment. We have explored several ways to find a solution to some important aspects of the problem, we have notably given more importance to the use of ontologies. Usability of ontologies, in real context, is still limited, but they are a very popular in the capitalization and the sharing of knowledge in the field of computer environments for human learning. Indeed, many researches, in this direction, are trying to build consensual ontologies for e-learning and also for learner's modeling, pedagogical documents structuring, and other concepts as well. In addition, many tools and languages for the creation of such ontologies are evolving and have reached currently an interesting level of maturity allowing them to be the basis for a suitable solution to our context of study.

The rest of this article is structured as follows; after reviewing the CBA's situation in Morocco, introducing the notion of ontological engineering and explaining the life cycle of an ontology, we highlight the features and the importance of stage of the operationalization of an ontology. Once the requirement of this stage asserted, we'll clarify the different usage scenarios of an ontology. The last part will be dedicated

to laying the first stones of the foundations of a learning system based on the CBA. In term of the conclusion, we'll present our future research's perspectives concerning these topics.

II. THE CBA IN MOROCCO

Despite the progress made in the Moroccan educational system since 2000, with the launching of large-scale re-engineering projects of the system according to the CBA specifications, the revision and the reformulation of curricula. This has not yet produced sufficient tangible results. The gains remain fragile, and the dysfunctions persist, especially for the effective and efficient adoption of the CBA [1].

The CBA is a pedagogical current, which considers learning by competencies. It brings a new vision to learning and teaching. It is now time to enable learners to build competencies, i.e. to provide them with a framework to help them develop competencies. This approach provides a reference framework richer than that offered by of the learning by goals. It is presented as a solution to remedy the inefficiency of the educational system, it represents a real opportunity to respond to school failure [2,3] and improves the quality of training. But the CBA faces difficulties to take place. This is due primarily to the low investment in training and capacity building of teachers and other staff of the educational system [1]. To address these problems, continuing education and self training are unanimously recognized as indispensable tools for updating and harmonization of teachers' knowledge and standardization of their competencies. But in the absence of methodological support provided to teachers, a lack of relevant theoretical framework guiding the conception of curricula, and a wealth of literature on the CBA, the various contributors in education are confused. Moreover, their material and social conditions demotivate them and increase their inertia. So, it is impossible to speak about teaching involving the CBA without all the contributors' in the process of teaching understanding unequivocally its concepts and its pedagogical approaches. Because that the discourse about this approach is expressed in the natural language, so it may be subject to many interpretations that may involve conceptual and terminological ambiguities.

Knowing that distance training tools are cheaper, more convenient and easier to implement, they have not yet seen the development they deserve. Motivated by a strong desire to

create the necessary conditions for the various contributors in this reform, so that they can adopt this approach effectively, we first proposed a formalism [4], in the form of an ontology, this ontology will explicit all the implicit practices of the "competency" in class learning and in e-learning, and finally will facilitate the implementation of this approach particularly by an e-learning platform.

III. ONTOLOGICAL ENGINEERING

Ontologies are representations of general properties of what exists in a formalism supporting a rational treatment. These are the result of an exhaustive and rigorous formulation of the conceptualization of a domain. These are alive objects, they follow a life cycle as software does, they may be software components that can be embedded in information systems and provide them with a semantic dimension, that has been lacking so far.

A real engineering has begun to emerge around ontologies and their scope of implementation continues to widen. Many principles and criteria for building ontologies have been proposed [5], without any real general methodology for the construction of ontologies in the field of ontological engineering. The life cycle of an ontology could be seen as follows:

The needs' evaluation can be presented into three aspects: to precise the operational objective, to define the scope of knowledge and to identify users. The conceptualization is done by proceeding to the analysis of documentary corpus, interviews, etc. in order to specify and explicit the semantics of the field, by defining the concepts (classes) of the domain and their relations, by organizing these concepts' hierarchy (super-class, sub-class) and by defining attributes and constraints characterizing these concepts. The ontologisation is a partial formalization that respects the integrity of the conceptual model, in accordance with the following criteria: clarity and objectivity of definitions, axioms' consistency, scalability of the ontology, the minimality of encoding postulates and minimality of vocabulary. The operationalization and implementation consist in equipping an ontology with tools to enable a machine, using it to manipulate knowledge in the field. Finally, the evaluation and the development are done by testing the correspondence to the operational objectives of the ontology, which are fixed at the stage of the needs' evaluation.

Many tools for building ontologies, using various formalisms and offering different features, have been developed. The most interesting are those which are implementations of methods. For example the methodology METHONTOLOGY[5], the environment ODE [6], the publisher ONTOEDIT [7] and recently PROTEGE2000 [8].

IV. CONSTRUCTION OF THE CBA ONTOLOGY

After extensive study of the CBA and its constraints for the adoption and the implementation as well as the constraints presented by the Moroccan educational system. As a first step towards a comprehensive solution to the problems of adoption of the CBA we thought of formalizing this approach [4]. To do

this we opted for the building a domain ontology, which we believe is the appropriate solution to reduce or eliminate the conceptual and terminological confusion and ensure a shared understanding in order to improve communication, sharing, interoperability and possible reuses.

To build our domain ontology, we first proceeded to the identification of conceptual primitives (concepts and relations) and semantics of the domain (conceptual properties of primitives) in a corpus of knowledge [4]. Secondly, we have structured and formalized the conceptual description [4]. The corpus that we have analyzed [4] is a set of documents expressed in natural language, and therefore is informal. This corpus covers the whole field of knowledge about the CBA, to help remove any semantic ambiguities. Specific knowledge of the field has been identified in terms of conceptual primitives and axioms.

Our ontology is a hierarchical organization of concepts and relations that we have emerged from the formal analysis of literature of CBA and pedagogies that have been developed around this approach, particularly the pedagogy of integration [3].

The concepts of our ontology (Figure 1):

A **situation** (or a class of situations) is *emblematic*, it presents *problems* to solve, *challenges* to rise, *constraints* to overcome, it belongs to a *domain* of life or a scientific *discipline*, it raises *questions* that must be answered and aims at one or several *purposes* to achieve. A situation may be, in terms of teaching, divided into **tasks** with a degree of *complexity*, *processes* to execute and *products*. A situation has a **context** that can be *real* with all its complexity or it can be *didactic* for learning (or target) i.e. a simple scope of practice or integration of a competence. The situation has **assessment tools** which defines the means and *criteria* of evaluating the performance under the circumstances of the situation and its context.

The main Classes of resources mobilized in a situation:

- **External resources** are often environmental resources needed to develop the competency (human resources, spatiotemporal and material resources, contextual resources, social resources, cultural resources, didactic resources, help, ...)
- **Internal resources** belong to the individual (competencies, cognitive resources, conative resources (experiences), physical and mental skills, ...)

Knowledge is a particular resource mobilized by the competencies in a situational problem. It is important to deepen the knowledge-competencies links. It is not enough that a knowledge is "vaguely" connected to a competency, its mobilization must be attested [9] [10].

In a didactic context, it is essential to define the knowledge needed to solve a situational problem, in order to enable the learner to acquire this knowledge before mobilizing it in a given situation.

A situational problem is the opportunity for practice, learning and assessment competencies, it is the key resource of teaching according to CBA. Indeed, a competency is always

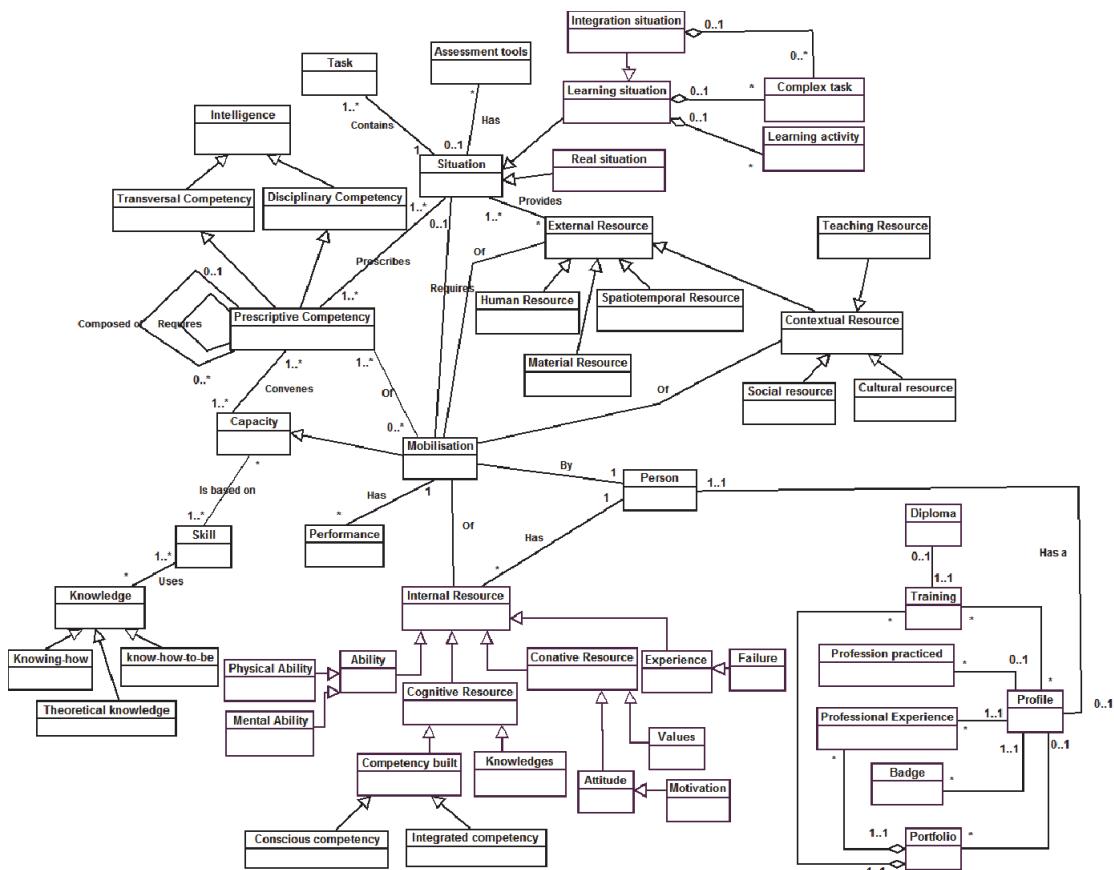


Figure 1: The CBA Ontology Overview

associated at least with a situation or with a class of situations. A competency is developed in situations and it is the result of completed, successful and socially accepted handling of these situations by a person or a group of people in a given context [11].

A situation is emblematic, it presents problems to solve, challenges to rise, constraints to overcome, it belongs to a domain of life or a scientific discipline, it raises questions that must be answered and aims at one or several purposes to achieve. A situation may be, in terms of teaching, divided into tasks with a degree of complexity, processes to execute and products. A situation has a context that can be real with all its complexity or it can be didactic for learning (or target) i.e. a simple scope of practice or integration of a competency. The situation has assessment tools which defines the means and criteria of evaluating the performance under the circumstances of the situation and its context.

The **mobilization** is more than a routine application or use; it is a meta-cognitive **capacity** of *identification, selection, activation, coordination and integration* of various resources to deal with situations. This is the central concept of our ontology; it combines the situation, the competences, the person, the performance and all kinds of resources.

The **Resources** effectively mobilized in a situation, far exceed, those determined in the prescriptive competences that are required for the resolution of the situation. Indeed they are of different nature and from various sources; **internal**

resources of the person (with a complex **profile**) which may be **integrated competences** (implicit, innate), **conscious competences** (acquired, explicit, conscious, transferable, conceptualisable) or cognitive (knowledge embodied by the person) or life experiences or **integrated competence** (implicit, innate) or **aptitudes** (body and mental predisposition), **external resources** of the situation may be **material** (tools that extend the perception and action of the person), **spatiotemporal** (the time and the space given, the opportunity) or **human** (support, aid, assistance, monitoring) and **contextual resources** may be **social** (prejudices, ethic) or **cultural** (religious prejudices, patrimony, shared memory).

Prescriptive (or required) **competence** is a simple pre-supposed cutting of effective competence that should take place, it is conceived as an organizational framework of the curriculum, according to the cascade architecture of Jonnaert [3]. **Transversal** (or extended) **competence** is a common competence to several disciplines. **Disciplinary** (or specific) **competence** is a competence associated with a specialty domain.

Competence is the result of an efficient coordination of the capacities of the person with all the categories of resources. **Capacity** is the unit, on which prescriptive competence is based. It is a *meta-cognitive structure stabilized, operative and reproducible* as the scheme.

The **skill** is a *meta-cognitive*, internal and *conscious process* of the person; it is *specific* to a class of tasks or specific situations and it is based on well-defined contents.

The **contents** may have different forms: "**Theoretical knowledge**" which is *conceptual, declarative, factual* and *codified in books* or "**Knowing-how**" which is *operative* and *procedural* or "**Knowing-how-be**" which is *behavioural* and *relational*.

Jerome S. Bruner considers in "Actual Minds, Possible Worlds, 1987" the speech on competence as a speech on the **intelligence**. This intelligence takes several forms according to Howard Gardner (1983):

These "intelligences" are: linguistic and logical-mathematical (the styles of thinking measured most often on psychological tests), musical, spatial, bodily-kinesthetic (including large and small motor skills), interpersonal (an area of strength for teachers, social workers, and politicians), and intrapersonal (self-knowledge). These "intelligences" represent absolute (or maximum) competences.

Our ontology does not present the concept of effective (or real) competence, this competence cannot be formalized nor represented, because it is the work (or the performance) of the actor in the situation that is taking place in time, that is the person builds in the context of the situation. The prescriptive competence is supposed to be the decontextualised representation of effective competence.

After the construction of the ontology, the obtaining and the maintaining of a consensus on the choices of representation and conceptualization made in this ontology, it is time we tackled the stage of operationalization and prepared the implementation.

V. THE OPERATIONALIZATION OF CBA ONTOLOGY

To integrate an ontology in an information system allows to formally declare some knowledge which is used to characterize the information managed by the system and to rely on these characterizations and the formalization of their significance to automate certain tasks of information processing. But, the use of a conceptual representation in a computer system is only possible if the system can use the concepts through the operations associated with them [14].

Using an ontology in a machine for reasoning requires that it is associated with an operational semantic which specifies the operations that the system will apply to the knowledge, these operations must comply with the formal semantic already specified in the ontology. This operational semantic is distinct from the formal semantic which only constrain the possible uses of conceptual primitives, without specifying how knowledge associated with these primitives will be implemented in an operational system.

In addition, the formal semantic is determined from a corpus at the end of the process of conceptualization and ontologisation. Although based on the conceptual representations in the ontology the operational semantic is not only depending on the knowledge of the field, but the

operational use that will be made of the considered ontology also.

Besides this, the operational use of an ontology requires its representation in a language not only formal but operational as well, i.e. providing reasoning mechanisms adapted to the envisaged knowledge manipulation [13]. It is therefore necessary to transcribe the ontology, from the formal language in which it is expressed into the operational language through which the system will handle the knowledge.

The so-called operational ontology is an ontology expressed in a language with operational semantics described as operational or computational. Thus, the operationalization of an ontology is to specify the operational semantic added to the ontology that allows to describe the mechanisms of reasoning which will be implemented in the projected system, and then to translate the conceptual representation of the ontology in an operational language, this transcription is forced and directed by the operational semantic specified.

According to Fürst [12], the usage scenario is the description of purpose of usage of the knowledge specified in the ontology, two extreme scenarios can be distinguished:

- The pure validation scenarios, where the ontological knowledge is used to validate a knowledge base in relation to the semantics of a field;
- The automatic or quasi-automatic deductive scenarios, where the ontological knowledge is used to produce or help produce new knowledge about a given case.

VI. TOWARDS THE IMPLEMENTATION OF CBA ONTOLOGY

Ontologies are mainly used in the field of Knowledge-Based Systems (KBS), they open up various large horizons in terms of target applications, which can be classified according to the objectives' use of ontologies in several categories; research by concepts in documentary bases, consultation and navigation [15], indexing and classification (content management) and problem-solving.

In our case, the ontology we have built to support the CBA in the Moroccan educational system did not only aim at making this approach an object of consensus commonly shared between the different contributors in the process of teaching to facilitate action, but our goals were much more ambitious. Indeed, ensuring the shared understanding between humans, of a field of knowledge and making explicit what is considered implicit as well as allowing software agents to manipulate information from an interesting semantic level to assist humans to produce knowledge are among the objectives of building ontologies. Therefore, we plan to deepen our research, in the near future, on what could be done with our ontology in a purely software context, mainly the application in the field of education, e-learning and probably in the field of professional training and human resource management. However, we should try to anticipate, to sketch the outlines of the learning system which will make use of this ontology, in accordance with the usage scenarios we set in th stage of the specification of requirements, which have certainly evolved

during the project. In fact, the choices we must make in the stage of the operationalization are conditioned by the use we will make of our ontology.

We present here an outline of a functional architecture of a learning platform integrating the CBA, based on the CBA ontology, that will enable the various actors involved in the process of learning to intervene, and will facilitate the adjustment of learning needs and expectations of the learner in the context of an online learning environment.

The expected objectives of such a system tend towards the implementation of various aspects of the CBA as follows:

- **Building a referential of all the competencies taught in the curriculum:** The competencies' base should be organized in a referential of competencies that will be common, standardized and shared. The guarantor of the integrity of this referential is, of course, the CBA ontology. It will be the core of any system based on the CBA. All programs and diplomas will be reformulated in terms of this referential. It goes without saying that we need to design and produce updating and consultation tools for this competencies' base.

- **Assisting the design of programs within the framework of the CBA:** A system of aid in the development of training programs will be designed to create new ones (prescriptive profiles) validated by the specifications of the Moroccan White Paper of education or the requirements of the job market.

- **Assisting and validating all productions according to the specifications of the CBA:** A support system construction of Learning and Assessment Situations (LAS) well be dedicated to assist both the author of content and teachers to build LAS in consistency with the targeted competencies respecting the rules of the development of LAS (obviously explained in CBA ontology). These LAS will be linked to the competencies on the referential.

- **Allowing the capitalization of the CBA resources:** The semantic referencing of the LAS (basic resources of the progress of learning by the CBA) would capitalize these resources in a structured warehouse according to several semantic dimensions such as the competencies they mobilize, their level of difficulty, their purposes, etc.

A multicriteria research system by concepts, in the resource base, will be used to associate educational resources and contents to LAS, and also to find and reuse existing LAS in contexts which may be different from the one for which they were originally planned, (by operating a probable simple modification).

- **Making the learner the main actor of the learning process:** A learner has a profile, expressed in terms of competencies which can be certified by acquired diplomas, which may be also claimed, or an effective profile.

A system, in direct interaction with the learner, will be able to get an estimated profile of him through the evaluation system.

- **Assisting the assessment of learning in terms of competencies:** A comprehensive system of assessment (or pre-evaluation) will be able to make the calculation of the proximity of the current profile to the targeted one, and to elaborate a probable plan of rapprochement between these

profiles, in order to personalize the learning, this would be possible if we define a metric to measure the distance between the current profile and the targeted one (corresponding to a degree for example). In fact, the comparison of the current profile of the learner with the targeted profile is necessary to evaluate the feasibility of training. An alternative goal (more reasonable intermediate step) is proposed if the level of feasibility is low. This metric should calculate the distance between two levels (eg "low" to "high") when competency is present in the current profile of the learner and in the targeted profile, and the distance between a competency which is not present in the current profile of the learner and a competency in the targeted profile.

In this brief study, we have made about the expected functionality of the system that will implement the CBA ontology, we find out that this system will appeal for both validating and production scenarios of usage of ontologies. The operationalization will focus on the prescriptive aspects of the CBA rather than the effective aspects, which can be represented only in an approximate way by making estimates.

VII. CONCLUSION

The object of this article was to emphasize the constraints and the problems posed by the stage of the operationalization of an ontology in the global context of its life cycle. As it was necessary to make discriminating choices in consistency and adequacy with the objectives planned for our CBA ontology, we have presented our proposition of a functional architecture of the future system that is going to implement the CBA ontology.

Thus, we have opened a big field that is going to initiate a debate which would lead to precisions. This will allow us to reevaluate our ontology in relation to the new operational specifications before its implementation. It is also necessary to choose an adequate transcription language to finalize the stage of operationalization. This is done, we can devote ourselves to study in detail the targeted applications of the CBA ontology without forgetting the technical specifications.

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A Modified GA-based Workflow Scheduling for Cloud Computing Environment

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Abstract— The Cloud computing becomes an important topic in the area of high performance distributed computing. On the other hand, task scheduling is considered one the most significant issues in the Cloud computing where the user has to pay for the using resource based on the time. Therefore, distributing the cloud resource among the users' applications should maximize resource utilization and minimize task execution Time. The goal of task scheduling is to assign tasks to appropriate resources that optimize one or more performance parameters (i.e., completion time, cost, resource utilization, etc.). In addition, the scheduling belongs to a category of a problem known as an NP-complete problem. Therefore, the heuristic algorithm could be applied to solve this problem. In this paper, an enhanced dependent task scheduling algorithm based on Genetic Algorithm (DTGA) has been introduced for mapping and executing an application's tasks. The aim of this proposed algorithm is to minimize the completion time. The performance of this proposed algorithm has been evaluated using WorkflowSim toolkit and Standard Task Graph Set (STG) benchmark.

Keywords—Cloud Computing; Task Scheduling; Genetic Algorithm; Directed Acyclic Graph; Optimization Algorithm

I. INTRODUCTION

The Cloud computing is emerging technology and great popularity in recent years which grants the users with high scalability, reliability, security, cost effective mechanism, group collaboration and ease of access to various applications [1]. In addition, The Cloud computing provides dynamic services as Software as a service (SaaS), Platform as a service (PaaS) and Infrastructure as a service (IaaS) via the internet [2].

The Cloud computing has some challenges (e.g., security, performance, resource management, etc.). Therefore, the task scheduling is considering one of the most challenges that related to resource management [3]. In general, task scheduling is a problem of assigning tasks to the machine to complete their work. In the same context, the scheduling in the Cloud computing environment means that large number of the tasks are executing on the available resources in a suitable way depending on many parameters (i.e., minimize completion time, minimize the cost of execution tasks, maximize resource utilization, etc.) [3]. Therefore, task scheduling in the Cloud computing environment is considered one of the most factors would affect reliability and performance of the Cloud services [2].

Generally, the problem of assigning tasks to apparently unlimited computing resources in the Cloud computing environment is an NP-Complete problem. According to the process of task scheduling, the user's jobs are submitted to the Cloud scheduler. In turn, the Cloud scheduler inquires the Cloud information service about the statuses of the available resources, and then allocates the various tasks on different resource (i.e., virtual machines) as per the task requirements [2]. The good task scheduling must assign the virtual machine in an optimal way [3].

Therefore, task scheduling problem is considering the challenge in the Cloud computing environment. The researchers are trying to apply heuristic methods to solve this problem and get optimal solution [4]. Therefore, the Meta-heuristic based techniques deal with this problem by providing near optimal solutions. In addition, Meta-heuristic has gained huge popularity in past years due to its efficiency and effectiveness to solve the large and complex problem. There are many of Meta-heuristic algorithms (e.g., Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), etc.).[5].

Further, task scheduling algorithms are different based on dependency among tasks to be scheduled. According to dependent task scheduling, there is precedence orders exist in tasks where any task can only be scheduled after finishing execution all its parent tasks. Otherwise, tasks are independent of each other, and they can be scheduled in any sequence. In addition, the dependent task scheduling is known as workflow scheduling and independent task scheduling is known as independent scheduling [5].

The aim of this paper is to develop a workflow scheduling algorithm in the Cloud computing environment based on Genetic Algorithm for allocating and executing dependent tasks to improve task completion time.

The rest of the paper is as follows: in Section 2, the related works are discussed. In Section 3, a model for task scheduling problem is described. Sections 4, the principles of the modified GA-based dependent task scheduling are described. The configuration of the Workflowsim simulator, implementation of the proposed Genetic Algorithm, as well as, performance evaluation is discussed in Section 5. Finally, conclusion and future work are given in Section 6.

II. RELATED WORK

In recent years, the problem of task scheduling in the Cloud computing environment has caught the attention of researchers. One of the solutions that try to solve task scheduling is use Meta-heuristic algorithm. On the other hand, task scheduling in the Cloud computing environment is considered critical issue by considering different factors like completion time, the total cost for executing user's tasks, utilization resource, power consumption, fault tolerant, etc.

In this paper, a modified Genetic Algorithm has been introduced to scheduling dependent tasks.

In many types of research, different GA based task scheduling algorithms have been introduced; each of these algorithms proposes some modifications to the default Genetic Algorithm. In [6], fixed bit string representation is used, where the solutions are encoded as a fixed length binary string. Also, there are others approaches as Direct Representation is used [7]. The Permutation based representation is applied using 2D vector to represent a chromosome. One dimension represents the resources and other shows the order of tasks on each resource [8-10]. In addition, the Tree representation has been used for mapping the relationship between virtual machine and physical machine [11, 12].

On the other hand, the initial population is generated randomly in basic Genetic Algorithm. Therefore, some approaches have been applied to enhance optimal results and increase the convergence of Genetic Algorithm. In [9], the Minimum Execution Time (MET) and Min-min heuristic are used to generate initial population. Genetic Algorithm has been used to solve workflow scheduling problem, where the precedence of tasks is considered through the initial population generation

Further, one of the main steps of Genetic Algorithm is crossover and mutation, therefore the modification on basic crossover has applied to enhance the performance of Genetic Algorithm. In [3], a new model of crossover has been used differently from the used crossover in the default Genetic Algorithm. Therefor, the two selected chromosomes for crossover process to generate two offspring are also considered as offsprings. After producing the offspring, the two best offsprings are chosen. In [12], the crossover and mutation operators have been developed to make them appropriate for a tree representation of chromosome.

On the other side, many studies have considered Genetic Algorithm to solve task scheduling problem to minimize makspan, improve load balance among virtual machines, minimizing total cost to execute tasks, maximize resource utilization and save energy consumption. In [13], an immune Genetic Algorithm has proposed for workflow scheduling to minimize the makspan and cost, which considered five objectives and solved constraint satisfaction problem associated with task scheduling constraints. A task scheduling algorithm based on Genetic Algorithm has been proposed with the aim of minimizing makspan and improve load balance among virtual machines [7]. Genetic Algorithm has been used to achieve good load balance among virtual machines [6, 8, 14, 15].

In [16], Genetic Algorithm and Fuzzy Theory called (FUGA) algorithm had been introduced to minimize makspan, cost and enhancement imbalance in the Cloud computing during scheduling task. The Fuzzy Theory is used to compute fitness value of the solution and for crossover operation.

The energy efficient is consider one of the most parameters of task scheduling process, so there are approaches have been introduced using Genetic Algorithm to enhance the energy consumption of datacenters. In [17], energy aware task scheduling algorithm has been presented based on shadow price guided Genetic Algorithm (SGA) where shadow price is used into Genetic Algorithm to improve solution's fitness value. In addition, the gene has been modified in order to enhance the probability of producing better solutions. In [18], pareto-solution based Genetic Algorithm approach for workflow scheduling has been introduced to optimize objectives.

In addition, there are many studies have been proposed using other Meta-heuristic approaches as Particle Swarm Optimization (PSO), Cuckoo Search (CS), Tabu Search, etc. In [19, 20], the authors have introduced a modified task scheduling algorithm by merging the PSO and Cuckoo algorithms to minimize the execution time, as well as, maximize the resource utilization. Two hybrid task scheduling algorithms have been introduced to enhance the default PSO algorithm by using a Best-Fit algorithm to initialize population instead of being initiated randomly as in the default PSO algorithm and using Tabu Search algorithm to improve the local search by avoiding the trap of local which could be occurred in default PSO algorithm [21, 22].

Further, a modified PSO algorithm has been proposed to allocate dependent tasks on available resources to minimize the execution time, as well as, computation cost [23].

III. MODEL OF TASK SCHEDULING PROBLEM

The model for task scheduling for Cloud computing according to this work is defined as follows:

The Cloud resources are provided to the user as a number of Heterogeneous Virtual Machine (VM) through virtualization technology. The user's application submitted to the Cloud service center and it has been split into several tasks with known data dependence. Generally, association task scheduling is defined as a Directed Acyclic Graph (DAG) composed of Nodes (n_1, n_2, \dots, n_N). Each node in the graph represents a task that must be executed sequentially without preemption in the same VM. If a node in the DAG has no parent node (input), calls (entry node), and if the node has no any child node, calls (exit node) [24].

In addition, the graph has directed edges E representing a partial order among the task nodes. The partial order introduces a precedence-constraints DAG and implies that for example if $n_i \rightarrow n_j$, then n_j is a child, which cannot start until its parent n_i finishes. After all task nodes have been scheduled, the schedule length is defined as Completion Time to execute the last task. The objective of task scheduling problem is to fined optimal

assignment task on available VMs and minimize the completion time with precedence-constraints are preserved.

IV. SCHEDULING ALGORITHM

Task scheduling problem is considered one of the most issues in the Cloud computing environment, perspective the Cloud provider and Cloud user. The Cloud provider should guarantee optimal scheduling of the user's task according to SLA. At the same time, he should guarantee throughput and good utilization of Cloud resources. Therefore, he needs a good algorithm to schedule the tasks in Cloud. As a result, task scheduling is classified as an optimization problem.

Therefore, heuristic algorithms such as Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), etc. could be used to solve the problem.

In this work, a workflow Scheduling has been proposed based on the default GA with some modifications. According to these modifications, the parents will be considered in each population beside the produced childs after the crossover process. Also, the Tournament Selection is used to select the better chromosomes to overcome the limitation of the population size. Therefore, the proposed algorithm is called Dependent Task Genetic Algorithm (DTGA).

A- Default Genetic Algorithm (DGA)

Genetic Algorithm (GA) is based on the biological concept of generating the population. GA is considered a rapidly growing area of Artificial Intelligence [25, 26]. The Genetic Algorithms (GAs) was inspired from Darwin's theory of evolution. According to Darwin's theory, term "Survival of the fittest" is used as the method of scheduling in which the tasks are mapped to resources according to the value of fitness function for each parameter of the task scheduling process [27].

Generally, the default Genetic Algorithm consists of five steps; Initial population, fitness function, selection process, crossover, and mutation (see Figure 1) [5].

Procedure GA						
1. Initialization: Generate initial population P consisting of chromosomes.						
2. Fitness:	Calculate the fitness value of each chromosome using fitness function.					
3. Selection:	Select the chromosomes for producing next generation using selection operator.					
4. Crossover:	Perform the crossover operation on the pair of chromosomes obtained in step 3.					
5. Mutation:	Perform the mutation operation on the chromosomes.					
6. Fitness:	Calculate the fitness value of these newly generated chromosomes known as offsprings.					
7. Replacement:	Update the population P by replacing bad solutions with better chromosomes from offsprings.					
8. Repeat steps 3 to 7 until stopping condition is met. Stopping condition may be the maximum number of iterations or no change in fitness value of chromosomes for consecutive iterations.						
9. Output best chromosome as the final solution.						
End Procedure						

Figure 1. Pseudo Code of Default Genetic Algorithm [5].

B- The Proposed Genetic Based Dependent Task Scheduling

In this work, a Genetic Based Dependent Task scheduling (DTGA) algorithm has been proposed for the Cloud environment. This proposed algorithm is considered an extension of our previous GA algorithm by concerning scheduling of dependent tasks instead of independent ones [3].

By considering a DAG with seven tasks to be executed on 4 VMs, the steps of the proposed DTGA algorithm is illustrated as follows (see Figure 2):

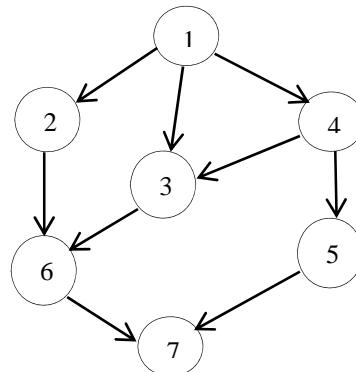


Figure 2. DAG with seven Tasks.

1. Representation of Chromosome

According to the proposed DTGA algorithm, the representation of chromosome is divided into two parts; mapping (for VMs) and schedule (for tasks Ts) as shown in Figure 3

VM 3	VM 1	VM 4	VM 1	VM 2	VM 3	VM 4
T 1	T 5	T 7	T 3	T 2	T 6	T 4

Figure 3. Representation of Chromosomes.

2. Initial Population

The population is randomly generated. The first part of the chromosome (VMs mapping) is chosen randomly from 1 to No_VMs where No_VMs is the number of the Virtual Machine in the Cloud system. The second part (schedule TS) is generated randomly such that the topological order of the DAG graph is preserved.

3. Fitness Function Representation

In the GA, each chromosome in population has a value called (fitness function) measured based on which fitness of solution. Therefore, the fitness function for task scheduling problem in the Cloud computing environment is considered the Completion Time of all tasks on the available VMs.

In the case of dependent task scheduling, a task may have more than one parent. Therefore, the maximum Completion Time of a task's parent is considered the start execution time of it.

According to Figs. 2 and 3, suppose task 2 completes its work on VM1 at 4 unit, and task 3 completes its work at 5 unit

on VM4, then the execution of task 6 will start from unit 5 on VM3 if no task active at that time.

Therefore, the starting time (ST) of a task is calculated using equation (1).

$$ST_i = \max [\max (\text{completion time of parent } T_i)] \dots (1)$$

Where ST_i is the starting time of task T_i on VM_j .

The completion time of task T_i is calculated using equation (2).

$$CT_{ij} = ST_i + \text{execution time of } T_i \text{ on } VM_j \dots \dots \dots \dots (2)$$

Therefore, the completion time for all tasks on all VMs is calculated as equation (3).

$$\text{Completion Time} = \sum_{i=1}^n \sum_{j=0}^{No_VMs} CT_{ij} \dots \dots \dots \dots (3)$$

Where n is the number of tasks, No_VMs is the number of VMs, and CT_{ij} is the execution time of task i on VM_j

4. Reproduction

- Tournament selection;** In this step, the selection method is applying to select two chromosomes from an available solution according to the fitness value to generate a new population. There are different approaches that can be applied in selection phase. Therefore, in our proposed DTGA algorithm the Tournament selection is used to select pairs of a parent for crossover process.
- Crossover;** After the selection process, the crossover is implemented on two chromosomes to generate a new solution with considering the dependency of the tasks

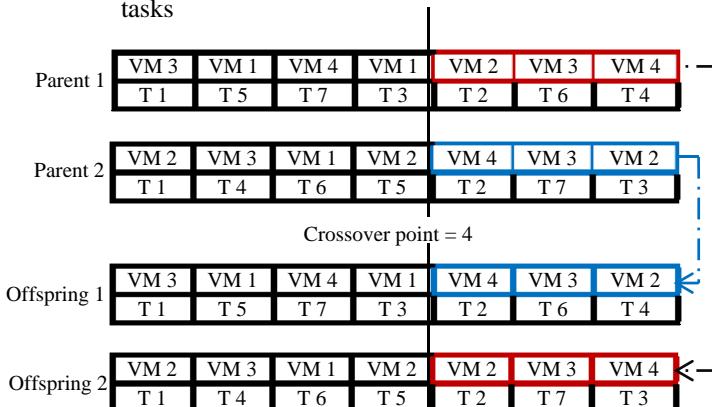


Figure 4. One point crossover operator.

In our proposed DTGA algorithm, the crossover is implemented using two steps:

a. Apply crossover point

The single crossover point is applied to mapping (for VMs) part according to a value generated randomly. As an example, two parents 1, 2 are used and crossover point value is 4 (see Figure 4).

This crossover generates new offspring and at the same time, its preserve the dependency for the tasks.

b. Apply New Model of Crossover

In this model, the two parents who are selected to crossover to generate two offspring will be considered as offspring too. So, the proposed new model of crossover produces 4 children (see Figure 5). After that, the two best children are chosen from these [3].

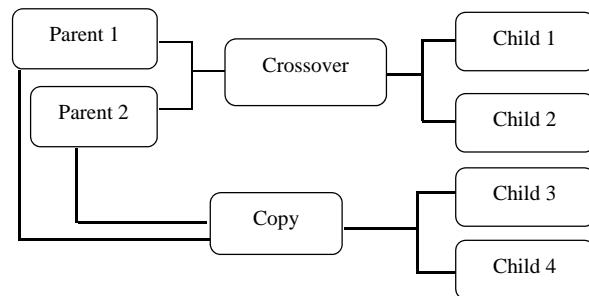


Figure 5. New Model of Crossover Process [3]

• Mutation

The mutation applies according to two points generated randomly and makes a check whether there is a dependency between tasks at these points or not. If no dependency, swap their position with VM number. Otherwise, generate another mutation point which allows mutation. As an example, Suppose the mutation point for parent 1 in Fig. 4 are (2 and 5). Now, check whether task 2 and task 5 are dependencies or not. Because there is no dependency between them, swap them and generate a new solution (see Figure 6).

Before mutation

VM 3	VM 1	VM 4	VM 1	VM 2	VM 3	VM 4
T 1	T 5	T 7	T 3	T 2	T 6	T 4

After mutation

VM 3	VM 2	VM 4	VM 1	VM 1	VM 3	VM 4
T 1	T 5	T 7	T 3	T 2	T 6	T 4

Figure 6. New chromosome after mutation.

5. Enhancement Population

Two modifications have been introduced to enhance population. According to the first modification, bad solutions will be considered besides the good ones instead of replacing them as in the default GA algorithm. These will help to generate an optimal solution.

According to the second modification, new chromosomes will generate randomly and involve in the population after each iteration to enhance the diversity of the population. These random chromosomes are considered 5% of the chromosomes in the population. The toleration of this percentage could be considered as a future work.

V. PERFORMANCE EVALUATION

In this section, the experimental evaluation of the proposed DTGA algorithm relative to the default GA, Random Algorithm (RA) and Round-Robin algorithms is presented.

A. The Experimental Environment

Workflow scheduling can be composed of a large number of tasks and execution of these tasks may require many complex modules and software. Also, the evaluation of the performance of workflow optimization techniques in real infrastructure is complex and time consuming. As a result, the simulation-based studies have become a widely accepted way to evaluate workflow system.

On the other hand, WorkflowSim simulator is considered the commonly used simulator to implement and evaluate the performance of task scheduling algorithms in the Cloud computing. It is considered an extension of the existing Cloudsim simulator by providing a higher layer of workflow management [28].

B. Experimental Results

By using WorkflowSim toolkit, the proposed DTGA algorithm is implemented, and a comparative study has been made among four algorithms; Round-Robin Algorithm (RRA), Random Algorithm (RA), the default GA, and the developed DTGA algorithms using benchmark programs [29]. The Completion time is considered to evaluate the performance. The used benchmark programs are listed in Table 1.

TABLE 1 SELECTED BENCHMARK PROGRAM [29].

No. Task	Notes
50	Random graphs
100	Random graphs
300	Random graphs
88	Robot control program
96	Sparse matrix solver

The completion time of RRA, RA, default GA and the proposed DTGA algorithms using 4, 8 and 12 VMs and tasks of Random graphs are represented in Tables 2, 3, 4 and Figures. 7, 8, and 9.

TABLE 2 THE COMPLETION TIME OF RRA, RA, GA, AND DTGA ALGORITHMS USING 4 VMS

No. Task	RRA	RA	GA	DTGA	No. VM
50	295.32	261.25	233.05	167.23	
100	564.59	505.3	455.6	322.29	
300	1,511.02	1,369.48	1,211.29	801.93	4

Tables 5, 6 and 7 illustrate the completion time improvement

TABLE 3 THE COMPLETION TIME OF RRA, RA, GA, AND DTGA ALGORITHMS USING 8 VMS

No. Task	RRA	RA	GA	DTGA	No. VM
50	175.71	157.91	138.47	87.4	
100	349.77	325.17	291.94	171.9	
300	1,009.31	945.51	862.82	537.01	8

TABLE 4 THE COMPLETION TIME OF RRA, RA, GA, AND DTGA ALGORITHMS USING 12 VMS

No. Task	RRA	RA	GA	DTGA	No. VM
50	107.22	99.82	80.51	56.07	
100	236.7	192.43	172.39	110.16	
300	702.95	584.1	499.07	335.46	12

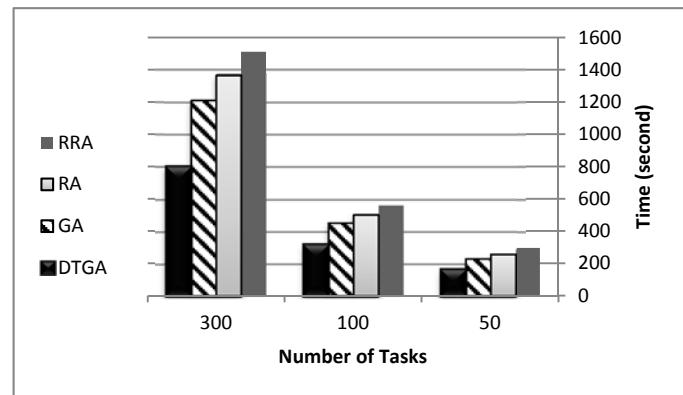


Figure 7. the comparison completion time of four algorithms RRA, RA, GA and DTGA.

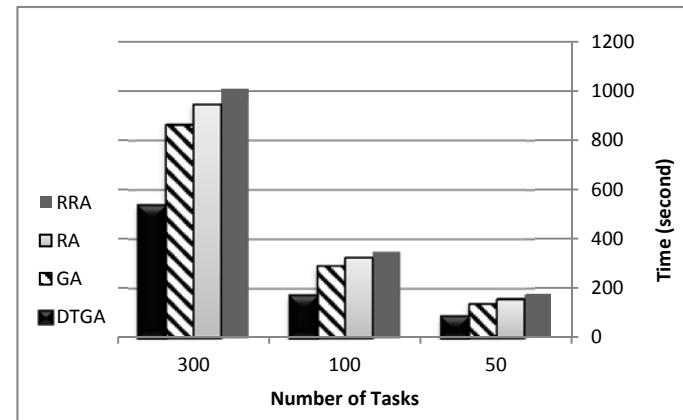


Figure 8. the comparison completion time of four algorithms RRA, RA, GA and DTGA.

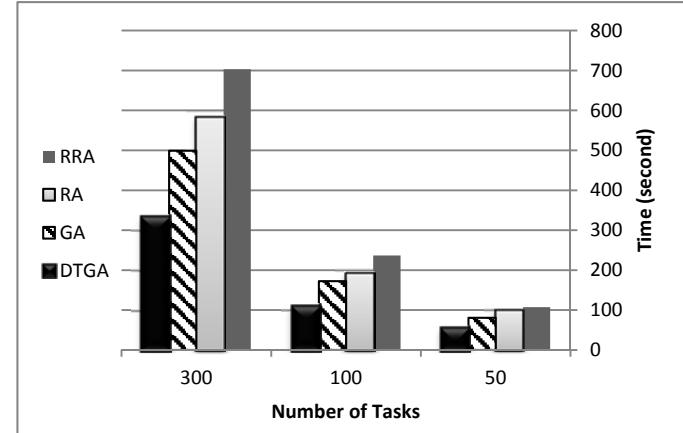


Figure 9. the comparison completion time of four algorithms RRA, RA, GA and DTGA.

for the proposed DTGA algorithm relative to RRA, RA, and default GA algorithms using 4, 8 and 12 VMs.

TABLE 5 THE IMPROVE COMPLETION TIME OF DTGA vs. RRA, RA, AND GA ON 4 VMs.

DTGA vs.				
No. Task	RRA	RA	GA	No. VM
50	43.37	35.98	28.24	4
100	42.91	36.21	29.26	
300	46.92	41.44	33.79	
Average	44.4 %	37.87 %	30.43 %	

TABLE 6 THE IMPROVE COMPLETION TIME OF DTGA vs. RRA, RA, AND GA ON 8 VMs.

DTGA vs.				
No. Task	RRA	RA	GA	No. VM
50	50.25	44.65	36.88	8
100	50.85	47.13	41.11	
300	46.79	43.2	37.76	
Average	49.29 %	44.99 %	38.58 %	

TABLE 7 THE IMPROVE COMPLETION TIME OF DTGA vs. RRA, RA, AND GA ON 12 VMs.

DTGA vs.				
No. Task	RRA	RA	GA	No. VM
50	47.7	43.82	30.35	12
100	53.46	42.75	36.09	
300	52.27	42.56	32.78	
Average	51.14 %	43.04 %	33.07 %	

Table 8 and Figure (10) represent the completion time of RRA, RA, default GA and the proposed DTGA algorithms using 4 VMs with the task of Robot control program and Sparse matrix solver.

TABLE 8 THE COMPLETION TIME OF RRA, RA, GA, AND DTGA ALGORITHMS USING 4 VMs

Task	RRA	RA	GA	DTGA	No. VM
Robot 88	629.4	581.02	529.33	375.24	4
Sparse 97	734.05	679.35	588.11	401.52	

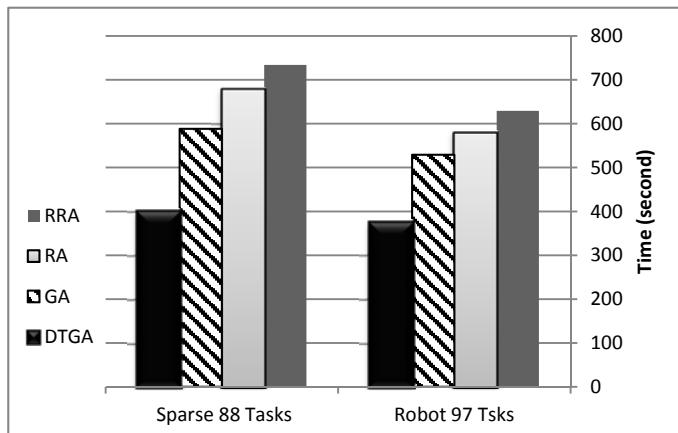


Figure 10. the comparison completion time of four algorithms RRA, RA, GA and DTGA.

Table 9 and Figure, (11) represent the completion time of RRA, RA, default GA and the proposed DTGA algorithms using 8 VMs with the task of Robot control program and Sparse matrix solver.

TABLE 9 THE COMPLETION TIME OF RRA, RA, GA, AND DTGA ALGORITHMS USING 8 VMs

Task	RRA	RA	GA	DTGA	No. VM
Robot 88	301.12	299.5	241.76	159.2	8
Sparse 97	415.87	374.2	299.47	195.69	

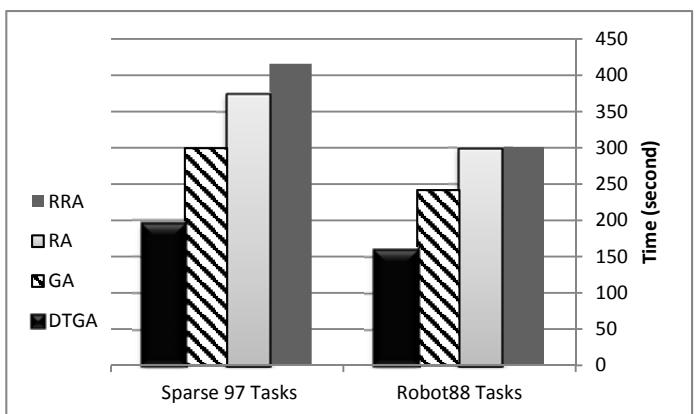


Figure 11. the comparison completion time of four algorithms RRA, RA, GA and DTGA.

Table 10 and Figure, (12) represents the completion time of RRA, RA, default GA and the proposed DTGA algorithms using 12 VMs with the task of Robot control program and Sparse matrix solver.

TABLE 10 THE COMPLETION TIME OF RRA, RA, GA, AND DTGA ALGORITHMS USING 12 VMs

Task	RRA	RA	GA	DTGA	No. VM
Robot 88	215.45	190.4	167.65	113.87	12
Sparse 97	300	271.02	199.05	134.1	

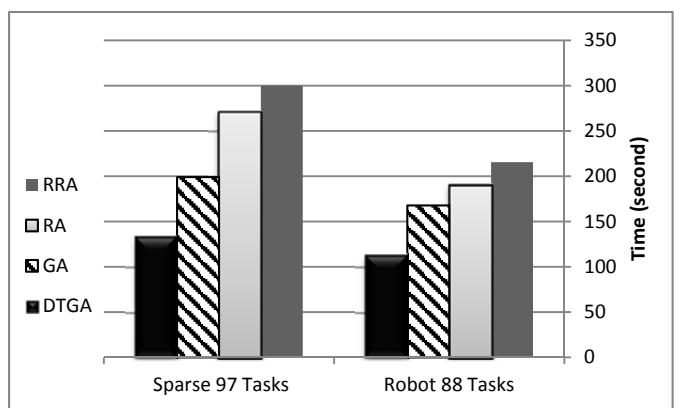


Figure 12. the comparison completion time of four algorithms RRA, RA, GA and DTGA.

Tables 11, 12 and 13 illustrate the completion time improvement of the proposed DTGA algorithm relative to RRA, RA, and default GA algorithms using 4, 8 and 12 VMs respectively.

TABLE 11 THE IMPROVE COMPLETION TIME OF DTGA VS. RRA, RA, AND GA ON 4 VMs.

DTGA vs.				
Task	RRA	RA	GA	No. VM
Robot	40.38	35.41	29.11	4
Sparse	45.3	40.89	31.72	
Average	42.84 %	38.15 %	30.41 %	

TABLE 12 THE IMPROVE COMPLETION TIME OF DTGA VS. RRA, RA, AND GA ON 8 VMs.

DTGA vs.				
Task	RRA	RA	GA	No. VM
Robot	47.13	46.84	34.14	8
Sparse	52.94	47.7	34.65	
Average	50.03 %	47.27 %	34.39 %	

TABLE 13 THE IMPROVE COMPLETION TIME OF DTGA VS. RRA, RA, AND GA ON 12 VMs.

DTGA vs.				
Task	RRA	RA	GA	No. VM
Robot	47.14	40.19	32.07	12
Sparse	55.3	50.52	32.62	
Average	51.22 %	45.35 %	32.34 %	

According to the results in Table 5, it is found that the completion time of the proposed DTGA algorithm is reduced by (44.4%), (37.87%) and (30.43%) with respect to the RRA, RA and the default GA algorithms respectively. With respect to the results in Table 6, the completion time of the proposed DTGA algorithm is reduced by (49.29%), (44.99%) and (38.58%) relative to RRA, RA and the default GA algorithms respectively. For the results in Table 7, the completion time of the proposed DTGA algorithm is reduced by (51.14%), (43.04%) and (33.07%) relative to RRA, RA and the default GA algorithms respectively.

According to the results in Table 11, the completion time of the proposed DTGA algorithm is reduced by (42.84%), (38.15%) and (30.41%) relative to RRA, RA and the default GA algorithms respectively . With respect to the results in Table 12, the completion time of the proposed DTGA algorithm is reduced by (50.03%), (47.27%) and (34.39%) relative to RRA, RA and the default GA algorithms respectively. For the results in Table 13, the completion time of the proposed DTGA algorithm is reduced by (51.22%),

(45.35%) and (32.34%) relative to RRA, RA and the default GA algorithms respectively.

VI. CONCLUSION AND FUTURE WORK

According to the work in this paper, an improved Genetic (DTGA) algorithm for dependent task scheduling problem has been proposed for the Cloud computing environment. The proposed algorithm targets to minimize the completion time. A comparative study has been contacted to evaluate the performance of the proposed algorithm with respect to the RRA, RA and the default GA algorithms using STC benchmark (three random graphs, Robot graph, and Spars graph). According to the comparative results using three random graphs and 4, 8 and 12 VMs, the completion time of the proposed DTGA algorithm has been reduced in average by 48.28%, 42%, and 33.98% with respect to RRA, RA and the default GA algorithms respectively. According to the comparative results using Robot and Sparse graphs, and 4, 8, and 12 VMs, the completion time of the proposed DTGA algorithm has been reduced in average by 48%, 43.59%, and 32.38% with respect to RRA, RA and the default GA algorithms respectively.

Generally, the proposed DTGA algorithm outperforms the RRA, RA and the default GA algorithms by 48.14%, 42.8%, and 33.18% respectively in average with respect to the completion time.

For future work, the proposed algorithm can be extended to consider the possibility of the dynamic characteristic of VMs. Moreover, the users QoS requirements would be considered.

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Towards a Semantic-based Context-as-a-Service For Internet of Things

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Abstract— there is an obvious trend toward the future Internet environment, where billions of sensors are connected in a highly dynamic environment to provide fine-grained information about the physical world. Applications that utilize such information are smart and belong to the Internet of Things (IOT) paradigm. There is a need for IOT systems to have a higher understanding of the situations in which to provide services or functionalities, to adapt accordingly. Information context should be collected, modeled, inferred, and distributed to serve IOT applications with the required knowledge. Developing context-awareness IOT applications demands a specialized framework that helps in applying computations transparently on the cloud and feed the context-awareness IOT applications with appropriate context information to prevent the direct access of the context sources.

In this paper, a framework for developing context-aware IOT applications is proposed. The framework is distributed, autonomous, and adaptive to fit the IOT applications' characteristics. The proposed framework utilizes agent's technology as well as semantic-based features to provide the basic functionality required to develop a context-awareness IOT application. A scenario for elder healthcare is explained to evaluate this framework.

Keywords— *Context-as-a-Service, Internet of Things, Context-awareness.*

I. INTRODUCTION

Nowadays, an obvious trend toward the Future Internet environment drives different applications to require access to Internet with the delivery of real time information generated from a variety of heterogeneous devices. As a result, Internet of Things (IOT) [1] has appeared as an important step in the evolution of the Internet. IOT is targeting using such devices to acquire different types of information, store, and process it,

in order to be able to use it later. Accordingly, several IOT applications have emerged and then they need specific characteristics relevant to their users that could be used to describe the circumstance concerning an entity (which may be person, place or object). For instance, a context-aware air-conditioner IOT application could change the air-conditioner's fan speed or its temperature based on the number of people present within a room at some time. These characteristics are normally referred to as application context [2]. We refer to IOT applications that rely on their context information to react and adapt its current state as context-awareness IOT applications. While developing such kind of applications, supporting both of the IOT applications characteristics in addition to handling the context life cycle phases are our target. The main IOT applications characteristics are *distributed*, where it require scalability beyond millions of devices over the Internet, *adaptive* according to the changes in the surroundings, and *autonomous* by applying actions based on its internal state, goal, and environment parameters.

Previous work targeting context-awareness and IOT applications failed to prove complete coverage of their characteristics. Each one of the previous trial is concerning set of features and neglect the others, which motivate us to build our own framework. For example, research efforts in [3] [4] [5] have a shortage in applying semantics modeling and reasoning to generate emergent context information. In addition, another research effort concerned with a special application type and its implementation details rather than building a general purpose context-as-a-service architecture.

The main idea of the proposed framework is to offer a high level abstraction to IOT applications' developers to access the context information without going into low-level details of access the context sources. The proposed framework is

supporting context-awareness by understanding the surrounding context resources, and automatically building internal data models to process and reason to get knowledge, which enrich the smart property for the IOT applications and services. The context management solution lies outside the application development boundaries. Such solution is developed and extended independently. Thus, context-awareness is no longer limited to desktop, web, or mobile applications. It has already become a service: Context-as-a-Service [6] [7].

We get a benefit from the well-established technologies; the Cloud [8]; Agents [9]; and Ontologies. Handling the distributed execution of the IOT application and offering a uniform interface to access a massive amount of data transparently are guaranteed by developing the proposed framework as a service on the Cloud guarantees. Therefore, delivering the context information as service through the Cloud supports usability, reusability, and unification properties. Moreover, applying the Agent technology inside the framework design enrich distribution, autonomy, and adaptability properties. An agent could be thought of as a software component which not only encapsulates code and data as in object-oriented programming, but can also be proactive; i.e. can take the initiative in interacting with its environment, or reactive; responding to changes in its environment. An agent exhibits autonomy in that it controls its own actions based on its beliefs and surroundings. Adaptation is another attribute exhibited by agents, where an agent improves its plan to achieving goals and learns from experience. Ontology is used as tool to enrich the semantics in the proposed framework. Ontology is used in Knowledge representation and emerged as an approach for context modeling in a higher semantic level to support sharing and reusing both of data and services.

This paper is organized as follow: Section II presents some related works with an illustration for their points of strength and weakness. Section III presents the background concepts of this work; Internet of Things; and context-awareness fundamentals. Section IV presents the proposed context-awareness framework and its main characteristics. A detailed description for the context-as-a-service layer is shown in section V. Section VI presents the Ontologies used for context information modeling. The paper is concluded in Section VII.

II. RELATED WORK

In this section, we briefly discuss the previous research efforts for developing context-aware IOT applications illustrating the variety and the shortage in their design

perspectives.

Some of the related approaches for building programming models that targeting context-awareness applications are focusing on pervasive and IOT systems [3] [4] [5]. The *Origins Model* [3] provides a programming model for the development of context-aware applications on large-scale pervasive systems. It consists of the *Origin* entity which represents an abstraction for different types of context sources. It is associated with a type and meta-information. The *Origin Model* has a set of elementary operations; filter; infer; aggregate, which used for achieving context information. It depends on its predefined properties of replication and mobility to enable creating distributed and reliable processing schemes and represented different types of context sources. It apply the concepts of actors and futures in the implementation to support scalability. Then a CAPA framework [4] is designed to build a programming model for developing context-awareness applications for distributed pervasive systems based on the *Origin* model. It utilizes the *Origin* model [3] to acquire context information and accessed by its *Entity* programming model. The *Entity* model is used for developing generic and reusable application components by decoupling the application layer and the physical layers. It supports the monitoring and controlling behaviors for the large scale heterogeneous context sources. PaRICIA [5] provides a different construct for its programming model; *Intent* (explicit representation of tasks) and *IntentScope* (group of physical entities). PaRICIA provides cloud-based IOT application execution environment and the supporting runtime mechanisms. It supports two logical views for both of the *domain expert* to define the domain libraries and *Developer* to use the programming model to write cloud-scale IOT applications. Although the frameworks structure for these works originate context information outside of the control of context-aware applications, it lacks form the clear identification of the full context life cycle phases and specially the context modeling. It lacks from the semantics modeling and reasoning to generate new context information to context-awareness applications autonomously.

Running context-awareness IOT application on the cloud guaranteed the execution of IOT main requirements of handling the distributed and massive amount of data through a uniform interface. Therefore Applying the context management in the form of Context-as-a-Service has a wide acceptance by researchers [10] [7] [11]. Authors of [11] design a prototype implementation to deliver the context information forms physical devices to its digital from for IOT

applications. Their design concerning application utilization for the context-aware services that help older people stay at their homes safely. The design main components are *Event Processing Unit*, which is responsible for detect and aggregate events acquired from the devices. *Data Repository* is defined to record things status to database. Such contextual events can be directly used by high-level applications or further processed by other modules. For process management, the defined *Rule Engine* and *Service container* provide flexible and full spectrum support for process management and customization. Here, the design is concerned with a special application type and its implementation details rather than building a general purpose context-as-a-service architecture. Another approach [7] targets a design for a general-purpose architecture and techniques for the contextualization of IOT data. The design aims to reducing complexity of data analysis, query, and extract valuable knowledge. Data is represented in RDF format and processed through three operations; filter; aggregate; and infer before accessed by the application. Although the scalability and a distributed solution applied through the implementation by utilizing the elastic cloud-based infrastructure, it lacks to guarantee scalability at design time. In addition it has a limitation in applying complex reasoning for more autonomous and adaptation.

Applying complex reasoning as a part of the architecture design can be guaranteed by adding self-organizing and self-adaptive components that encapsulate such features to the architecture. Research work such as [12] [13] utilizes the agent technology in their design for this purpose. Authors of [12] proposed an agent-based model to generate IOT applications. It utilized the multi-agents system characteristics for applying autonomous and adaptive behaviors. Their agent-model is tightly coupled with the IOT application, which exceeds the developer effort to be aware of the agent model details.

Although authors in [13] do not exclude the human intervention for ontologies matching and alignment, they do not determine a detailed specification for such intervention. Moreover, no overall framework illustrating the data flow from the physical resources till the application that interested in such data.

III. GENERAL CONCEPTS

A. Internet of Things

"The Internet of Things allows people and things to be connected anytime, anywhere, with anything and anyone, ideally using any path/network and Any Service." is widely

accepted definition for the IOT. It promises to create a world where all sensors around human are connected to the Internet and communicate with each other with minimum human intervention [14].

The IOT comprises a large number of objects (sensors and actuators) that interact autonomously. Moreover, real-time data processing is essential. When the number of objects gets larger, tracking becomes a key requirement for IOT applications. In addition, Interactions are highly dependent on their locations, their surroundings, and presence of other entities (e.g. objects and people). Due to the popularity of cloud computing [8], consuming resources as a service has become a mainstream. Everything-as-a-service model is highly efficient, scalable, and easy to use. These characteristics need to be considered when developing IOT context-awareness solutions throughout all the phases from design, development, implement and evaluation [15].

B. Context-awareness Fundamentals

Context-awareness provides the facility to store context information which will be used in order to adapt the application's current situation; therefore it is essential for systems developed in areas that have intelligent behaviors [8]. Thus, developing a context-aware framework that is easily integrated within any IOT application allows the developer to develop autonomous and adaptive applications.

The Context can be defined as any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves [16]. Therefore, not all data can be considered as a context. Raw (sensor) data is unprocessed and retrieved directly from the data source, such as sensors, but the context information is generated by processing raw sensor data. Further, it is checked for consistency and metadata is added. Context-aware system uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task [16]. Context-awareness frameworks should support the context life cycle stages; acquisition; modeling; reasoning; and dissemination [15] [17] survey] as follow:

- *Context acquisition*: The techniques used to acquire context can be varied based on responsibility, frequency, context source, sensor type, and acquisition process.
- *Context Modeling*: Acquired data is converted into a unified format such that the context can be understood and shared. This can be achieved by a model that

defines, represents and processes the context. The six most popular context modelling techniques: key-value, markup schemes, graphical, object based, logic based, and ontology based modelling. There are many surveys that describe context modeling techniques in details such as [8] [17] [18] [19]. According to [19], using ontology for context modeling would satisfy both of the normalization and formality of the model.

- *Context Reasoning:* It is a method of deducing new knowledge, and understanding better, based on the available context and by applying reasoning techniques.
- *Context Dissemination:* It is the process of context distribution to the consumers who are interested in that context such as applications, services, or users.

IV. CONTEXT-AS-A-SERVICE FRAMEWORK

The basic idea of the proposed framework is to offer a structured solution for developing context-awareness IOT application. The proposed framework is based on delivering the context information as a service to the IOT application as shown in Fig. 1. The framework presents a unified interface for context-awareness IOT applications to access its context information through the context-as-service layer.

The proposed framework is defined over three different Layers; Physical layer; Context-as-a-Services layer; and Application layer. The Application Layer is the layer that contains the high level constructs for developing context-awareness IOT applications based on a domain-based ontology defined by the application domain experts and context information delivered by the Context-as-a-Service Layer. The Context-as-a-Service Layer is responsible for processing data achieved from data sources that belongs the physical layer and taking decisions to generate the context information. The generated context information is the target knowledge for the context-awareness IOT application. The physical layer has set of sensors and actuators. The sensors are used to collect data, which is raw data before the processing and decisions are made. Finally, actuators perform the decided actions.

A. Physical Layer

The *Physical Layer* represents the space of the context sources. Context sources can be categorized as physical, logical, or virtual sources [15]. Physical sources are the type of sensors that generate data by themselves such as the temperature sensors and light sensors. Virtual sensors retrieve data from many sources and publish it as sensor data (e.g.

calendar, contact number directory, twitter statuses, email and chat applications). Logical sensors (also called software sensors) combine physical sensors and virtual sensors in order to produce more meaningful information. A web service dedicated to providing weather information is an example for a logical sensor.

B. Context-as-a-Service Layer

The *Context-as-a-Service Layer* encapsulates all the context life cycle phases starting by context acquisition from sensors in the physical layer till the context delivery to context-awareness IOT applications in the application layer. Massive processing steps are done by Agents for validation, modeling, and reasoning purpose. The *Context-as-a-Service* layer hosts a set of agents organized in an agent model. Each agent type is responsible to handle a certain phase of the context life cycle. Agents' types descriptions are summarized in Table I. Ontologies are used by agents to solve the integration issues for different types of domain knowledge as well as for modeling purpose. More details about agent model and ontologies used in the framework are described in section V and section VI.

C. Application Layer

The *Application Layer* is the high-level developing space for the context-awareness IOT applications. It includes a programming model API for context information access, and application domain ontology for building semantic based applications.

The programming model for such type of large-scale applications encapsulates the application behaviors and increases the abstraction Level. It offers an interface used to access the context information, which delivered by the Context-as-a-Service layer. Application developer has the ability to access the relevant context information without going into the low level details of neither dealing with context sources nor programming for context processing. The context information is a guide for changing the application behavior during the run time.

Domain ontology is used to enhance the explicit semantic of the context information based on different domains. It is built by each domain expert and used by the application developer to enrich the context information semantics. The application layer detailed design and API are not our focus in this paper.

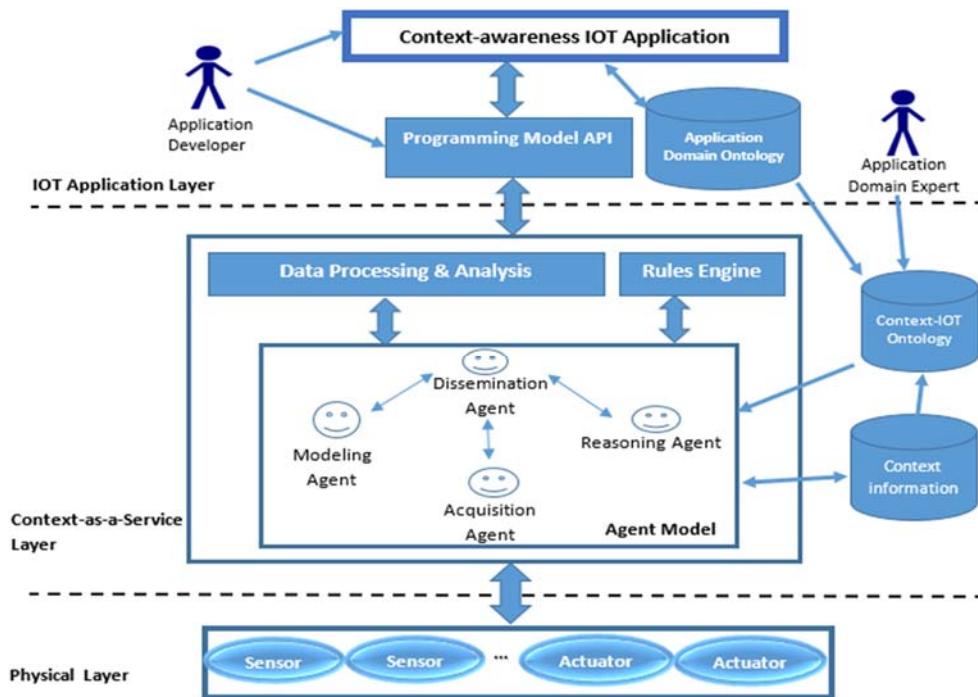


Fig. 1. Context-as-a-Service framework for developing context-awareness Internet of Thing (IOT) applications.

TABLE I AGENTS' TYPES DESCRIPTION

	Goal	Behavior	Believes
Acquisition Agent	Obtain a maximum amount of data	Pull, Push, Manually_provided, Derive	Context sources meta-information Knowledge about the required data..
Modeling Agent	Define context model Store context model in a machine readable and processable form	Generate_context_model, Aggregate Validate_model, Store_context	Context representation structure Model validation_mechanism
Reasoning Agent	Efficient Context reasoning and Validation. Check for Quality of Context	Clean_data, Derive, Infer, Validate_context	Reasoning Techniques Validation rules. Cleaning data parameters
Dissemination Agent	Reasoning Techniques Validation rules. Cleaning data parameters	Query, Subscribe, Deliver, Execute, Manual_add	Context delivery mechanism

V. CONTEXT-AS-A-SERVICE LAYER

The *Context-as-a-Service Layer* is responsible to deliver the context information to the IOT application. Agents are playing different roles to accomplish this goal. The agents' roles are classified as *Acquisition Agent*, *Modeling Agent*, *Reasoning Agent*, and *Dissemination Agent* as illustrated in Fig. 1. The flow of work through this layer starts by an initiation from the context-awareness IOT application that asks for specific context information. The *Dissemination Agent* receives the application request of context information and then triggers the *Acquisition Agent* for fetching the required information. After finishing the acquisition process, the *Acquisition Agent* acknowledges the *Dissemination Agent* for finishing its task, and then the later triggers the *Modeling Agent* to start its job. The *Modeling Agent* converts the unprocessed data into a unified format to enable sharing and understanding. After that, it stores the context information in the *Context Information* repository, and sends a confirmation message to the *Dissemination Agent* informing it about finishing its job. After this phase, the context information is ready to be delivered to the application if it is required in this form. Otherwise, a reasoning phase is started for extra knowledge generation. And then, the *Dissemination Agent* initiates the *Reasoning Agent* to start the reasoning process. Therefore, new entries are added in the repository that can be delivered to the application by the *Dissemination Agent*. *Data Processing and Analysis* component is used by agents through the four phases according to the need of each phase and the preferences determined through the context information requests. *Rule Engine* is the storage for the validation rules and constraints needed while modeling and reasoning process or context management rules that used through the four phases.

An agent has its own belief that could be changed over its lifetime according to its inference strategy. It also has goals, behaviors, and access permissions to the available resources. A *behavior* specifies the actions that an agent can do through the interaction with its environment to affect and be affected by it. It can be either a perception behavior or an effector one. *Beliefs* represent the agent's knowledge about its environment, other agents, and itself. The agent's background knowledge is assigned to it as it is created and becomes part of its mental state. Then it can be changed during its life due to the agent's perception or its communication with other agents or with the environment. A *Goal* is a strategic target that an agent aims to achieve through executing a plan. This is in case the agent is proactive, but if it is only reactive, so it does not need a goal.

An agent can deal with ontologies defined in different namespaces.

Acquisition Agent is responsible for acquiring data from different types of context resources exists in the physical layer either a physical, virtual, or logical sensors. Data is acquired from different context sources such as servers, sensors, middleware, web service, files, or database. In the IOT paradigm, context can be generated based on two different event types: instant events and interval events. Open the door, switch on the light are example to the instant event which needs to be acquired when the event occurs. Sense and send data to the software every 20 seconds is an example for the interval event, which span a certain period of time.

Acquisition agent adapts its behavior to acquire data accordingly to context sources meta-information. Data can be sensed from sensors, derived by using computational operations on the sensed data, or manually provided by users via predefined settings options such as user preferences.

Accordingly, two main sensed behaviors are assigned to sensing function; *Pull*; and *Push*. In *Pull* behavior, the acquisition agent makes a request from any physical device (such as sensors) periodically or instantly to acquire data. While in *Push* behavior, the physical or virtual device pushes data to the agent's input buffer data periodically or instantly. Periodical or instant pushing can be employed to facilitate a "publish and subscribe" model. Additional effort is needed here for refining different type of acquired data to extract the target context information. The acquired information is buffered to the modeling agent. Applying Agent as an intelligent component will enrich the context acquisition with richer context information.

Modeling Agent is responsible for context modeling and context organization. Regarding the context modeling, the agent converts the acquired data into a unified format to enable sharing and understanding. The generated context model defines, and represents the context information. The technique used in context modeling affects the possibility and efficiency of the reasoning process. Semantic-based modeling using ontology is our choice for context modeling. Ontology is competitive technique over other models in terms of interoperability, and reusability [20]. IOT_Context_Ontology that used in the proposed framework refers to set of ontologies connected with each other to define both of the IOT paradigm concepts, and the context types and categories. A detailed description for the IOT_Context_Ontology is in section VI. Regarding the context model organization, *Modeling Agent* validates the context model for consistency, and stores them in

repository. Applying Agents in context modeling process enrich dealing with the dynamic contexts [17]. For example, in smart city application, the smart traffic control has a highly dynamic context, where the environment is frequently changed and it is not the case of only having predefined context information that will be collected and stored.

Reasoning Agent is responsible for selecting and applying the reasoning technique to deduce knowledge from the available context information. First, cleaning unnecessary data, merge the related context is applied. Validation is applied against validation rules or set of constraints that are stored in the *Rule Engine*. Also, sensor data fusion can be applied by the reasoning agent for combining sensor data from multiple sensors. Finally, inferring new knowledge by applying the reasoning technique is occurred. Applying Agents in context reasoning phase get benefit from agent's learning and adaptive characteristics that can enrich the design of the context reasoning component. As an example from [15], if we have data represented by a tuple <Who: John, What: walking:4km/h, Where: ANU, Canberra, When: 2013-01-05:9.30am). Inference can generate that PurplePickle cafe in canberra, PurplePickle cafe in canberra, and may be inferred as John's favourite cafe.

Dissemination Agent supports a generic interface to be accessed by context-aware IOT applications and provides methods to deliver context information to the applications. A set of essential behaviors is supported by agent such as: *Query* behavior, which is used by the context IOT application to ask for the required context information. **Publish** and **Deliver** behaviors are used to send adaptive context information to the application layer periodically or when an event occurs. Applications ask to apply *subscribe* behavior to receive notifications about certain context service, which is used in real time processing. Dissemination Agent is responsible for disseminating useful and relevant context information to corresponding applications.

VI. CONTEXT-IOT ONTOLOGY

Ontology-based modeling is the way towards standardization and unification of context-awareness concepts. Although, there are well accepted ontologies used to develop applications and services for the IOT [20], Ontologies should be extended by users to meet the evolving context-awareness IOT application. In this case the extended ontology can be used by user only to prevent the conflicts. It allows context-

aware applications to further filter relevant information from irrelevant ones. IOT_Context_Ontology presented in our framework should interpret both of the IOT paradigm and context-awareness concepts. Context Categorization should be presented from both of the operational perspective, and Conceptual perspective. From Operational perspective categorize context based on how they were acquired, modelled, and treated. From Conceptual perspective: context is defined based on the meaning and conceptual relationship between the context location, identity, time, and activity. Thus, the main concepts of Context IOT ontology consist of: Context, User, location, and time. Each of those concepts could be mapped with one of the general ontology such as Friend of a Friend (FOAF) [21] for users, GeoNames [22] for location, and Time Ontology in OWL [23]. Regarding defining context concept is an entity that represents the context information in our model. Context Information has set of attributes that should be modeled to enrich the context delivery process:

- *Type*: is used to describe the context information provided.
- *Context_Quality*: It is a measure to define quality criteria that the context should satisfy. It is important to assign a sensitive means by which to judge the reliability of information to support the quality of context [19] as well as other measurements which differ based on type of the context. E.g. the quality of the user's location is measured by the standard error of the location system.
- *Context_dependence*: the association with other related contexts. This property is important in context-awareness systems to provide updated and relevant information when the dependencies are changed.
- *Context_Timestamp*: the time of the acquired context. It is useful in the inference to get a conclusion according to the time of the context.
- *Context_AccessRight*: this relationship is used to identify who has the privilege to access this context information.
- *Context_source*: this relationship is used to identify sensed, user_defined, derived.

VII. APPLICATION SCENARIO

Humans, data, communication and devices play key roles in the IOT ecosystem [24]. IOT paradigm contributes in monitoring the progress of a point wherein each physical

“Thing” is a digital shadow of the person using its services, just as the social network era [25]. Healthcare applications were based on tracking systems for monitoring medical assets, extracting the location footprints of patients and doctors and others [24]. Such applications should rely on the advanced devices and technology such as smartphones and [24]smartwatches to meet the needs of its users.

Elder Healthcare

Elder Healthcare scenario is inspired from [26]. Elder people are alone for long time usually. Their relatives want to know their health indicators. Some scenarios can indicate their health state. Indicators for the daily performance are steps walked a day; rooms changed a day, Locations visited outside, Time the TV set was running. Other situations that trigger the alarm such as falling alert (resident on the floor for more than a certain amount of time), Irregular movement pattern (fast movement between rooms, or standing up and sitting down repeatedly in a short time), Lack of movement, Active alert (resident has pushed the alert button), Dramatic decrease of steps for a longer period. There are some status that indicate a person may be in danger such as: Room doesn't change anymore and person is at home, TV is not used at all and the person is in home, location outside doesn't change for long and it is night, and location outside and bad weather (e.g. very cold).

In order to apply the proposed framework in elder healthcare domain, a set of devices is assigned in the physical layer such as: watch geer, mobile phone, ibeacons to locate current room, accelerometer to count steps, GPS to locate person outside, and Powermeter to detect TV usage. Flip button is used to send alarm.

A set of application rules is defined to guide through the context life cycle phases. Such rules are defined by the application developer and imported to the *Context-as-a-Service* layer through the programming model API. Examples for these rules are as the following:

- if count_flic_pressed >5 within (5 min) call emergency
- if (step_aggregated < min_Normal) Then silence_period
- if (silence_period > max_Silence_Level) call emergency

With the mentioned scenario, the application will have the following features:

- Check periodically the health status of an elder person

- Generate an alarm in case of danger
- Generate alternative scenarios based on the current situation
- Alternative reactions in case of no response for the danger alarm

The context-awareness IOT application subscribes at the *Context-as-a-Service* layer to be informed about the elder health state (the target Context Information). Such subscription and publication of the elder state is handled by the *Dissemination Agent*. During the period from the subscription till the publication of the elder state, the *Dissemination Agent* coordinates with other agents to achieve a full detail about the elder state. Moreover, Notifications about dangers and suggested actions are generated through the reasoning process by the *Reasoning Agent*. For an example to get the elder location as a part of his/her state, the *Acquisition Agent* applies the *pull* behavior to fetch the elder coordination. The *Modeling Agent* converts this coordination to a standard format (e.g. OWL, or RDF format). The *Reasoning Agent* applies the *Drive* behavior to the elder coordination to get his/her location by using the GeoNames ontology. A sample for agents' behaviors for elder healthcare application is illustrated in Table II.

VIII. CONCLUSIONS AND FUTURE WORK

Delivering the real-time context information as a service to context-awareness IOT applications has an obvious impact on improving the efficiency of information processing and delivery of right information to right person at a right time. In this paper, a framework for context-awareness IOT applications is presented with a focus on the *Context-as-a-Service* layer. The design is light-weight agent-based model supporting the scalability, reliability, unification, and has an autonomous, adaptive behavior based on a semantic reasoning mechanism.

In future work, programming model module to access the context-as-a-service module will be presented. A complete case scenario to illustrate this model is going to be implemented by using Akka's actor model[27], which communicate via messaging between actors in distributed virtual machines and JADE (Java Agent DEvelopment Framework) [28].

TABLE II SAMPLE FOR AGENTS' BEHAVIORS FOR ELDER HEALTHCARE APPLICATION

Function	Agent	Behavior
Validate indoor location	Reasoning Agent	validate(coordination)
Receive alarm from Flic button	Acquisition Agent	push (alarm)
Aggregate the elder steps	Modeling Agent	aggregate (steps)
Call a contact person	Dissemination Agent	Execute (phone_call)
Publish data about the current situation	Dissemination Agent	subscribe (elder_state) publish (elder_state)
Detect silence period	Reasoning Agent	infer(silence_period)
Generate suggestion for the current indicators	Reasoning Agent	infer()
Detect GPS and Beacons location	Acquisition Agent Modeling Agent Reasoning Agent	pull (coordination) store (location) derive (coordination, location) - GeoNames Ontology infer(elder_state)

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Improvement And Enhancement Point Search Algorithm

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Abstract— Point Search Circle Detection (PSCD) Algorithm is one of circle shape recognition methods, which introduced in the field of pattern recognition and digital image processing. Because of PSCD has some weakness points, therefore this paper aims to determine the weakness points of PSCD and find solution for these points, furthermore adding enhancements to the algorithm and adding ellipse shape recognition algorithm to the recognition process of the PSCD.

The improved algorithm is applied on image contains circle and ellipse shapes. The recognition results were finding center of each shape and its radius for circle shape and both radiiuses for ellipse shape, MATLAB is used to conduct the improved algorithm.

Keywords- *Image processing, Pattern recognition, Computer vision, Circle recognition, Ellipse recognition, Circle detection, Ellipse detection.*

I. INTRODUCTION

They say "Image speaks thousands of words"; starting from this common sentence, it can say that the computer vision and image processing started to drive best techniques, to get different scenes for same image to help us to see its contents, meaning and denotations. Although image processing is not rival or emulate the accuracy of human eye yet, but it may able us to convert the images to mathematics operation to get information as much as possible from the image.

So, image processing is one of subjects that got great attention, where expand got variety of applications. Image processing now becomes the most important and the major spread applications of computer because it uses in different fields and not confined in processing personal photograph but it extended to sciences field such as processing medical images, producing films, remote sensing and monitoring applications [1]. As well as to enhance the images to facilitate its interpretation, understanding and image data processing to store it on different storage media speedy and fewer size to automate the realization of images [2]. The more important application in the medical field is detection and prediction cancer diseases.

Where it is possible now diagnosis the cancerous cells by using computer or detects the disease type from X-ray or

others. Due to all that a wide attention gave to the digital image processing [1]. Where image processing and enhancing is the more important thing that computer presents to the image [3].

There are several projects or researches which employ the digits recognition idea in the several fields, in 2000, Rodolfo and Stefano presented a method based on vector quantization (VQ) to process vehicle images. This method makes it possible to perform superior picture compression for archival purposes and to support effective location at the same time [3].

It can define any image as two dimensional function $f(x, y)$, where x and y are plane dimensional. The image stored digitally in the computer as a matrix of two dimensional pixels (while in colored image each pixel has three value to represent the colors RGB which their value ranges between 0, 255 and it has value equal to zero or one in black and white images). Therefore the digital image is consisting of limited component, each called image elements or pixels [4].

II. IMAGE ANALYSIS STAGES

Image analysis process has many stages as follows [4][5][6]:

- Image acquisition: this stage involves picture capturing through photo sensor (e.g. camera, laser sensor, scanner...etc).
- Preprocessing stage: it is a set of processes that prepares the data for analysis and to manage the errors. The techniques used in this stage differ according to type of information that needs to be extracted from the image and enhancement processes related to the data type that managed.
- Segmentation: in this stage the image is divided to many zones or elements. This stage can be described as processes that its input is an image and its output is the important elements in the image.
- Features extraction: in this stage the important information extracted from the image.
- Classification: this stage involves pattern recognition and classifies the patterns that extracted from the previous stage.

III. RELATED WORKS

There are many methods to recognize the shapes, belong these methods, the methods of recognize the circular shapes. These methods may be suitable for some kinds of images, and there is no general recognition technique that can be used for all type of images. Recognition methods and segmentation are suitable for application that needs automatic image analysis and involves some of intelligent. Researchers work on this field and they are still. In view of importance, circle detection to determine the goals in the images. In 2010 Ebraheem proposed a new method which was Point Search (PS) to recognize the circular shapes [7], the researcher approved the efficiency of this method to fast recognize the separated and interlocked circles regardless with its number by comparing the method with common available methods such as Hough method. In the same year Ebraheem [8] used the PS algorithm to find the index light point to find the object dimensions in the digital images. In 2014 Ebraheem et. al. [9] used efficiently the PS method to recognize the green light points to find the object area by using digital images. In 2016 [10] PS method improved to find the amount of the material in the images and to find efficiently the object area and its position by using digital images.

For the importance of using circular and elliptical shapes to determine the locations e.g. medical checkups, determine the eye border, recognition traffic signs and in the study of cells...etc. therefore this paper aims to enhance and develop the PS algorithm by detecting the weakness points of algorithm and treating them as well as adding elliptic shape detection to develop the algorithm.

IV. IMPROVED POINT SEARCH ALGORITHM(PSA)

To extract features from digital images it is necessary to have ability to detect some basic shapes (like: straight lines, circles and ellipses), to do this it should at first detect some points located on the shape circumference.

In this paper PSA used to detect circles and its weakness points is treated to enhance it and to able it to detect elliptic shapes in addition to circles. So this item declares the steps of enhanced algorithm at first weakness points of the old algorithm declared, then the treatment of the weakness points. Lastly the enhanced algorithm steps are declared as follows:

A. Weakness Points Of The PSA

Although the algorithm is very efficient for detection of circle but yet it has the following some weakness points:

- 1) *Inspection point*: due to noise the first point detected and considered as inspection point on the circle (it assumed to locate on the same column of the center) this point may represents by many pixels on the same row, therefore it will leads to an error to determine the point that is on the same column with circle center. See Fig.1 the points with red color are possible inspection points but the old algorithm considered the first point as inspection point (x, y), while due to noise there are five points each of the them may be inspection point in the figure.

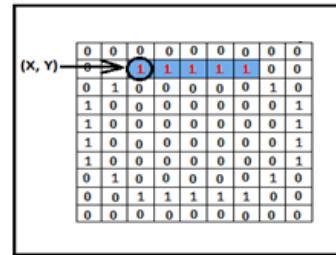


Figure 1. The inspection point process.

- 2) *Supposed circle circumference points*: because it depend on circle equation to find the circumference points of supposed circle in the old search point algorithm, the number of points is fixed for the supposed circle which will compare with it. So the number of points of the supposed typical circle template is constant regardless the size of the actual circle size in the image, therefore the points will scatter on the circle circumference in the image if the circle size is big, while if the circle is very small these points will repeated on the circumference, that means increase the run time.

- 3) *The old search point algorithm cannot recognize ellipse*.

B. Treatment Of Weakness Points Of PSA

- 1) *Finding inspection point accurately*: to solve the first problem of more than one point on the same row due to noise, consider the midst point of these points which are on the same row. See Fig. 2, where (a) represents image data matrix and (col) represents the column number in the image, (x, y) are coordinates of the first point (inspection point previously), y^{new} represents the new correct position for inspection point.

```
Function ynew =find_line(a, col, x, y)
Z=a(x, y:col);
C=find(Z==0, 1);
ynew =round(C/2)-1;
End
```

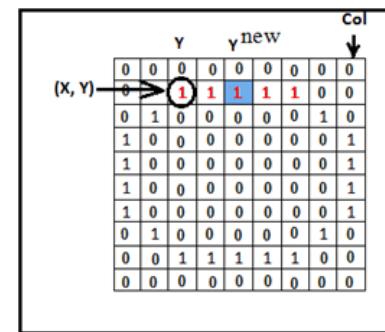


Figure 2. The inspection point process.

- 2) *Supposed circle circumference points*: this problem solved by using Midpoint. The algorithm Midpoint draws the circle starting from each ($0^\circ, 90^\circ, 180^\circ, 270^\circ$) and extends until reach the nearest multiple of 45° where $y = x$, during

this extending y does not repeat nor skip any y value. Therefore in the while loop y increments by 1 and x decrements by 1, until reaching at 45° then this changes because the tangent is rise=run, where rise>run before each 45° and rise < run after it[11]. See Fig.3.

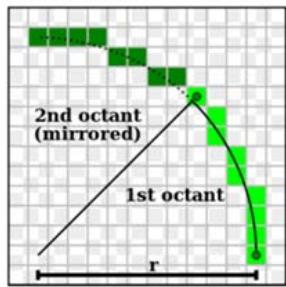


Figure 3. Midpoint circle algorithm.

- 3) *Ellipse*: Midpoint algorithm used to draw the ellipse to create the supposed template for the ellipse to detect this shape in the image. Assume an ellipse center located at the origin and its axis parallel to x and y axis then the equation of this ellipse will be [12]:

$$f(x, y) = \frac{x^2}{a^2} + \frac{y^2}{b^2} - 1 = 0, \quad (1)$$

Where a and b are the major and minor radii, f is equal to zero if a point is located on the ellipse circumference. The slope of the ellipse circumference at any point is given below:

$$\frac{dy}{dx} = -\frac{\partial f}{\partial x}/\frac{\partial f}{\partial y} = -\frac{b^2 x}{a^2 y}. \quad (2)$$

To draw the ellipse it can scan only one-fourth of the ellipse, where for each (x, y) scanned it can draw (x, y), (-x, y), (-x, -y), and (x, -y).

Starting from the top of ellipse which is point (0, b), the slope is initially less than one, therefore x will be increment. For the next x, use f to determine whether to increment y or not. Thus, continue with this procedure until reach the location that f is greater than one. Then change the rolls of x and y until y=0.

C. Midpoint Algorithm To Draw The Circle Template

The following steps are midpoint algorithm steps:

- 1- Enter the values of the circle radius (r) and coordinate of center point (xc, yc).
- 2- Give initial values for x and y as coordinate for starting point to draw the circle template which its center (xc, yc), where (x, y)=(0, r).
- 3- Calculate the initial value for d1 from the equation:
$$d1 = 1-r$$
- 4- Compare between x and y, if x less than y then continue, else go to step 8.
- 5- Increment x by one.
- 6- If ($x < 0$) then
$$d=x+2*x+1$$

- 7- Else decrement y by one
$$d=x+2*x-2*y+1$$
- 8- Find other symmetric points for the circle:
($xc+xc, y+yc$), ($y+xc, x+yc$), ($y+xc, -x+yc$), ($x+xc, -y+yc$), ($-xc+xc, -y+yc$), ($-y+xc, -x+yc$), ($-y+xc, x+yc$), ($-x+xc, y+yc$),
- 9- Go to step 4.
- 10- End .

D. Midpoint Algorithm To Draw The Ellipse Template

To apply this algorithm it should give the value of center (xc, yc) and both horizontal and vertical radius a and b, then apply the following steps:

- 1- Begin
- 2- Give initial values (0, b) to (x, y).
- 3- $d1=b^2-(a^2b) + (0.25 a^2)$
- 4- If ($a^2(y-0.5) > b^2(x+1)$) and ($d1 > 0$) then
$$d1=d1+b^2(2x+3)+a^2(-2y+2)$$

Decrement y by one.
Increment x by one.
Else $d2=b^2(x+0.5)^2+a^2(y-1)^2-a^2b^2$
- 5- If $y > 0$ and $d2 < 0$ then
$$d2=d2+b^2(2x+2)+a^2(-2y+3)$$

increment x value by one.
Else $d2=d2+a^2(-2y+3)$
Decrement y by one.
- 6- Find other symmetric points for the circle:
($xc+xc, y+yc$), ($y+xc, x+yc$), ($y+xc, -x+yc$), ($x+xc, -y+yc$), ($-xc+xc, -y+yc$), ($-y+xc, -x+yc$), ($-y+xc, x+yc$), ($-x+xc, y+yc$)
- 7- End .

E. Improved PSA Stages

The improved algorithm involves three main stages which are: preprocessing, circle detection and ellipse detection, as shown in the block diagram in Fig. 4.

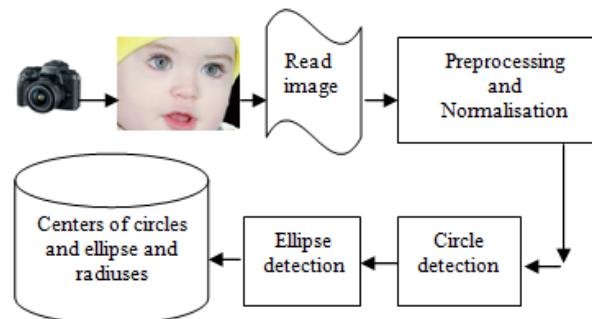


Figure 4. General block diagram for improved PSA.

The detailed steps for each stage of the improved PSA are:

- 1- Begin
- 2- Read the image
- 3- Preprocessing and Normalization
- 4- The Preprocessing and Normalization steps are:

- Step 1: Converting to Gray scale from RGB.
- Step 2: Resizing the image to 512 x 512.
- Step 3: Histogram Equalization.
- Step 4: Gaussian Filtering.
- Step 5: Canny Edge detection.

5- Circle detection:

Circle detection steps are:

- Step 1: Begin horizontally scanning from highest left point for the binary image which resulted from previous stage to find the continuous adjacent point on same row.
- Step 2: Find the correct inspection point (midst point) which lies on the circle circumference and consider it as P1(x1, y1) else go to step (12).
- Step 3: Start from the inspection point P1(x1, y1) begin the vertical scanning to find the second point and consider it as P2(x2, y2) else go to step1. See figure (5).

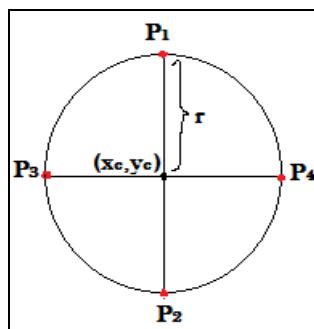


Figure 5. Position of P1, P2, P3 and P4.

- Step 4: Find the distance (d) between points (P1 & P2) by using the following equation:

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

- Step 5: Find the radius (r).

$$r = d/2.$$

- Step 6: Find the coordinates for the center C (xc, yc) of the shape.

If P1 and P2 located on the same column, thus y1 and y2 are equal, then:

$$xc=x_1+r.$$

$$yc=y_1.$$

If P1 and P2 located on the same row, thus

x1 and x2 are equal, then:

$$xc=x_1.$$

$$yc=y_1+r.$$

- Step 7: Start scan to find P3 (xc-r, yc) and P4 (xc+r, yc), continue if one or both of them exist.

Else remove P2 and go to step 2 to resume vertical scanning.

- Step 8: Create template for the supposed shape depending on P1 and P2 by using Mid Point algorithm.

- Step 9: Matching the supposed template with the shape in the image. If the matching percentage equal or greater than 50% then consider these points as actual points exists in the image and store the diameter of the shape and center coordinates in the file. But if matching is less than 50% neglect P2 and resume vertically scanning to find another point to consider it as P2 instead of the previous.

- Step10: If the matching occurs, remove the detected shape to reduce the execution time.

- Step11: Go to step1 and repeat the algorithm steps on the new image produced after removing the detected shape to find other shape if exist.

Step12: End.

- 6- To detect the ellipse same algorithm steps in the (5) will be applied (to find major radius). Adding additional steps to find d2 which represent the second diameter for the ellipse. Depending on d2 find second radius (r2) (minor axis radius), where: $r_2=d_2/2$ and find P3 and P4.
- 7- Store data (radius and center coordinates) in the file.

V. APPLICATION

In this section preprocessing steps declared to produce the binary image which will be used with improved PSA and final file is declared too. See table (1).

TABLE I. EXAMPLES EXPLAIN THE STAGES OF IMPROVED PSA.

Input Eye Image	Image After Gray Conversion'	Image After Resize	Image After Histogram Equalization	Image After Canny Edge Detection (Input Image To Improved PSA)	Produced File After Applying Improved PSA
					Circle: Xc Yc radius 262 241 53 263 240 182 Ellipse Xc Yc radius1 radius2 286 163 20 39
					Circle: Xc Yc radius 259 260 79 Ellipse Xc Yc radius1 radius2 285 280 144 129
					Circle: Xc Yc radius 194 115 30 209 266 23 373 352 29 138 428 30 Ellipse Xc Yc radius1 radius2 0 0 0 0

VI. CONCLUSIONS

- Improved PSA is efficient and accurate for circle and ellipse recognition.
- Determining the inspection point accurately (by taking the midst point for the point located continuously on the same row) reduced the possibility of consider other points as inspection point for other shape and reduced the reaching fault shapes from beginning that means reducing execution time and finding shapes accurately.
- Using Midpoint algorithm to create supposed template makes the number of points of template approximately equal to shape in the image. Therefore the problem of shape size (small or big) dominated, that means the points for big shape is more than for small shape.
- Noise that may be existed in the image like random points or other shapes do not effect on this algorithm.
- This algorithm can be used in the beauty salon to change the color of eye image to choose the suitable color for the customer.

ACKNOWLEDGMENT

Our thanks to the journal staff for their patience and cooperation.

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Access date 17/7/2017.

Simulation and Experimental Analysis of an AC-DC Converter with D.C Load

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Abstract—In this research paper total harmonic distortion of three phase supply system (half and full wave) AC/DC converter-fed with DC motor load is analyzed ,using both simulation and experimental arrangements, it is keenly important to analyze harmonic contents, because of harmonics injection has very bad effects in electrical power system and the overall efficiency of the system becomes low, which results poor power quality, current and voltage distortion and at input AC mains power factor becomes also low. [4] In this research work we have proposed three phase full wave AC-DC converter topology which is better for energy conversion as compared to three phase half wave AC-DC converter topology ,using MATLAB /simulation as well as from the experimentally performed setup, it was found that DC motor efficiency for three phase full wave rectified-fed is better as compared to three phase half wave rectified-fed.

Keywords: AC-DC converter, total harmonic distortion and DC motor.

I. INTRODUCTION

AC-DC converters are the type of power electronic devices, also called rectifiers and these converters play an important role in the power system, where there is a need of DC power for the operation and control of electrical and electronic equipments. An AC-DC Converter which is mostly used in various consumer applications, mainly are single phase AC-DC converters, but in industrial machinery, high power applications (High Voltage DC Transmission System), medical, military, telecommunication equipment and commercial products, mostly three phase AC-DC converters are used [1]. Three phase AC-DC converters can be used for half wave or full wave conversion, Fig. 1 and Fig. 2 shows equivalent circuits of half and full wave rectifiers.

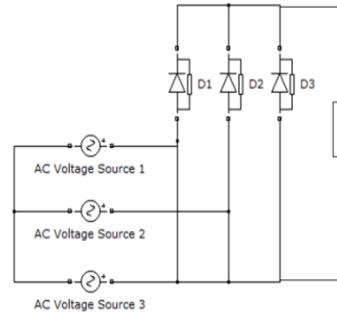


Fig. 1. Half wave rectifier

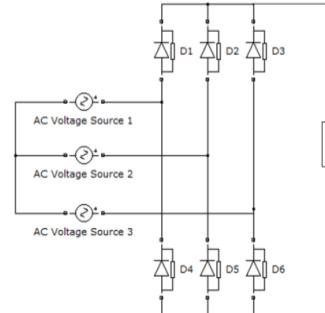


Fig.2. Full wave rectifier

II. POWER SYSTEM HARMONICS

Power system consists of the major part of the loads, which are non-linear in nature and the rate of injection of harmonics is increasing in the system, because of the interaction of distorting customer loads with the supply network impedance. In addition to that ,nowadays due to intigeration of more number of the renewable energy sources into the electric utilities, the rate of harmonics becomes more. When these type of non-linear operating characteristic devices are used in power distribution circuits, they will produce non-linear voltage and current distortion and effects can be observed for these periodic non-linearities by using tool Fast Fourier Transform.

Power system equipment are generally designed to work at the frequency of 50 or 60 hertz, and non-linear

loads produce current with frequency, which are the integral multiple of the frequency of the supply system. These integral multiple frequencies are a source of electrical pollution known as power system harmonics [9-11]. Due to the occurrence of harmonics in supply current, losses will be increased. To control these harmonics research is still in progress, and always try to supply consumers with electric power which is clean and reliable, without an integral multiples of frequency, and reducing damaging threats to their equipment faced by them normally.

Mathematical expression of total harmonic distortion of current and voltage is given below in equation (a) and (b)

$$THD\% i_h = \frac{\sqrt{\sum_{k=2}^{\infty} I_k^2} \times 100}{I_1} \quad (a)$$

$$THD\% v_h = \sqrt{\sum_{k=2}^{\infty} V_k^2} \times 100 \quad (b)$$

Where,

THD = Total harmonic distortion

i_h = H^{th} harmonic component of current

V_h = H^{th} harmonic component of voltage

III. DC MOTOR

The DC motor has an important role in many applications like traction, elevation, mines, etc. In industrial applications where variable speed and load characteristics are required, DC motor is mainly used, because of their easy access of controllable features despite of their higher maintenance costs as compared to induction motors, but in addition to that due to use of power electronic devices, power factor and total harmonic distortion problem is becoming too faced [3]. In the past many researchers have worked on various converter topologies of DC motor for their different industrial applications, here separately excited DC motor is used with three phase AC-DC converter topologies whose rated parameters are given in Table. 2.

IV. MATLAB/SIMULINK RESULTS

Three phase uncontrolled rectifier is simulated by using MATLAB/Simulink software. Fig. 3. and Fig. 9 shows simulation and experimental setup for three phase half wave AC-DC converter circuit, and Fig. 6. and Fig. 11 shows both setups for three phase full wave AC-DC converter circuit. For both systems i-e simulation and experimental, rectifiers are fed by three phase supply mains and separately excited DC

motor is connected as a load, and each phase is fed by $240 \times \sqrt{2}$ volts at a constant frequency of 50 Hz.

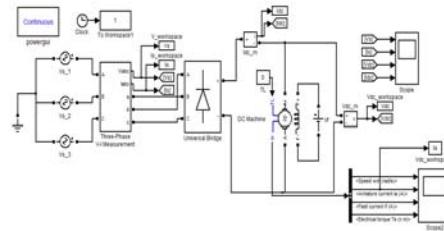


Fig. 3. Simulation model

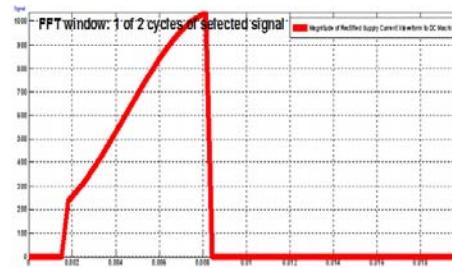


Fig. 4. Time domain

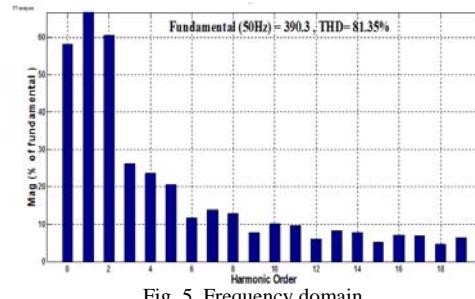


Fig.4 and Fig. 5 shows the time and frequency domain for supply current of half wave simulated circuit, in which total harmonic distortion is 81.35% of the fundamental frequency is observed.

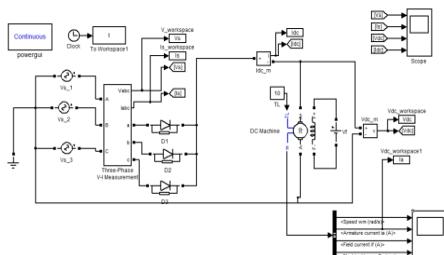


Fig. 6. Simulation model

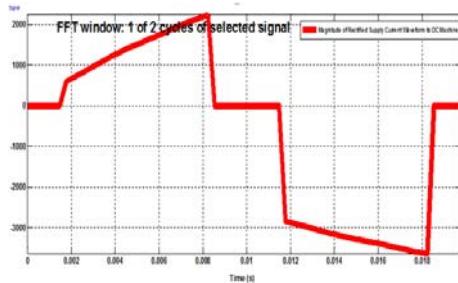


Fig. 7. Time domain

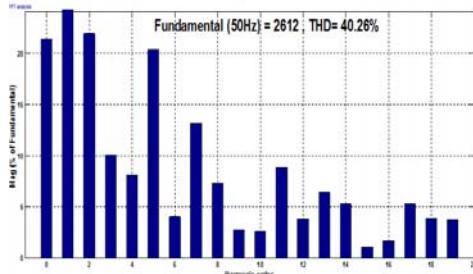


Fig. 8. Frequency domain

Fig.7 and Fig. 8 shows the time and frequency domain for supply current of full wave simulated circuit, in which total harmonic distortion is 40.26% of the fundamental frequency is observed.

A. EXPERIMENTAL RESULTS

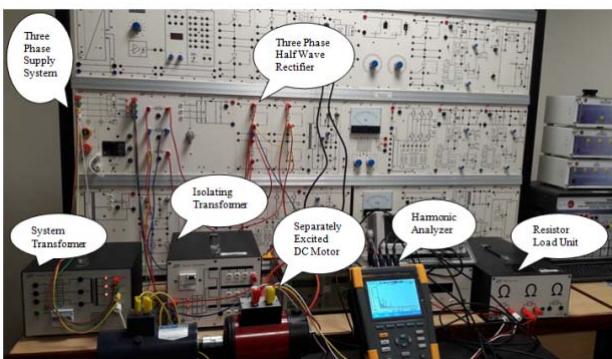


Fig. 9. Experimental set up

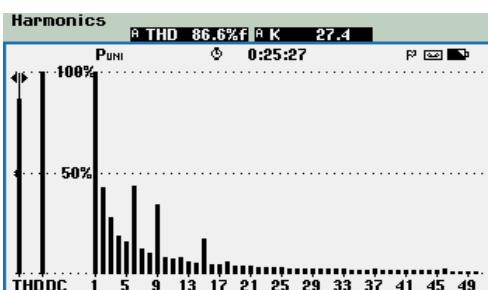


Fig.10. Experimental results

Fig. 10. shows 86.6% total harmonic distortion of the fundamental frequency of the supply current for half wave rectifier using the power quality analyzer.

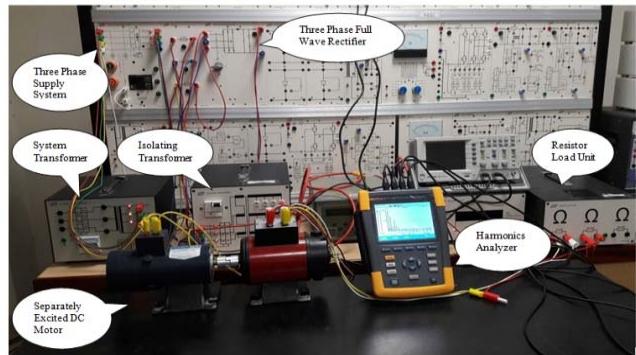


Fig.11. Experimental set up

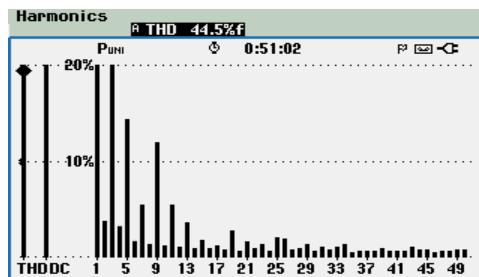


Fig. 12. Experimental results

Fig. 12. shows 44.5% total harmonic distortion of the fundamental frequency of the supply current for half wave rectifier using the power quality analyzer.

TABLE: 01
SEPERATELY EXCITED DC MOTOR PARAMETERS USED IN SIMULATION AND EXPERIMENTAL WORK

Parameter Name	Symbol	Rated Value
Rated Power	P _{in}	50 HP
Rated Speed	ω	1750 RPM
Rated Field Voltage	V _f	300 V
Armature Resistance & Inductance	R _a & L _a	0.1113 Ω, 0.001558 H
Field Resistance & Inductance	R _f & L _f	84.91 Ω, 13.39 H
Separately Field Excitation	V _f	300V

TABLE: 02
MATLAB/SIMULINK AND EXPERIMENTAL RESULTS OF TOTAL HARMONIC DISTORTION OF SUPPLY CURRENT FOR THREE PHASE AC-DC CONVERTER TOPOLOGIES

Parameter Name	Simulation		Experimental	
	% THD of supply current	Three phase half wave rectifier	Three phase full wave rectifier	Three phase half wave rectifier
I _s	81.35%	40.26%	86.6%	44.5%

Table. 2 shows the comparison of simulation and experimental setup results.

V. CONCLUSION

Research was carried out on three phase half and full wave AC-DC converters and analyzed total harmonic distortion effects. Through simulation and also experimentaly obtained results, it was, it was found that three phase full wave AC-DC conversion topology produces less total harmonic distortion as compared to three phase half wave AC-DC conversion.

ACKNOWLEDGEMENT

The authors are thankful to Mehran University of Engineering & Technology SZAB Campus Khairpur Mir's, Sindh, Pakistan, for providing all necessary laboratory facilities for the completion of this research work. The authors also would like to thank, Dr. Mazhar Hussain Baloch, Faculty member, Mehran University of Engineering & Technology SZAB Campus Khairpur Mir's, Sindh, Pakistan, Professor Dr. Mukhtiar Ahmed Mahar, Faculty Member, MUET Jamshoro, Sindh, Pakistan, and Professor Dr. Abdul SattarLarik, Sindh, Pakistan, for their valuable input to this paper.

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Heterogeneous Networks of Remote Monitoring with High Availability and Resilience Application to Wireless Sensor Networks

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Abstract- Lately, the Wireless Sensors Networks (WSN) have moved to the concept of the hybrids networks in order to get universal platforms in various types of monitoring and information collecting applications. The work presented in this paper aims in designing a hybrid remote monitoring architecture, largely secured by a high availability and resilience WSN. The modeling approach intends to describe the main operation of polling and dispatching between the communications channels with the purpose of ensuring the information availability and reducing the resilience time. To achieve our goal, we have realized an experimental platform of measuring, processing and routing data through hybrid communications technologies. We have illustrated, via curves, the routing of the data measured by a WSN (ZigBee Technology) to a final user through several communication technologies (HTTPS, SMS, ...).

Keywords- Wireless Sensors Networks, hybrid architecture, communication technology, remote monitoring, resilience, availability, security.

I. INTRODUCTION

Recently, the technological developments in various fields related to computing and microelectronics have given rise to a new type of sensor network called WSN [1].

These networks, with no fixed infrastructure, can be deployed widely in critical areas, hostile and difficult to access by humans. They can detect, calculate and communicate with other devices in order to collect local information. This information will be used to make decisions regarding the various parameters characterizing the monitored environment. The structure of a sensor node model and its dynamic aspect were approached in [2]. More generally, in [3] the authors are interested in the WSN model in its entirety.

Increasingly, the WSN promise a new range of services and a better understanding of the world around us. For instance, improving the quality of the monitoring service, which can retrieve and continuously transmit the measurements to a secure data processing server accessible by authorized users. Several works have been devoted to the problematic of hybrid networks; among others, [4], [5], [13], [14], [15], [16], in which different networks were merged and federated to get heterogeneous platforms, using various protocols. In this context, a style of architecture dedicated to distributed hypermedia systems (REST: Representational State Transfer), was created by Roy Fielding [17]. REST is a hybrid model founded on multiple models and network concepts, combined with additional constraints. In the same context, [18] presents a monitoring architecture model with WSN based on a Web service that allows users to access data remotely via an Internet connection. In [19] the authors present a methodology for designing a hybrid remote monitoring architecture.

In this work, we have modeled and designed a robust prototype with hybrid architecture based on a WSN and various communication technologies.

II. MODEL OF THE PROPOSED HYBRID REMOTE MONITORING ARCHITECTURE

The objective of this work is to propose a model of implementing a hybrid architecture that aims to improve the robustness of certain existing architectures. In fact, the proposed architecture model is meant to ensure a local or remote connection of multiple users to a sensor network through different communication technologies. The developed architecture should respond to an acceptable level of requirements in terms of availability, reliability and safety according the case study in question.

A. *Proposed platform*

We are interested in the Zigbee technology [6], [7], also known as IEEE 802.15.4 [8], [9], which allows to obtain wireless links with a low energy consumption.

Let's review the main elements of our Platform:

- *Zigbee* [6], [7]: it is a wireless network protocol, just as Wi-Fi or Bluetooth, which is suitable for the control and command devices networks, and other applications requiring low debit but high reliability.
- *MQTT* [10]: (Message Queuing Telemetry Transport) it is a publish-subscribe messaging service based on the simple and extremely light TCP / IP protocol. It works on the client / server principle. The server, named broker, collects the information transmitted by the publishers (Communicating objects).
- *HTTPS* [11]: (Hypertext Transfer Protocol Secure) it is an Internet communication protocol that protects the integrity and confidentiality of data while transferring information between the client and the server.
- *Sockets* [12]: it is a model for inter-process communication (IPC) in order to allow various processes to communicate on the same machine through a TCP / IP network. These sockets will allow managing incoming and outgoing flows to ensure communication between the client and the server.

Our architecture (figure 1) is composed mainly of a WSN, a processing server and users (clients). The processing server is composed of two parts. The first part, reserved for the configuration (web services), allows to receive physical and protocol configuration of each client connected to it to generate a polling program. The second part deals with polling, monitoring the environment in real time and access to database in order to visualize the collected data archive. This last part is made between the different protocols (MQTT [10], Sockets [11], HTTP / HTTPS [12]), and the channels of communication (Wi-Fi [20], Ethernet [21], Internet [22], GSM / GPRS [23]).

In order to carry out our modeling, we opted for the choice of UML modeling language [24]. In this context, we have established the following diagrams: Use Case Diagram, Class Diagram, Sequence Diagram and Deployment Diagram. Moreover, we have established a flowchart to better expose the proposed solution.

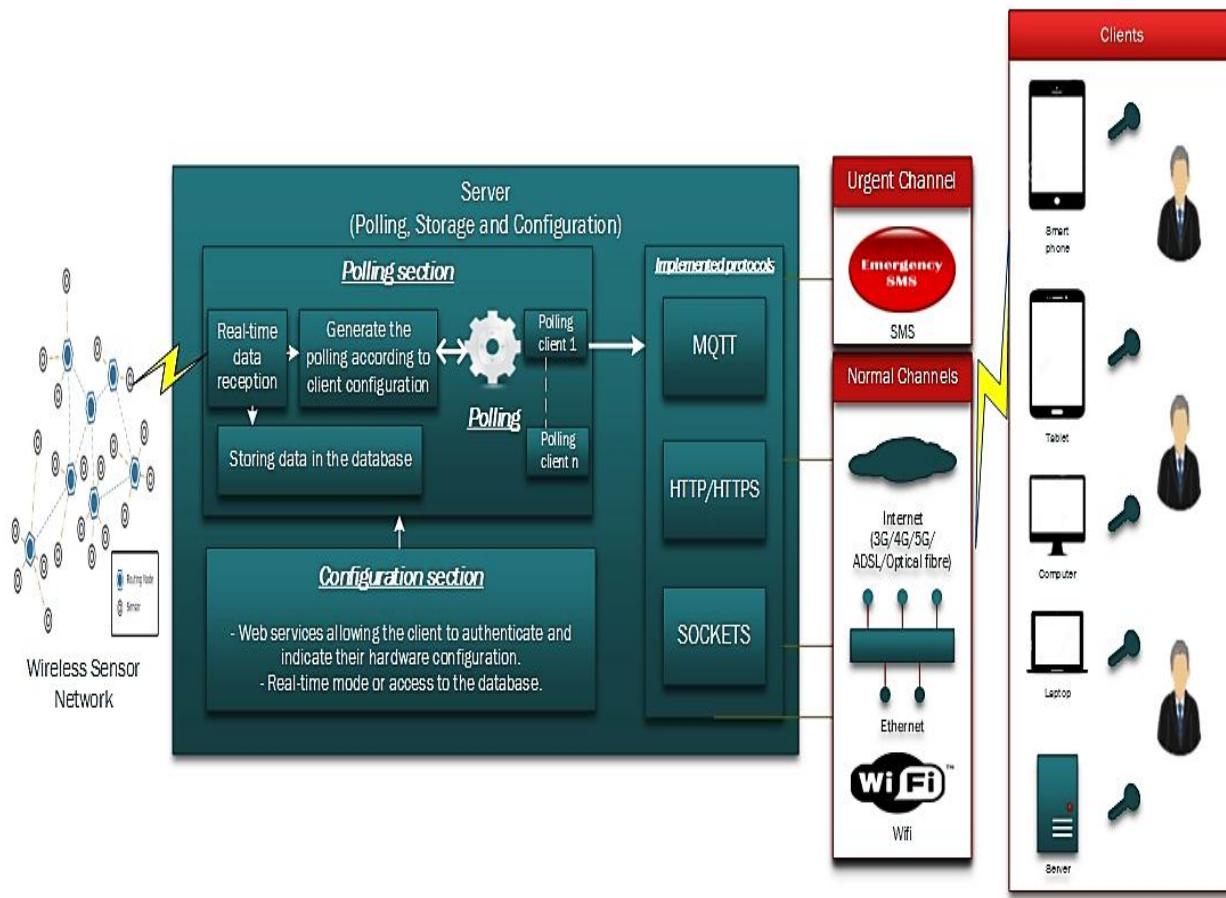


Figure 1. Hybrid Architecture of the proposed remote monitoring

B. Use case of the platform

The use case diagram (figure 2) shows the possible uses related to our system. We have implemented a "client" interface that allows, on the one hand, to receive live issued data from the WSN, taking into consideration our strategy of tolerance to technical failures and, on the other hand, to consult the database (processing server). In addition, the "client" interface allows users to authenticate and select the desired configuration (protocols, communication channels). Therefore, the processing server generates a polling program (flowchart polling figure 3) specific to the client's request and then the data are displayed in the specific interfaces to the protocols (figure 9). This polling program allows the routing of data (packets) from the WSN to the clients.

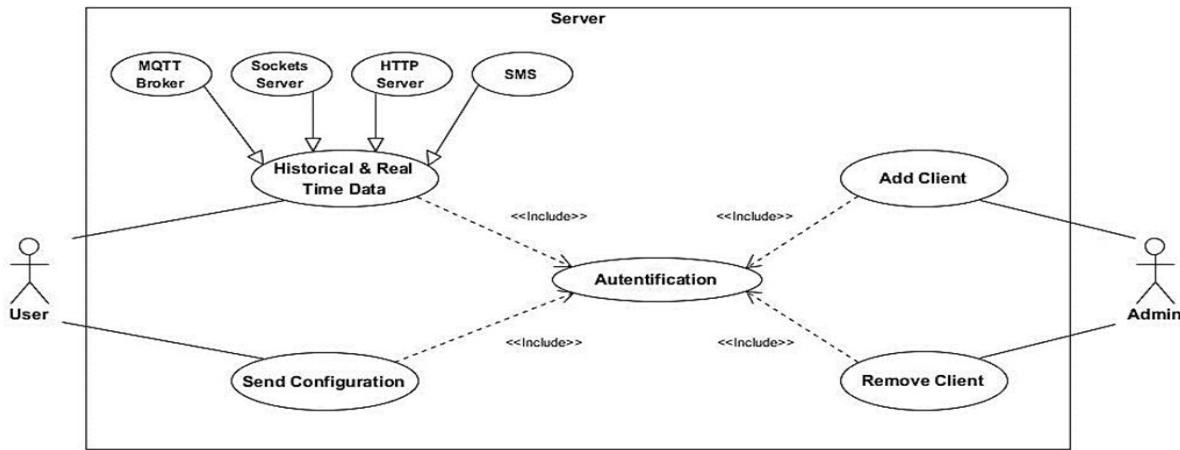


Figure 2. Use case diagram of the hybrid architecture of remote monitoring

C. Structural and dynamic aspects of the platform

We approached several issues related to the design of this architecture. First of all, we can list the adaptation and identification of data from the sensor network before storing them in a database. Fault tolerance due to random error is processed. In case of emergency (critical values, abnormal overflow, fault ...), the information routing is done on a priority approach (passing by the emergency channel) to the concerned users. Given the confidentiality of the data, we proposed, for our architecture, a secure authentication solution.

The "Polling" flowchart (figure 3), is established in order to better project our method for the tolerance to the technical failures.

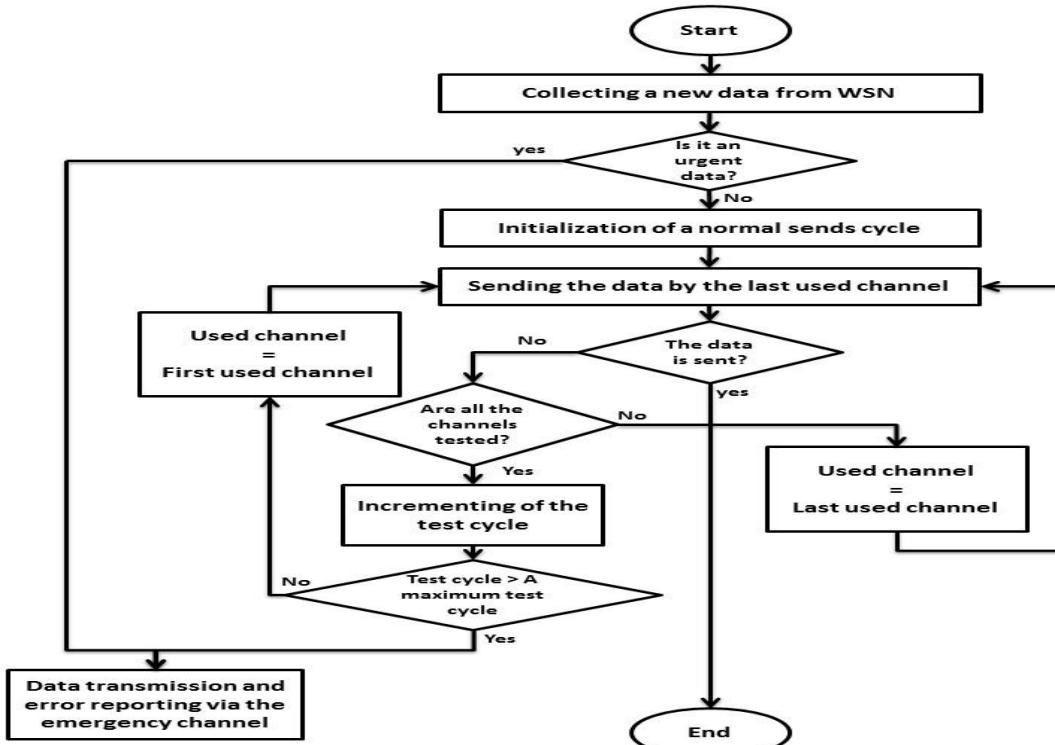


Figure 3. Flowchart treating the polling

WSN allows the collection of environmental, physical parameters (temperature, humidity ...) from the sensor nodes to the base station (sensor gateway). These data (packets) are routed to connected clients taking into account the algorithm. At the collect of a new packet, the system automatically triggers its issuance. This packet is usually treated with a treatment interval of urgent packets (priority) that we set according to the application. If, for example, the detected temperature, for agricultural greenhouses, exceeds the maximum set temperature, the system automatically performs the sending to the concerned users via the emergency channel (SMS messaging). In the opposite case, it initializes and resumes the normal cycle of transmission via the last channel used. This one is systematically exploited as long as the data arrive successfully to destination. In the case of a failure, the channels testing procedure is triggered to select a new functional channel. If after five test attempts, no channel is detected, the system calls upon the emergency channel, which is responsible for both the sending of the data and the report on the breakdowns occurring. All packets are transmitted with acknowledgment of receipt.

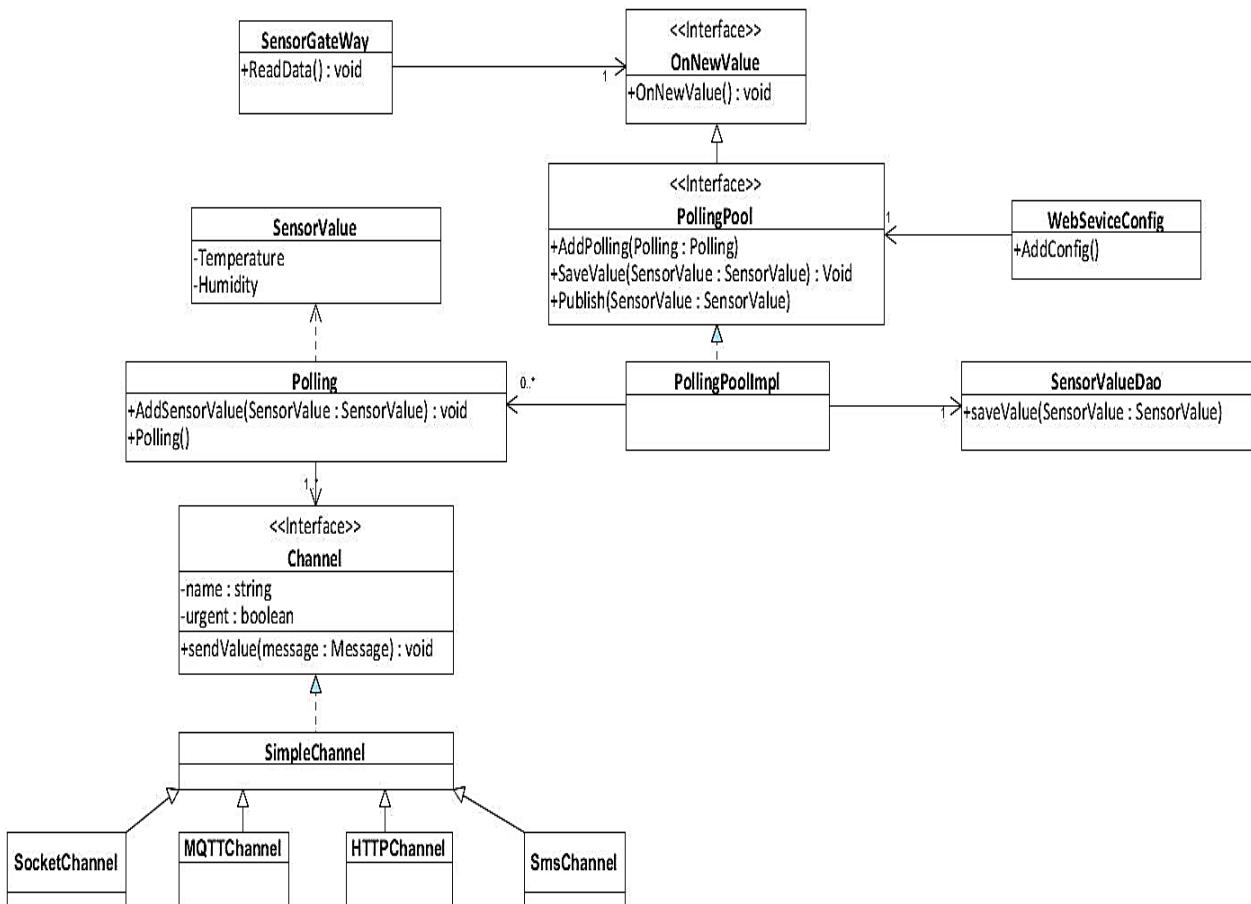


Figure 4. Class diagram of the hybrid architecture of a remote monitoring

Figure 4 shows the class diagram of our architecture:

- *SensorGateway*: it can acquire data from different sensor nodes.
- *OnNewValue*: it represents the event of receiving new data.

- *PollingPool*: this is an interface that allows in one hand to manage connected clients and in the other hand the recording and the outbreak of the diffusions measures.
- *PollingPoolImpl*: it is an implementation of the PollingPool.
- *WebServiceConfig*: it is the web service that allows the identification of customers and receipt of their configuration. This configuration is assigned to PollingPool to generate the adapted polling program.
- *SensorValueDao*: it saves data in a database implemented in the processing server.
- *Polling*: it allows publishing the values from the WSN to different clients using the polling.
- *SensorValue*: it contains the physical measurements from the WSN.
- *Channel*: an interface that represents a sending channel.
- *SocketChannel*: a channel for the implementation of Sockets protocol.
- *MQTTChannel*: a channel for the implementation of the MQTT protocol.
- *HTTPSCChannel*: a channel for the implementation of the HTTPS protocol.
- *SMSChannel*: a channel for SMS implementation.

After describing the structure of our architecture, we describe the dynamic aspect of our approach using the sequence diagram (figure 5).

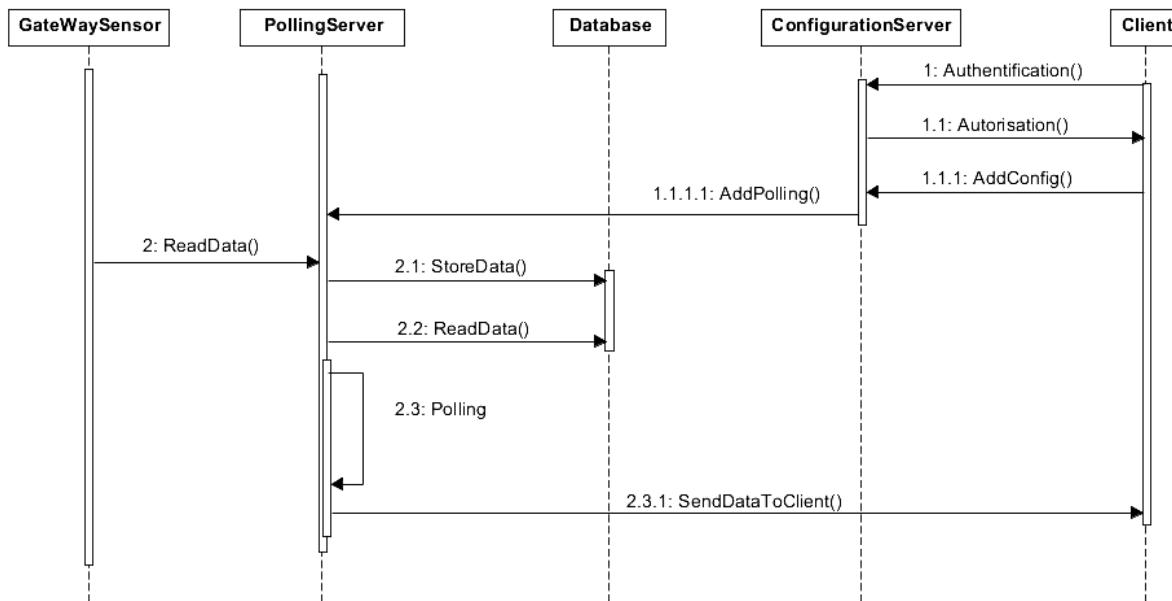


Figure 5. Sequence diagram of the hybrid architecture of a remote monitoring

The events of this diagram are described as follows:

- The sensor nodes send the measured physical measurements to the sensor gateway.
- The sensor gateway collects and routes the data from the WSN to the polling server.
- The polling server allows, the delivering, of data to connected customers and their storing in the database.
- This server is in place for client requests (Reading data in real-time by polling or access to the database).
- A client attempts to connect and authenticates with a username and a password.
- The server configuration allows him to connect and send its configuration via a Web Service (web interface).

- The client configuration is received by the polling server. This generates a polling program adapted to the client's request (this program is unique to each client connected to the architecture).
- The customer receives real-time data from the WSN.
- Access to the database is described in another sequence diagram (figure 6).

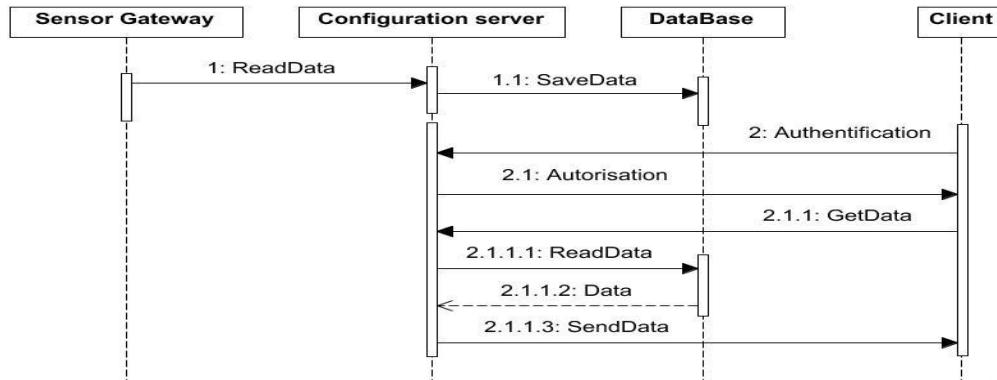


Figure 6. Sequence diagram represents the access to database

Figure 6 represents, in the case of need, the events related to the history access mode:

- First of all, the WSN collects the data by the sensor gateway.
- Thereafter the data are automatically stored in the database.
- The users, who want to access the stored values, must authenticate with a username and password and select the period of desired values.
- After authentication, the configuration server receives the client request (History according to the period).
- The configuration server starts the playback and diffusion of the historical requested by the client.

D. Components of the platform

The proposed architecture consists mainly of modules illustrated in the deployment diagram in figure 7. The main component of our system is named PollingPool. It manages all configurations received from the users. These configurations are secured by an authentication system with login and password, and received by the Controller Web component. The Sensor Reader component allows the collection of data from the WSN. The polling component contains a polling program dedicated to each client. Finally, the four redundant and diverse channels represent the implementation of the communication between the server and the users.

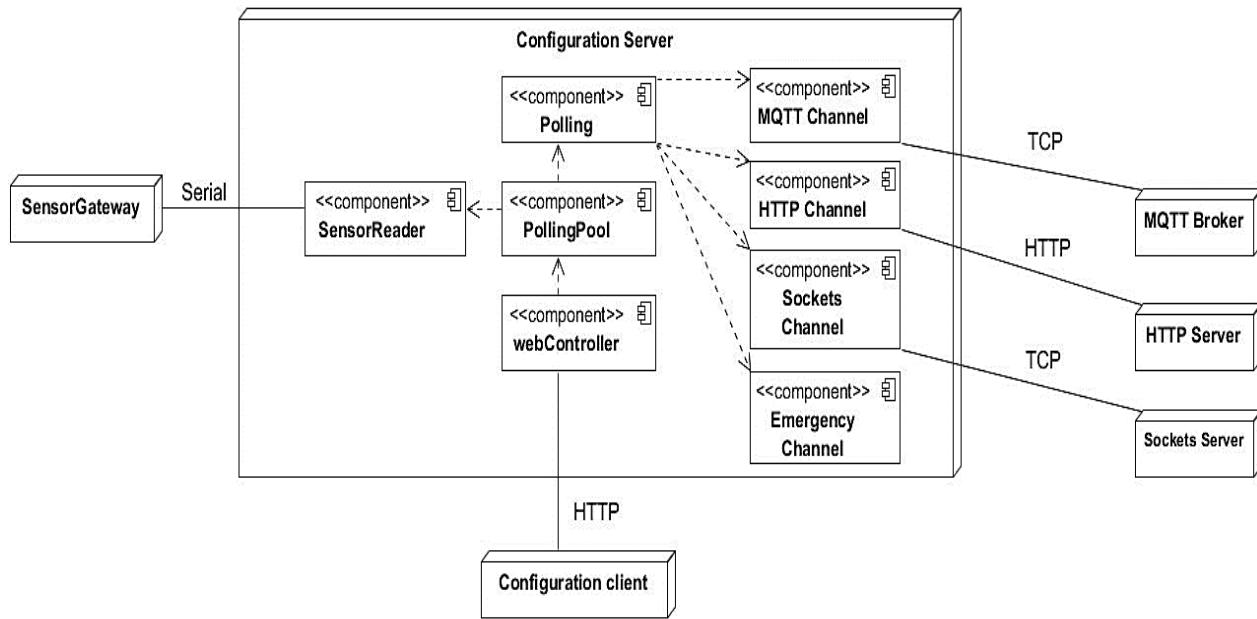


Figure 7. Deployment diagram of the hybrid architecture of a remote monitoring

III. IMPLEMENTATION OF THE PROPOSED HYBRID ARCHITECTURE, EXPERIMENTAL TESTS AND RESULTS

To validate its feasibility, our hybrid architecture of remote monitoring, based on WSN and interconnection techniques, has been realized in JAVA.

A. Implementation and experimental tests

We have implemented a platform of ZigBee WSN (Crossbow MicaZ) [25] consisted of 40 nodes of sensors based on the "MPR2400" microcontroller based on "Atmel ATmega128L" of ZigBee-Alliances [6]. The Sensor nodes ("MDA 100" and "MTS 420") are connected to the gateway in Mesh topology.

Firstly, we collect physical measurements such as temperature, humidity, the geo-position of the node in relation to the gateway and the energy consumed by each node. These physical measurements are stored in a database. Secondly, we perform various tests by a computer and a smartphone with interfaces designed under JAVA (figures 8, 9, 10). SMS sending is handled by a GSM / GPRS modem [23].

The implemented "client" interfaces allow to receive data from the WSN in real time and consult the database (figure 10). On the other hand, the "client" interface (figure 8) allows for authenticating and selecting the desired configuration (Protocols, Communication Channels). Thus, the server generates a polling program specific to the client's request. Therefore, the data are displayed in interfaces specific to the protocols. In this sense, Figure 9 represents the client interface specific to the MQTT protocol.

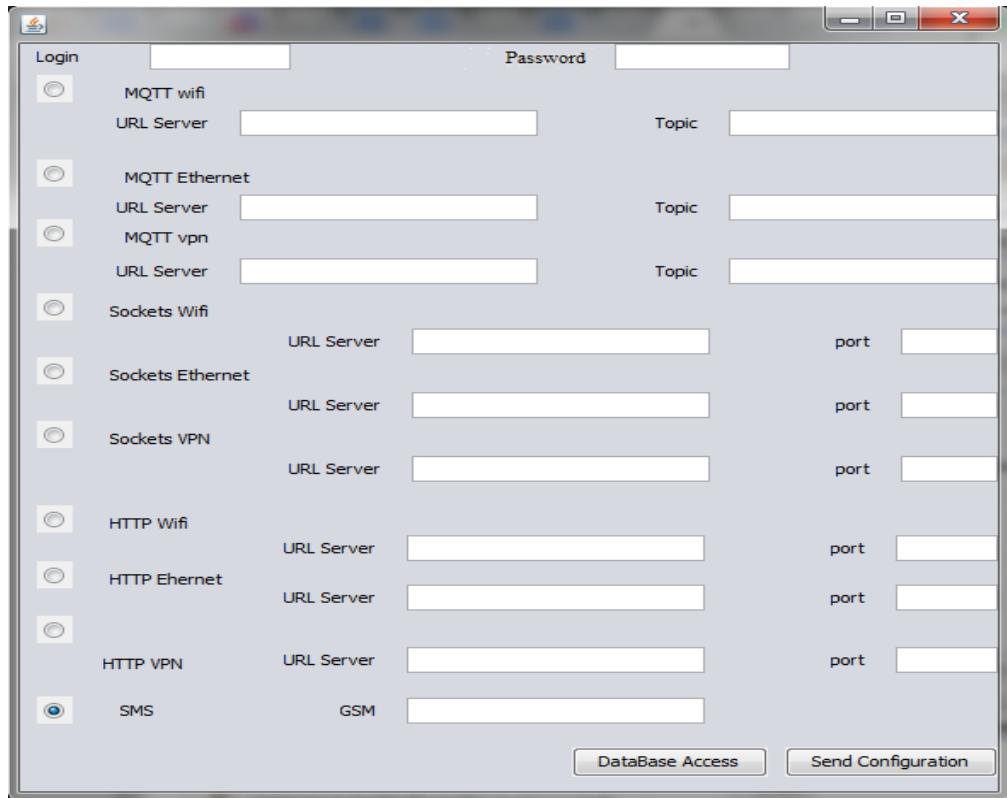


Figure 8. A client interface of authentication and configuration choices

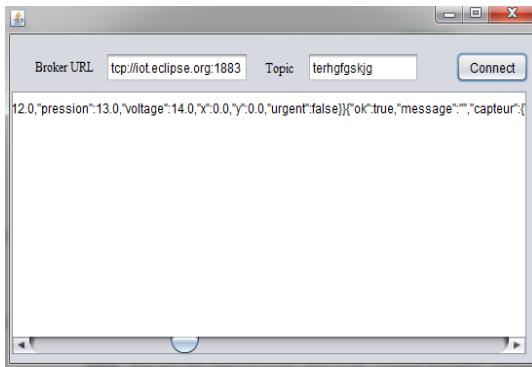


Figure 9. A client interface specific to protocol MQTT

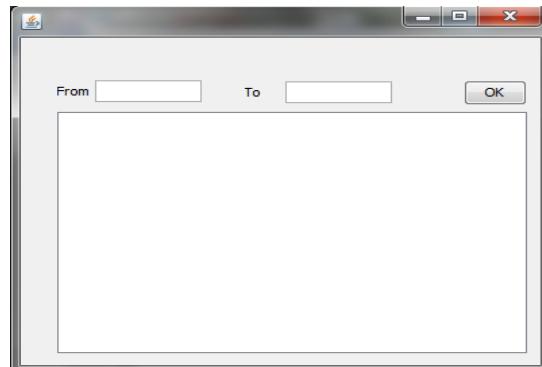


Figure 10. Database access interface

B. Results and Discussion

The database is powered by sensor data records and their archiving. This allowed us to draw up an evaluation and validation graph (figure 11) of our polling algorithm. The abscissa axis contains the data Id, while the ordinate axis includes the sending time of the data by each protocol. In this case, the packets are routed to the client by the sockets protocol. At ID 138, we notice an increase in the sending time of about 1300 ms which corresponds to the detection of the failure of the used channel and the switching to the MQTT protocol. The latter takes over the sending cycle from the non-transmitted data. The same phenomenon occurs at ID 160 between the MQTT protocol and the HTTP / HTTPS protocol. Another failure occurs at ID 171, the system resumes the test of the communication channels until the resumption of the transmission by the sockets.



Figure 11. The evolution of the polling between channels as a function of time

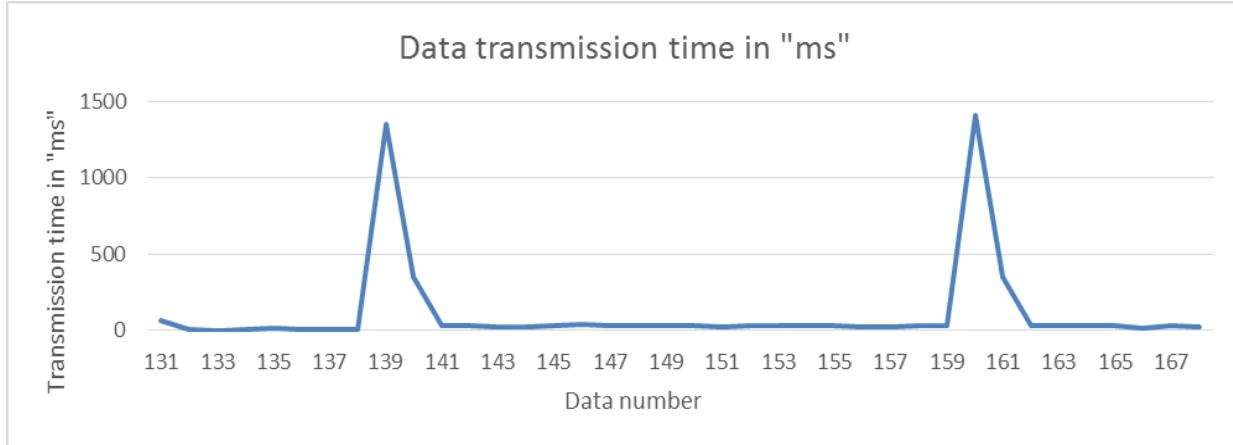


Figure 12. Data transmission time in case of polling to another channel

Figure 12 illustrates the variation of the time transmission to another channel by the polling processing due to the failure of the used channel. The evolution of this transmission time depends on the transmitted data. We note that, this time is around 1300 ms as described above.

IV. CONCLUSION

In this paper, we have proposed a hybrid remote monitoring architecture model based on WSN at high availability and resilience. This architecture allows users to access to data locally or remotely using multiple communication technologies. We presented the structural and dynamic aspects and the components of our proposed platform for the main operations: acquisition, storage and distribution of data by polling.

To validate the feasibility of the proposed architecture, we have built a prototype using a ZigBee WSN type and implemented a platform developed under JAVA.

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Principle Component Analysis for Classification of the Quality of Aromatic Rice

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Abstract—This research introduces an instrument for performing quality control on aromatic rice by utilizing feature extraction of Principle Component Analysis (PCA) method. Our proposed system (DNoe v0.2) uses the principle of electronic nose or *enose*. *Enose* is a detector instrument that work based on classification of the smell, like function of human nose. It has to be trained first for recognizing the smell before work in classification process.

The aim of this research is to build an enose system for quality control instrument, especially on aromatic rice. The advantage of this system is easy to operate and not damaging the object of research. In this experiment, ATMega 328 and 6 gas sensors are involved in the electronic module and PCA method is used for classification process.

Keywords— Enose, Principal Component Analysis, Aromatic Rice, Quality Control Instrument

I. INTRODUCTION

One of the natural wealth of Indonesia is the diversity in tropical plant, and aromatic rice is a part of it, especially from group of rice. Aromatic rice is different to the common one in term of smell and quality [1]. It has a musty smell because of sugar fermentation [2]. The experiment for such kind of rice actually can be conducted in laboratories, but it takes a long time and costly.

A new hope as an alternative way to test the aromatic rice quickly and accurately has landed and it is available in the body of electronic nose (hereinafter referred as *enose*) [3]. The application of *enose* is so wide nowadays, including medical field [4]. *Enose* even can bring the benefit on the daily activity, like to monitor the ripeness level of tomatoes based on its aroma [5]. By looking at the potentiality, *enose* is proper to be developed more and more and to be implemented, especially in Indonesia.

II. SYSTEM DESCRIPTION

Dinus Nose (DNoe) v0.2 is a new version of enose that developed in UDINUS (Universitas Dian Nuswantoro, Indonesia), with some improvements on pattern recognition engine. Our previous system, DNoe v0.1 [6], could successfully recognize 80% the smell of tofu.

This DNoe v0.2 is composed of sensor array system, electronic data acquisition system, and clustering system using PCA method. In this research, DNoe v0.2 is developed with the aim to determine and classify the rice quality on food industry.

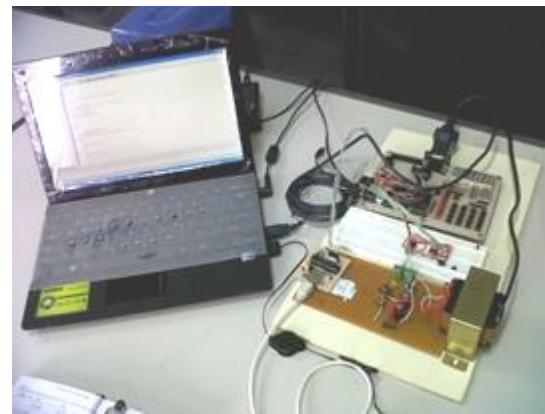


FIGURE 1. DNOSE v0.2

A. Array Sensor System

This enose system consists of 6 gas sensors: TGS825, TGS826, TGS822, TGS813, TGS2620 and TGS2611. Those sensors are metal oxide sensor and very useful for olfactory system. Figure 2 describes the characteristic respond of sensor array when tested with aroma. Initially the aroma was sprayed into chamber sampler, then absorbed and thrown away slowly.

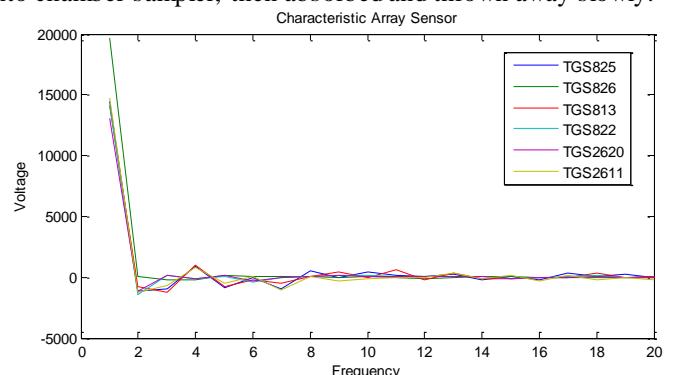


FIGURE 2. CHARACTERISTIC OF SENSOR ARRAY

B. Clustering System

PCA is a method to extract and reduce initial pattern vector numbers into fewer pattern vectors, called principle component. In MATLAB, PCA has some functions that can be used to improve our system performance. The steps of PCA are as follows:

- Define the template vector

- Find the reduction vector and variance matrix. The value of variance matrix represents eigen value.

$$\Sigma = \begin{bmatrix} \text{var}(A_1) & \text{cov}(A_1, A_2) & \text{cov}(A_1, A_3) & \text{cov}(A_1, A_4) \\ \text{cov}(A_2, A_1) & \text{var}(A_2) & \text{cov}(A_2, A_3) & \text{cov}(A_2, A_4) \\ \text{cov}(A_3, A_1) & \text{cov}(A_3, A_2) & \text{var}(A_3) & \text{cov}(A_3, A_4) \\ \text{cov}(A_4, A_1) & \text{cov}(A_4, A_2) & \text{cov}(A_4, A_3) & \text{var}(A_4) \end{bmatrix} \quad (2)$$

- The result of theorem 2 will be used to find the covariance matrix. The value of covariance matrix represents the eigen value.
 - To create Matrix L we can check the diagonal value of theorem 2 (Matrix A). That diagonal matrix represents the eigen value.

- Where $\lambda_1 > \lambda_2 > \dots > \lambda_n$.
 - Find the set of eigen vector $\{u_1, u_2, \dots, u_n\}$ from matrix S where v_i is orthonormal eigen vector and consistent to the eigen value λ_i .
 - Principal Component is obtained from the equation below [7].

C. Normalization

Gas sensing system which is also known as system for aroma detection and identification, become an important research for examining the quality of food material. An enose with VOC (Volatile Organic Compound) system can works very well in a special place with certain air temperature, signal booster, and gas sensor. Figaro gas sensor is also using VOC system. However, there is a main problem on VOC system that it cannot identified well on the patterns which almost alike. It has low sensitivity on sensing system[7]. On this case, the success rate of PCA with VOC is considered low since there is no algorithm to perform the learning process from new aroma.

Actually, the process of pattern normalization can affect to the loss of information on concentration level, but somehow, some algorithms like NN, GA, and Cluster Analysis are using the normalized response.

The most common normalization methods for enose research are amplitude and frequency normalization. The result of amplitude normalization is linier amplitude where the highest value of normalized amplitude is 1. Amplitude normalization method keeps the form of the signal and it only moves on positive axis of Cartesian coordinate y.

One of the popular amplitude normalization methods is Power Average. This method is begun by finding the highest score of pattern vector. It then performs division between pattern vector and the maximum score of pattern vector. After completing this step, then we find the average of normalized pattern vector for each class. Finally, the obtained average score is taken as template pattern that going to be compared with experiment data.

On frequency normalization, the result is in the form of polarized amplitude, and it is moving on the positive and negative axis from Cartesian coordinate y. Frequency normalization method that commonly used is fft (fast fourier transform). This method is begun by finding fft score of each pattern vector. Next, the normalized pattern vector is calculated to find the average score for each cluster. Finally, this average score is compared with experiment data, as a pattern template.

III. EXPERIMENT⁽¹⁵⁾

The aim of this research is to propose a DNose v0.2 based on PCA method for recognizing the smell of aromatic rice. The steps are as follows:

1. Measuring odorant, weight: 1 ons.
 2. Collecting censor data for 1 minute in a room with 27°C temperature, and volume of odorant chamber is 1573 cm^3 .
 3. Perform sampling odorant data to find the Analog Digital Converting (ADC) value from Microcontroller, $\text{fs} = 3\text{Hz}$.
 4. Performing data normalization by using 2 methods: power average and fft (fast fourier transform) method.
 5. Applying PCA clustering with the results of those 2 normalization method.
 6. Repeating the experiment up to 3 times for each method.

IV. RESULT AND DISCUSSION

A. Experiment of Power Average Normalization

Power average method is done by processing voltage data that yielded by those six censors, which initially have 60 samples then reduced to 20 samples, with sampling frequency $f_s = 3$ Hz. The average of FFT normalization is listed in Table 1, whereas the graph for normalization result of censor 1 to 6 is illustrated in Figure 3.

TABELL I

RESULT OF POWER AVERAGE NORMALIZATION

Quality	Censor 1	Censor2	Censor3	Censor4	Censor5	Censor6
KW1	2.14E+08	3.89E+08	2.05E+08	2.03E+08	1.73E+08	2.23E+08
KW2	56845310	1.7E+08	1.95E+08	1.39E+08	1.07E+08	2.68E+15
KW3	84248108	3.07E+08	93200111	76526991	69535669	3.27E+08

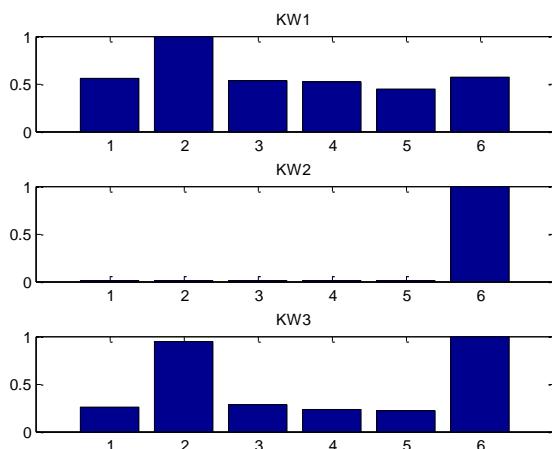


FIGURE 3. THE RESULT OF POWER AVERAGE NORMALIZATION

The gathered result of power average normalization is clustered by using PCA, as illustrated in Figure 4, 5, 6, and 7.

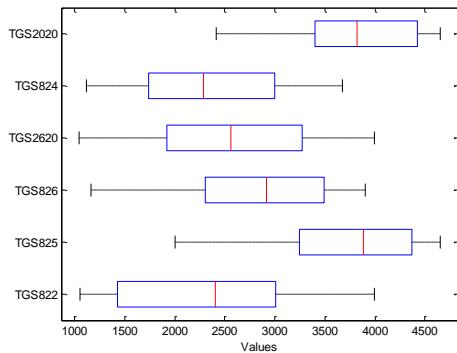


FIGURE 4. BLOCK PLOT OF POWER AVERAGE NORMALIZATION ON PCA

TABEL 2
DEVIATION STANDARD ON PCA POWER AVERAGE NORMALIZATION

Censor 1	Censor 2	Censor 3	Censor 4	Censor 5	Censor 6
869.4426	710.0997	675.6139	646.1813	580.0782	626.4368

Table 2 shows that deviation standard of PCA with power average normalization is still high, with the highest deviation is on censor 1 (869.4426) and the lowest deviation is on censor 5 (580.0782). Those data can be a reference to extract some censors that have high deviation standard as it can obstruct the pattern recognition process.

The clustering result of power average normalization shows that the clusters are still distributed and the distance of each cluster is still close, as illustrated in Figure 6.

The pareto chart illustrates the plots of variable percentage which explained on each Principle Component (PC). Figure 6 shows the clear differences between first and second component. However, the variance differences between those two components is still less than 50%, so it is required more components to be involved. According to Figure 6, the first two components represent 2/3 of total variabilities on the template.

Here, we can use FFT to reduce the dimension so that we can visualize the data.

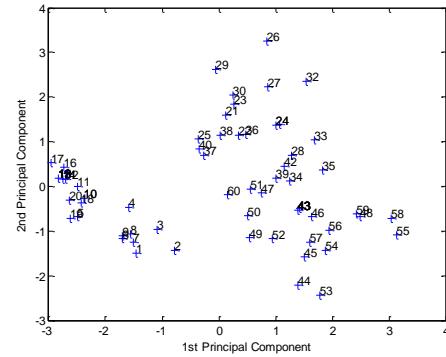


FIGURE 5. THE FIRST AND SECOND PRINCIPAL COMPONENTS WITH POWER AVERAGE NORMALIZATION METHOD

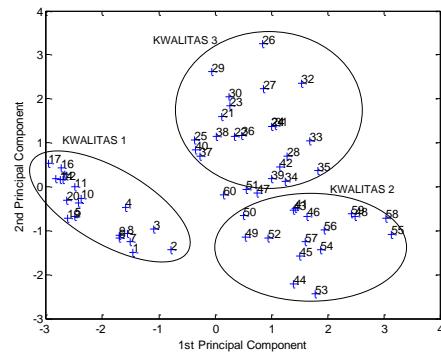


FIGURE 6. THE FIRST AND SECOND PRINCIPAL COMPONENTS CLUSTER DESCRIPTION WITH POWER AVERAGE NORMALIZATION

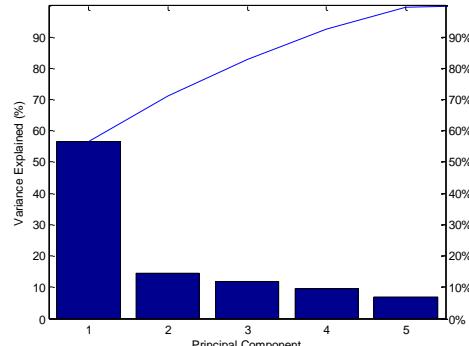


FIGURE 7. PARETO DIAGRAM OF EACH PRINCIPAL COMPONENT WITH POWER AVERAGE NORMALIZATION

B. Experiment of FFT Normalization

Power average method is applied by processing the voltage data that obtained from those six censors. Initially it has 60 samples and then reduced to 20 samples, with sampling frequency $f_s = 3$ Hz. The average of FFT normalization is listed in Table 3, whereas the graph for normalization result of censor 1 to 6 is illustrated in Figure 7.

TABEL 3
THE RESULT OF FFT NORMALIZATION

Quality	Censor 1	Censor2	Censor3	Censor4	Censor5	Censor6
KW1	4.2E+09	7.77E+09	4.02E+09	3.97E+09	3.4E+09	4.36E+09
KW2	1.02E+09	3.29E+09	3.82E+09	2.76E+09	2.05E+09	1.91E+19
KW3	1.54E+09	6.13E+09	1.79E+09	1.44E+09	1.33E+09	6.41E+09

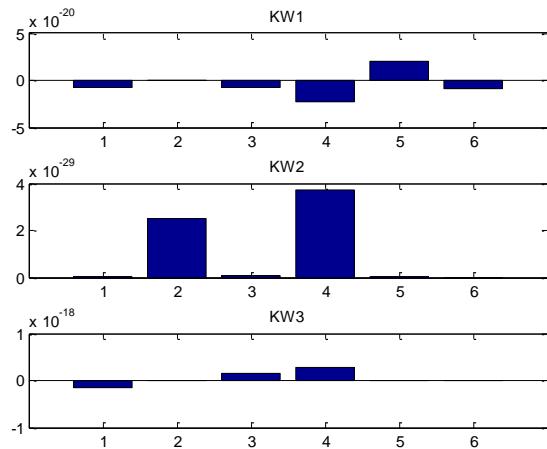


FIGURE 8. RESULT OF FFT NORMALIZATION

On this step, the result of FFT normalization is clustered by using PCA, as shown in figure 8, 9, and 10.

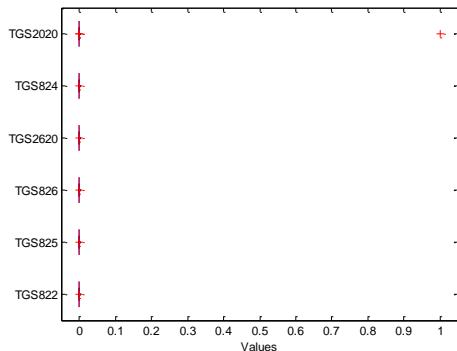


FIGURE 9. BLOCK PLOT OF FFT NORMALIZATION ON PCA

TABLE4
DEVIATION STANDARD ON PCA WITH FFT NORMALIZATION

Censor 1	Censor 2	Censor 3	Censor 4	Censor5	Censor6
0	0	0	0	0	0.1291

Table 4 explains the deviation standard of PCA (FFT normalization) which has slight better score, with the highest deviation is only on censor 6 (0.1291) and the lowest deviation is on censor 1 to 5 (0). Those data can be a reference to remove the censor that has high deviation standard. This is because a censor with high deviation standard can obstruct the pattern recognition process. So, in this case, we remove censor 6.

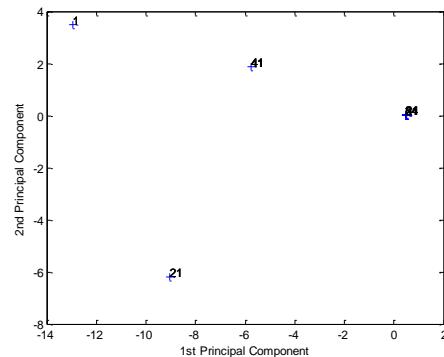


FIGURE 10. THE FIRST AND SECOND PRINCIPAL COMPONENTS

The clustering result of power average normalization shows that the clusters have been well concentrated, and the distance among each cluster is far enough. There is a new cluster created by merging between cluster 2 and 3. Table 5 shows the list of clusters involved.

TABLE5
PATTERN VECTOR DISTRIBUTION OF PCA WITH FFT NORMALIZATION

Quality	Rows
KW1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20
KW2	21,22,23,25,26,27,28,29,31,33,34,35,36,37,39,40
KW3	41,43,44,45,46,48,49,50,51,52,53,54,56,57,58,59
New Cluster	24,30,32,38,42,47,55,60

According to Table 5, Q1 (Quality 1) has distribution 0%, whereas the distribution of both Q2 and Q3 are 20%.

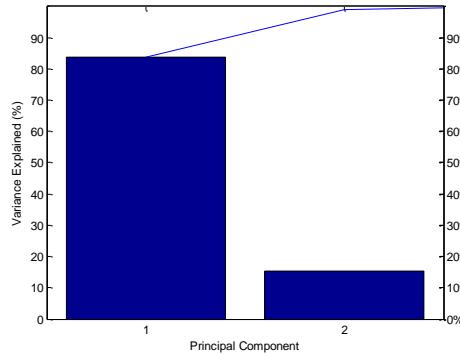


FIGURE 11. PARETO DIAGRAM OF EACH PRINCIPAL COMPONENT

By applying the result of PCA into pattern recognition algorithm, the smaller distribution score on PCA system means the pattern can be recognized easier.

The above pareto chart illustrates the plots of variable percentage which explained on each Principle Component (PC). Figure 10 shows the big differences between first and second component. However, the variance differences between those two components is still less than 84%, so it is required more components to be involved. According to Figure 6, the first two components represent 2/3 of total variabilities on the template. Here, we can use FFT to reduce the dimension so that we can visualize the data.

V. CONCLUSION

Based on the experiment and gathered result, we conclude that FFT normalization method is better than power average one. It is proved by the score of *variability explained* on FFT is higher than the score of *variability explained* on power average normalization method. However, by using FFT, the result of clustering process is still less than 0.1%. Therefore, the further research is needed to find the better normalization method that can produce significant improvement of the percentage of variability explained.

ACKNOWLEDGEMENT

We would like to express our gratitude to Dr. Eng. Kuwat Triana, M.Si, he has been our mentor for this research: eNose for detection of quality of aromatic rice.

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Mathematical Modeling of Security Issues of WLAN's using Space Time Processing in DSP.

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Abstract

Due to an explosion of demand for high speed wireless services such as wireless internet,email,stock quotes and cellular video conferencing wireless communication has become one of the important field in modern engineering.Wireless networks are broadly classified into four different kinds such as wireless lans,satellite networks,cellular networks and personal networks. In most of the scenarios WLAN's systems are based on single hop operation but in now a day's significant study has been done on WLAN's with multi-hop operation.In this research article we have studied the various security issues of wlan especially with respect to bluetooth.wireless local area networks are different from Wired networks in terms of cost,security,high reliability,resource sharing,scalability,communication media etc. One of the important

I.Introduction

As we know that computer network is a collection of heterogeneous systems or a homogenous computer systems such as super computer,mini computer, micro computer,laptop,desk top computer,printer,scanner etc. The networks are broadly divided into three types such as local area networks, metropolitan networks,wide area networks. The local area networks are again broadly classified as wired local networks and wireless local area networks. The wireless local area networks in now a days is a commonly operated internet access technologies but it is also enlarged across a wide variety of markets such as mobile phones,consumer and automobile technologies etc. With widespread deployment of wireless local area networks in offices,buildings,schools,university campuses,hotels,railway

problem for wireless network is limited frequency spectrum. In now a day's wireless local area network consists of multiple stations that coexist with in a limited geographic jurisdiction and share a common wireless channel to communicate with each other.This research work proposes a mathematical model based security issues of wlan by investigating,design,implementation and performance analysis using Digital Signal Processing(DSP) Space Time Processing.Space time processing technology which uses more than one antennas with an appropriate signaling and receiver methodology provides a powerful tool for improving the performance of WLAN's.

Keywords:Bluetooth,WLAN,Security,Performance,Space time Processing,Rayleigh fading,Maximal ratio combining etc.

stations,bus stands,air ports and also in other public locations it is highly essential to understand the basic performance requirement of wlan's which are based on the IEEE 802.11 standard technology and also to know how efficiently and effectively design, deploy and manage them. As we know that IEEE 802.11 supports two modes of operation such as ad-hoc mode(infrastructure less) and the infrastructure mode. The commercial and enterprise wireless local area networks are usually operate in the infrastructure mode. In certain kind of wireless networks one node is necessary to reach the mobile terminal. The mobile terminal is a collection of mobile desktop and mobile keypad. Usually in wireless networks ad-hoc networks normally requires a multi-hop wireless path from source location to the destination

location. The multi-hop mobile ad-hoc networks mainly concentrate on the heterogeneous routing protocols and medium access control methods. Several issues have been considered into account while considering a wireless network. The Quality-of-Service(QoS) is one such issue. The key issues of wireless local area networks such as mobility of users, bit errors and bugs in wireless channel, scarce wireless services[17].

The trend for WLAN's systems is growing rapidly in the communication industry. It is very difficult to understand the performance issues of WLAN's when there is a great demand for WLAN products. In computer networking WLAN's are mainly used to substitute wired LAN's,or extension of the wired LAN infrastructure. Network connectivity is one of the basic performance metric of wireless local area networks. The study of WLAN's performance enables better understanding of resource sharing and network connectivity. The performance of WLAN's is calculated on the three main technologies such as analytical modeling, direct measurements,simulation[17]. Network mathematical analysis is performed for a specific scenario with very limited and with very rigid conditions. Due to higher bandwidth supported by the standards,WLAN's are mainly deployed for large number of users which consists of

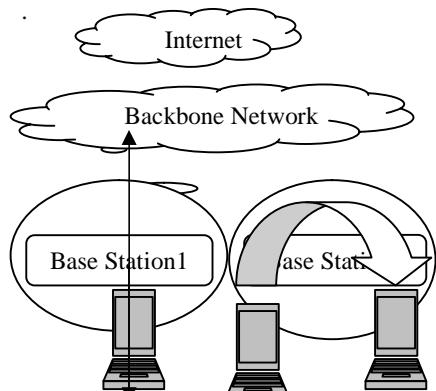


Fig.I.Structured network architecture of WLANs.

II.Related Work

We can find a couple works carried out in this direction. Hanumanthappa.J[1][2][3][4] has studied in depth about wireless local area networks,ip mobility,wlan

applications such as browsing, email and database access. The different types of protocols used in wireless local area networks are Ad-hoc on demand distance vector(Aodv),Temporarily ordered routing algorithm(Tora),Dynamic source routing protocol(Dsrp),Destination sequence distance vector(Dsdv) etc. The popular physical layer and Medium Access control(Mac) sub layer standard are provided by IEEE in the notation of 802.11 protocols. The different types of factors affecting the performance of WLAN's are Radio Frequency Interference,Physical layer technologies,hidden terminals. The WLAN performance is also improved in a better manner by fragmentation option which divided 802.11 data frames into smaller pieces forward separately to the destination. The different types performance model used in WLAN's are TCP congestion control in wireless environment, signal to noise ratio estimate of 802.11g, performance enhancement of WLAN systems using RTS/CTS and fragmented frames. In wireless local networks communication terminals is supported via two common network topologies such as ad-hoc mode and structured mode[17]. The Fig.1 shows how to create wlan's by using structured network architecture and Fig.2.shows the formation of wlan's using ad-hoc network architecture

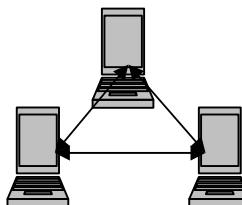


Fig.II.Ad-hoc network architecture of WLANs.

performance,an overview of security wireless networks,wlan technologies,wireless security protocols,how to transit from wlan's to ad-hoc networks, peer to peer approach for wlan's,space time processing for wlan's,wlan

security,decreasing security risks of wlan,application of wlan in telemedicine service etc. S.Alamouti[19] has also proposed a simple transmit diversity methodology for wireless communications. They have also presented a simple two branch transmit diversity scheme. They have also shown that a scheme may easily be generalized two transmit antennas and M receive antennas to provide a diversity order of $2M$. Weifeng Su,Stella.N.Batalama,Dimitris.A.Pados[23] have presented a necessary and sufficient condition for any orthogonal space time block code(stbc) to permit transceiver signal linearization. He has also proved and confirmed that square orthogonal stbc's which satisfy the criteria that has rate that

III.Proposed Methodology

This research work proposes a mathematical modeling of security issues of wlan's using space time processing. The focus of recent research in wireless networks especially on wlan's is to identify the different ways to increase throughput and decreasing Bit-Error-Rate(BER). One of the conventional approach to security issues of wlan's is increasing signal strength and thereby increasing signal-to noise ratio. However it is not a practical approach in WLAN's. Because whenever output power increases for one of the LAN cards this also increases the interference for rest of the cards. Therefore it decreases overall throughput of a system, moreover maximum bandwidth is allocated[17]. As we know that the process of allocating maximum bandwidth is also not a practical solution because bandwidth is more costly. Therefore it raises a question in our mind how decrease BER and effectively increase

goes to zero linearly with the number of transmit antenna's. Lori Anne Dalton[31] has presented complex full rate codes, for four transmit antennas. By using carefully tailored constellation phase relations, he has proved new orthogonal space time bloc codes can achieve full diversity for specialized PSK and PAM symbol constellations. The ABBA code presented in[25] and similar codes[26] – [28] have full rate but are quasi-orthogonal and offer a diversity order of only 2. The STTD – OTD code[29] which provides some diversity achievement by grouping symbols into alamouti blocks and transforming using Walsh Hadamard matrix.

throughput[17].This condition can be satisfied with extensive error correction schemes and increase redundancy in data. In BER the channel equalizers are mainly used to nullify the effect of channel impurities up to a certain level. In Multipath fading equalizers can be treated as an enemy of a signal and are basically used to equalize the effect of multipath fading. In Maximal Ratio Combining (MRC) multipath property is used to maximize the throughput and overall performance of a system. Space time coding is a technique in WLAN's to operate a signal in both time and space[17].In Maximal Ratio Combining(MRC) which consists of one transmitting and two receiving antennas. The signal which reaches the two receivers by two different paths namely h_1 and h_2 .These two paths are modeled by two complex quantities such as phase and a magnitude[17][19].The Fig.3. shows alamouti space time processing in WLAN'

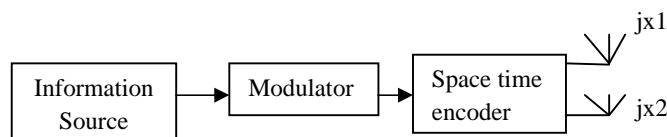


Fig.3.Alamouti space time processing code in WLAN's.

$$h_1 = e^{f^1} \quad \text{(i)}$$

$$h_2 = e^{f^2} \quad \text{(ii)}$$

where f_1, f_2 are fading magnitudes and ϕ_1, ϕ_2 are phase values. Noise is added at each receiver, so the received signal at each receiver is specified by

$$y_1 = h_1 s + n_1 \quad \text{(iii)}$$

$$y_2 = h_2 s + n_2 \quad \text{(iv)}$$

The equations (i), (ii), (iii) and (iv) are represented in the form of matrix using equation (v)

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = S \begin{bmatrix} h_1 \\ h_2 \end{bmatrix} + \begin{bmatrix} n_1 \\ n_2 \end{bmatrix} \quad \text{(v)}$$

The receiver side combines the two signals y_1 and y_2 as follows [17].

$$s^- = h_1 y_1 + h_2 y_2 \quad \text{(vi)}$$

$$s = (h_1 s + n_1) + h_2 (h_2 s + n_2) \quad \text{(vii)}$$

The Table-1 shows the simple space time coding given by Alamouti [17][19]

Symbol period	Tx ₁	Tx ₂
1	S ₁	S ₂
2	-S ₂ [*]	S ₁ [*]

Table-1: Simple Space Time Coding for the security issues of WLAN's.

Assume that channel response remains constant over the two symbol periods, the two paths h_1 and h_2 are calculated as follows.

$$h_1(T=1)=h_1(T=2)=e^{f^1} \quad \text{(x)}$$

$$h_2(T=1)=h_2(T=2)=e^{f^2} \quad \text{(xi)}$$

Now the received signals can be calculated as follows.

$$Y_1=Y(T+1)=h_1 s_1 + h_2 s_2 + n_1 \quad \text{(xii)}$$

$$Y_2=Y(T+2)=-h_1 s_2 + h_2 s_1 + n_2 \quad \text{(xiii)}$$

The received signals are combined as follows to get S_1 and S_2

$$S_1 = h_1 y_1 + h_2 y_2 \quad \text{(xiv)}$$

$$S_2 = h_2 y_1 - h_1 y_2 \quad \text{(xv)}$$

$$S_1 = (|h_1|^2 + |h_2|^2) S_1 + h_1 n_1 + h_2 n_2 \quad \text{(xvi)}$$

$$S_2 = (|h_1|^2 + |h_2|^2) S_2 - h_1 n_2 + h_2 n_1 \quad \text{(xvii)}$$

$$s = (|h_1|^2 + |h_2|^2) S + h_1 n_1 + h_2 n_2 \quad \text{(viii)}$$

By elaborating the equations (vi), (vii), (viii) we get and choose S_i iff $(|h_1|^2 + |h_2|^2) |S_i|^2 - s S_i - s S_i <= (|h_1|^2 + |h_2|^2) |S_k|^2 - s S_k - s S_k$ if $k \neq i$. $\#$ (ix).

3.1. Implementation of WLAN's using Space time processing using Two Transmitters and one Receiver.

The simple and a general space time code is specified by Alamouti [19]. During the first symbol period the two different symbols are transmitted simultaneously from Tx₁ and Tx₂ respectively. During the next symbol period the transmitter Tx₁ forwards $-S_2^*$, Tx₂ forwards S_1^* where * is a complex conjugate.

3.2. The Space Time Processing based on Alamouti code for two antennas and two receivers.

The scenario for two transmitters and two receivers the encoding and transmission methodology is same as that for two transmitters and one receiver [17][19]. The difference in this system is the number of channels have been increased to four. The results computed by Alamouti mechanism which consists of two transmitters and two receivers is similar to those calculated by four branch Maximal Receiver Ratio Combining (MRRC). The power forwarded per antenna is half as compared to the Maximal Ratio Combiner (MRC) [17]. One of the important result of Alamouti technique was that

the combined signals from two receiving antennas were computed by the simple addition of combined signals from each receiving antenna. The epilogue was that by using two transmitting and m receiving antennas when each of the m antenna has its own combiner. By adding the output of all combiners we get the same diversity order as 2m branch MRC[17][19].

3.3.The Space time Processing based on alamouti code for four transmitter and one receiver antenna.

When a symbol period is given, the four different signals are transmitted simultaneously from four transmit antennas. The signal one which transmitted from antenna one is called Tx1 is specified by s1, the signal from antenna two Tx2 is represented by s2, the signal from antenna three Tx3 is shown by s3 and finally the signal from antenna four Tx4 is represented by s4. This mechanism will continue on in a same manner until transmitting the last row of the G4 transmission matrix as shown in equation. This matrix has a rate of half(1/2) encoding and is used as a space time processing(stc) encoder to forward any complex signal constellations. The space time processing encoding and mapping for four forwarder antennas using complex signals. The four transmit and one receive antenna channel coefficients are specified by complex multiplicative distortions such as j1 for the first antenna, j2 for the second antenna, j3 for the third antenna and j4 for the fourth transmit antenna.

The various channel coefficients for the alamouti code with four transmit and one receive antenna is beautifully explained in Table-3. The various benefits of the space time processing are as follows[31].

i.Improved performance with Diversity:-Space time processing is mainly used to improve the performance such as diversity[31]. Diversity is the amount of average

number of channels fully utilized by each piece of information transmitted. The maximum amount diversity of space time processing is specified by $N_t N_r$, where $N_t N_r$ is the total number of channels available between receiver and transmitter. Diversity if Rayleigh fading channel is directly calculated from error probability[31]. The diversity of any Wireless local area network system is represented by error probability salient feature as

$$SNR = \dots \dots \dots \text{(xviii)}$$

$$i.e \text{ probability(error)} = K^{-D} \dots \dots \dots \text{(xix)}$$

where D is called as Diversity order in rayleigh fading model, is Signal Noise Ratio(SNR) and K is a Coding gain constant[31].

ii. Higher datarate, Capacity and Spectral efficiency: Higher data rate, capacity and spectral efficiency is also consider as the second important benefit of space time processing in Digital Signal Processing. The datarate of space time processing is computed by average number of symbols sent per time epoch[31].

$$R=L/T \dots \dots \dots \text{(xx)}$$

$$\dot{\eta}=\text{Datarate/Bandwidth} \dots \dots \dots \text{(xxi)}$$

The spectral efficiency of a space time processing using a two dimensional constellation with M points to be

$$\dot{\eta}=R\log_2 M \text{ bits/sec/Hz} \dots \dots \dots \text{(xxii)}$$

*iii.Simpler handheld design:*Simpler handheld is also one of an important benefits which belongs to space time processing[31]. It is also possible to increase diversity in all subscriber units by fixing one antenna to the base station, instead of new antenna to each receiving unit[31]. In Multiple Input Multiple Output(MIMO) channel with Gaussian fading is[31]

$$C = E_H \left[\log \det \left(I N_r + \frac{1}{N_t H^H H} \right) \right] \dots \dots \dots \text{(xxiii)}$$

$$= E_H \left[\log \det \left(I N_t + \frac{1}{N_t H H^H} \right) \right] \dots \dots \dots \text{(xxiv)}$$

	Tx1	Tx2	Tx3	Tx4
--	-----	-----	-----	-----

t	s1	s2	s3	s4
t+T	-s2	s1	-s4	s3
t+2T	-s3	s4	s1	-s2
t+3T	-s4	-s3	s2	s1
t+4T	s1*	s2*	s3*	s4*
t+5T	-s2*	s1*	-s4*	s3*
t+6T	-s3*	s4*	s1*	-s2*
t+7T	-s4*	-s3*	s2*	s1*

Table-2:Four transmit and one receive antenna encoding and mapping of space time processing using complex signals.

	Rx
Tx1	j1
Tx2	j2
Tx3	j3
Tx4	j4

Table-3:Four transmit and one receive antenna channel coefficients.

Let us assume rayleigh fading channel is constant over the four consecutive symbols and the channel coefficients are specified by xx,xxvi,xxvii,xxviii.

$$j_1(t)=j_1(t+T)=j_1= |j|e^{j^2} \quad \text{---(xx)}$$

$$j_2(t)=j_2(t+T)=j_2= |j|e^{j^2} \quad \text{---(xxvi)}$$

$$j_3(t)=j_3(t+T)=j_3= |j|e^{j^3} \quad \text{---(xxvii)}$$

$$j_4(t)=j_4(t+T)=j_4= |j|e^{j^4} \quad \text{---(xxviii)}$$

where $|h_i|$ and $i=1,2,3$ and 4 are amplitude and phase shift for the path from transit antenna i to receive antenna j. The receiver will receive eight different signals[31].

IV.Results and Discussion

As we know that in space time processing based on alamouti code is one which supports for orthogonal scheme. Orthogonal space time processing is mainly used to achieve full transmit diversity of $N_t=2$. The Bit-Error-Rate(BER) versus Signal-to-

Noise Ratio(SNR) performance for alamouti transmit diversity technique on low fading rayleigh channel is evaluated by Matlab. This research work simulation results by using Rayleigh fading channel for alamouti transmit diversity methodology confirms that the Bit-Error-Rate(BER) decreases with respect to the Signal-to-Noise Ratio(SNR). As we know that space time processing which supports multiple antennas along with an appropriate methodology becomes an important powerful tool to improve the security issues of WLAN's. The future research issues in Wireless Local Area Networks offers Multiple Input Multiple Output(MIMO) technique which is planned for mobile networks using Wireless Local Area Networks[17][19]. A plot of capacity for different kinds of receive antennas is shown in Fig.4.

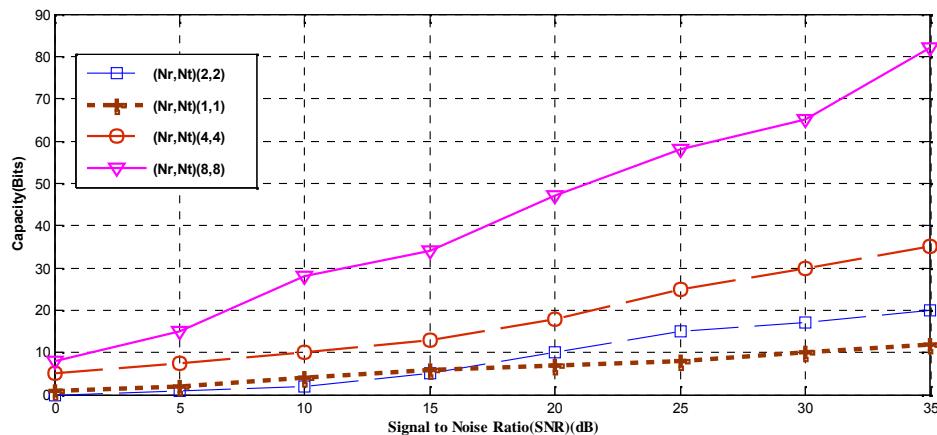


Fig.4. Capacity for various systems with $N_r=N_t$ receive antennas.

The Fig.4.briefly elaborates the capacity of different systems with $N_r=N_t$ receives antennas and it compares the signal to noise ratio for 0,5,10,15,20,25,30 and 35 decibels

with capacity of systems for 0,10,20,30,40,50,60,70,80 etc for 2 antennas,2 receivers,1 antenna,1 receiver,4 antennas and 4 receivers,8 antennas and 8 receivers.

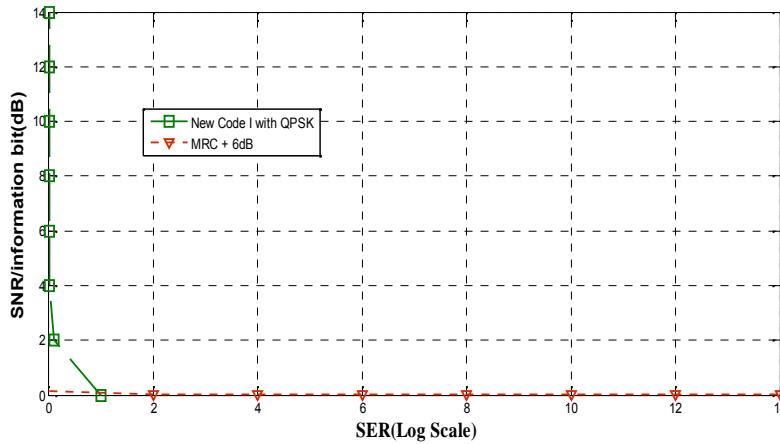


Fig.5.Performance of Maximal Ratio Combining(MRC) The figure-5 illustrates very briefly how to compute the performance issues of Maximal Ratio Combining vs QPSK non-linear orthogonal code with full diversity. Most simulations forward 2bits/sec/Hz with QPSK for 1 rate codes. Performance is also computed for MRC with Signal to Noise(SNR) normalized by a factor of 6dB($N_t=4$). The curve

and QPSK non linear orthogonal code with full diversity. specifies a performance aim analogous to MRC with Alamouti Code in two transmit antenna case.

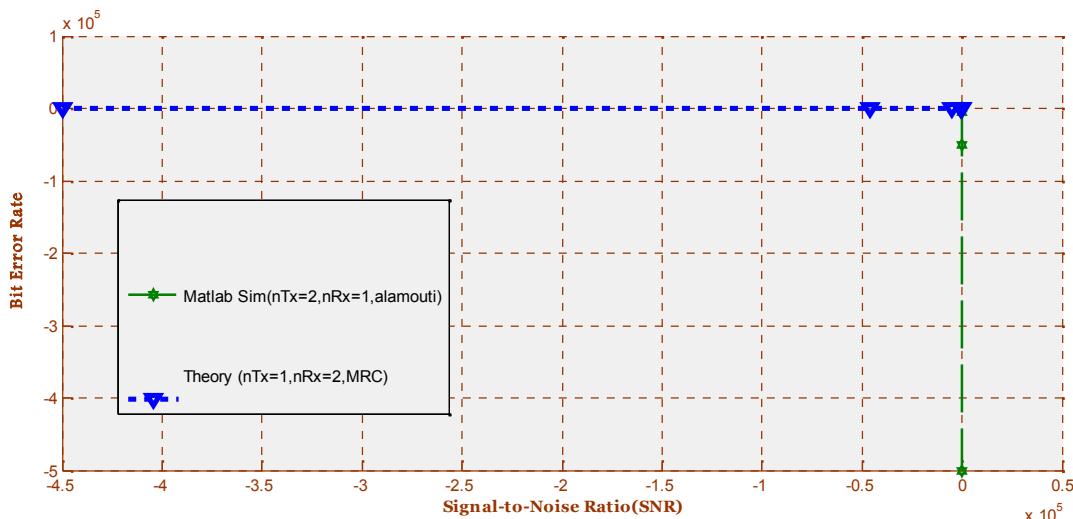


Fig.6.Performance comparison of Alamouti Scheme.

V. Epilogue and Future research issues.

In this research paper we have simulated the security issues of wlan's using space time processing based on alamouti code. This research also elaborates space time processing as a concept to implement the security issues of wlan's by presenting Alamouti technique. In this research work it also possible to increase number of antennas at both transmitter and receiver without using interference in between antennas is also one of the important technique to improve the security issues of WLAN's. This paper is also possible to extended for further research work by applying amplitude modulation,frequency modulation,phase keying modulation etc. in this research work manuscript we have simulated the research work result to improve security issues of WLAN's by increasing throughput and decreasing Bit-Error-Rate(BER).We have also decided to extend the proposed class-II non linear orthogonal code to more than four transmit antennas. We have already learnt that full rate delay optimal orthogonal codes are not square unless $N_t=2$. The process of constructing full rate non square orthogonal codes for $N_t > 2$ remains an interesting research challenge in WLAN's and Digital Signal Processing. In this research work also we have computed Performance of Maximal Ratio Combining(MRC) and QPSK non linear orthogonal code with full diversity and

also Capacity for various systems with $N_r=N_t$ receive antennas. Finally our research work proves and confirms that security issues of WLAN's are easily implemented by Space Time Processing of Digital Signal Processing(DSP) technique.

Acknowledgement

The **First author** would like to thank **Dr.Hanumanthappa J.**,Associate Professor,DoS in CS,Uni of Mysuru and Dr.Sheshadri.H.S,Retired Professor,E&C Dept,PES College of Engineering,Mandya,for his valuable guidance and helpful comments throughout writing of this journal paper. The author also would like to thank the all the reviewer's of this Journal paper.

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Intelligent Agents in Telecommunications.

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ABSTRACT

The underlying fabric for communication among intelligent agents will in many cases be provided by telecommunication networks. But telecommunication networks have been seen as a natural domain for the investigation and application of intelligent agents' technology as it emerged from the area of Distributed Artificial Intelligence (DAI). Telecommunication network administrations are vast organizations dedicated to operating and managing networks with broad functional segmentations: telephone network outside plant, switching and transmission plants, public network, all supporting different layers of specialized customer or service networks. These networks are organized into multiple physical and logical layers built with large quantities of repeated network elements and sub network structures. All these elements need to be configured, monitored, and controlled. In the future, this will preferably be done by automated operation support systems and without substantial human intervention.

Keywords

Distributed Artificial Intelligence (DAI), Telecommunication network administrations.

INTRODUCTION

The telecommunication networks have been seen as a natural domain for the investigation and application of intelligent agents' technology as it emerged from the area of Distributed Artificial Intelligence (DAI). Telecommunication network administrations are vast organizations dedicated to operating and managing networks with broad functional segmentations: telephone network outside plant, switching and transmission plants, public network, all supporting different layers of specialized customer or service networks. These networks are organized into multiple physical and logical layers built with large quantities of repeated network elements and sub network structures. All these elements need to be configured, monitored, and controlled. In the future, this will preferably be done by automated operation support systems and without substantial human intervention.

Although many recent efforts in applying DAI techniques have come from the telecommunications industry, the legacy information infrastructure that services interoperations in this industry has so far dampened immediate attempts at introducing DAI-based systems in the field. Consequently, the experimental DAI-based systems that have been developed for telecommunications have been primarily aimed at future networks and laboratory environments.

This paper presents a brief survey of recent efforts in applying DAI to telecommunications including some of our specific experiences with such applications. Applications and domain descriptions thus take precedence over focused analytical study of the corresponding agent systems and their theoretical justifications.

Our communication engineering and automated 'coarse-grained' co-operative agent perspective leads us to omit treatment of human-computer interaction themes, 'information agents,' etc. Thus, we do not consider here applications based on *mobile* agents and scripting languages such as offered by Java and TeleScript, which lack explicit support for co-operative behavior, even though these types of agents have received a lot of attention in the telecommunications domain over the last couple of years. This is not to say that this technology is not promising. In fact, the commercial application of mobile agents and scripting languages may be closer than that of intelligent, co-operative agents.

Overview of Distributed Artificial Intelligence (DAI) and Telecommunications

After providing the basic rationale for DAI and telecommunications, this section briefly surveys the field with a small classification that also serves to ground the bibliography.

Rationale for DAI in Telecommunications

Inherent distribution and interconnectedness of telecommunication networks and their constituent components provide the basic rationale for DAI approaches to the solution

of telecommunication problems. DAI approaches address a number of dimensions of this distribution:

1. Between physical network elements and logical network management layers, such as facility agents and customer agents in TEAM-CPS, e.g., (Appleby, 1994; Weihmayer, 1992).
2. Between information, knowledge, and capabilities belonging to different entities and roles in a telecommunication system and its environment, such as the service profiles of different users in the negotiating agents approach, e.g., (Griffeth, 1993b).

Distribution is not the only criterion for determining the relevance and appropriateness of application of DAI techniques. DAI can be rationalized in terms of performance, partitioning global information (privacy domains), and requirements for intelligent co-ordination and negotiation between the different agents (users, subscribers, service providers, network operators, etc.) of future telecommunication software infrastructures.

Broad Survey of Applications

DAI techniques have been applied to a wide range of different telecommunication problems. This is illustrated in Table 11.1. First, we recognize the following layering of telecommunication systems: the transmission and switching layer, the network control layer, and the service layer; second, we distinguish between the network development and maintenance tasks of network design, network management, and service management; and third, we single out process support, i.e., systems that support and automate (typical telecommunications) business processes.

We are aware of one application in the transmission and switching layer. Nishibe et al. have presented an approach to dynamically allocating channels in an ATM (asynchronous transfer mode) network.

We are aware of one application in the transmission and switching layer. Nishibe et al. have presented an approach to dynamically allocating channels in an ATM (asynchronous transfer mode) network.

Two applications focus on the network control layer: the work by Fleteher and Deen (Fleteher, 1994) on dynamic routing and congestion control; and some of the work by Weihmayer et al. (Weihmayer, 1993), on mediation between control wielded by public network provisioning systems and integrated private network management systems.

One application focuses on the service layer. This approach uses DAI techniques to mediate between preferences users may have for the behavior of a telecommunications system and as it is typically implemented by their subscribing to particular service features (Griffeth, 1993); This work

builds on an agent-based service execution environment on top of a network. This approach has since been adopted by various others (Busuoic, 1996; Rizzo, 1995; Zibman, 1996). A related approach uses mobile agent technology within the constraints of the Intelligent Network architecture to offer services in a fully deregulated environment (Magedanz, 1996). The work by Pujolle proposes to use DAI techniques to integrate standardized architectural concepts for the areas of service provisioning (in the service layer), service management, and network management.

Table 11.1. Telecommunication application areas

Process support (Huhns, 94)	Services & features (Gaïti, 93; Griffeth, 93; Magedanz, 96; Rizzo, 95; Zibman, 95)	Service management (Busuoic, 93; Gaïti, 93; Weihmayer, 92)
Network control (Fletcher, 94; Weihmayer, 93)	Network management (Adler, 89; Biron, 92; Conry, 91; Esfandiari, 96; Gaïti, 93; Garijo, 92; Gyires, 96; Rao, 90; Reilly, 96; Silver, 93; Skarmaes, 96; So, 92; Somers, 96; Sugawara, 92)	
Transmission & switching (Nishibe, 93)	Network design (Lirov, 91; Liempd, 90)	

Service management is furthermore addressed by Weihmayer et al. (Weihmayer et al, 1992) and Griffiths and Whitney in their applications of DAI to distributed service provisioning among service maintenance agents and customer agents.

Network management is the most frequently addressed application area. Three of the more advanced applications in this group are described in more detail in Section 11.3. In network management, a distinction can be made between the traditional network management functions: configuration management, fault management, accounting management, performance management, and security management. Not all of these functions have been addressed by DAI approaches: accounting and security management are, as yet, uncharted grounds, although Reilly has studied in particular the security aspects involved in extending TMN-based network management systems with mobile agent technology.

In several cases, one system combines more than one functionality, e.g., fault and performance management, but most approaches focus on fault management. We mention:

Work on the Multistage Negotiation protocol developed with the task of restoring transmission paths in telecommunication networks in mind (Conry, 1991);

Two applications are mentioned in the literature for network design: one by Lirov and Melamed (1991) where loosely coupled expert systems perform sub-sequent tasks in finding an optimal network configuration; and one by van Liempd et al. (1990) where blackboard-based nodes are used to configure sections of network connections spanning multiple administrative domains.

The last application referenced in Table 11.1 addresses a process support task which is particular to telecommunications, requiring co-ordination among many operations support and database systems.

Several activities studying the application of DAI techniques to telecommunications have abstracted from particular network architectures workflow management for support of provisioning of digital telecommunications services, but others address a particular type of network. TCPIIP-based LANs have been used in a number of applications (So, 1992; Sugawara, 1992), probably because this type of network is readily accessible for experimentation in many research organizations. One application looked at network configuration of a leased-line corporate network (Liempd, 1990). The work by Weihmayer et al. addressed the interplay between a virtual corporate networks implemented over a voice/data PBX network with public TI links (Weihmayer, 1992). The MAITE system was targeted at a network of 800 interconnected PBXs (Garijo, 1992). In (Nishibe et al., 1993), Nishibe et al. describe an application for the ATM network concept.

Present-day public telephony networks have not been the subject of detailed study according to our survey.

DAI Techniques.

It may be too early, given how few implementation efforts we have found, to begin a classification according to DAI techniques used. We found that a few well-established DAI techniques are mostly referred to in current applications to telecommunications, for example: blackboard systems in (Adler, 1989; Garijo, 1992; Liempd, 1990); the Contract Net Protocol in (Biron, 1992; So, 1992).. Most other references use specialized representations or algorithms for such aspects as agent architecture and organization, negotiation and co-ordination, planning, etc.

Overview of Four Applications

The significance of the four DAI applications presented in this section lies in the range of DAI techniques used, the underlying domain analysis, and the extent of experimentation work.

'Distributed Big Brother': Campus Network Management

'Big Brother' is a centralized LAN manager operating at the University of Michigan's Computer Aided Engineering Network (CAEN). 'Distributed Big Brother' (DBB) is a research test bed built at CAEN to investigate higher performance and more robust LAN management techniques using a combination of a number of DAI techniques.

The specific domain under consideration is management of campus-level LAN inter connect systems, i.e., multiple LANs connected with bridges, routers, gate-ways, etc., (spanning less than 10 miles) without intervening WAN. The target functionality is system support, specifically for fault management (So, 1992)

The operational requirements for DBB include maintaining a centralized view of network fault management, improving the robustness of network management processing, and increasing its performance and parallelism. Individual LAN segments and local subnets are loosely coupled in this domain but interdependent inasmuch as they share components, e.g., multiport bridges, and as decisions regarding these components have impact across subnet boundaries. In DBB, those are the entities across which distribution takes place.

The rationale for a DAI approach is to manage a distributed set of homogeneous LAN managers as a dynamically self-reconfigurable organization driven by fault conditions in the campus LAN network. This organization is hierarchical because centralized control remains embodied in a root management agent that maintains a global network view but operates under a delegation of authority scheme to manage distributed manager agents. The intelligence of co-operative agents is thus geared toward maintaining this organization, through organization structuring and hierarchical control; performing load management, e.g., which agents manage what entities in the network; as well as contracting and voting to distribute roles.

DBB agents are fairly large and complex entities loosely coupled in their activities. No single DBB agent, regardless of organizational role or position in the hierarchy, can be a single point of failure. DBB uses the Contract Net Protocol to announce, bid on, and award roles and tasks. Hierarchical control is applied within the context of election procedures, with simple rules to designate agents that officiate election to network management roles.

Agents are structured as interacting communication, contracting, and task processes. They use control problem solving and domain problem solving message types. DBB agents are homogeneous and are implemented as UNIX processes in their host workstation. An internal rule base specializes agent behavior based on dynamically assigned

roles. Inter-agent communication occurs 'in-band' using UDP over the TCPIIP LANs managed by DBB.

Customer Network Control and TEAM-CPS

TEAM-CPS (Testbed Environment for Autonomous Multi-agent Co-operative Problem Solving; Tan, 1992; Weihmayer, 1992) evolved from a number of communication domains, each requiring distributed problem solving among geographically and functionally distributed problem solvers performing inter-dependent planning tasks. An industry perspective on this effort is provided in (Mantelman, 1990).

Customer networks are integrated voice/data networks in which switching and transmission facilities can be owned by the customer and/or leased from the public network. A distributed co-operative agent-based architecture for customer network control was developed. Facility provisioning in the public network is assigned to a computer system with the ability to satisfy real-time demand for circuit addition and deletion requests from multiple customer network systems. This is the physical network layer, in contrast to the logical customer network layer.

The DAI approach to this problem models the joint problem solving and co-ordination that the respective network managers go through in resource constrained situations where compromise solutions need to be found to partially or fully restore failed circuits. The problem solvers are by necessity distinct and heterogeneous; the customer manages his logical network layer, which is functionally separated and involves private data and proprietary operations on services, traffic, and usage; the same applies to the public network, which delivers a complex service using a distinct and private infrastructure in a competitive environment. The local problem solving required is in both cases complex and knowledge intensive, and integrates lots of information, e.g., fault management, trunk network design, and provisioning in the public network; and traffic, service, session, and configuration control in the customer network.

TEAM-CPS evolved as a framework for building co-operative agents that are heterogeneous at the domain problem solving level but for which common agent control abstractions can be applied to co-ordinate their problem solving behavior. Customer and public network agents share agent control and problem solving mechanisms but can be endowed with different domain models for planning and problem solving as well as different control policies, represented as rules in agent programs. The TEAM-CPS framework integrates Agent-Oriented Programming (AOP) and classical AI planning as the 'head' and 'body,' respectively, of problem solving agents.

A more flexible and general agent control structure was needed to model plan interactions using higher level knowledge and to deal with pragmatic issues in managing

compromise and query dialogues among the agents. Agent-Oriented Programming (Shoham, 1993) is a framework that integrates agent control and communication. In AOP, agents have persistent mental states that use techniques of modal and temporal logic to represent agent beliefs and commitments to other agents. Speech-act models of communication are used to support simple communication to inform, request, and commit about actions.

TEAM-CPS integrates this form of agent control with planning-based problem solving by providing common representation of world states in planning and belief in agent mental states. Agent programs are constructed with simple heuristics to generate proposals and counterproposals. Co-ordination in systems of up to three agents was studied.

LODES: Distributed TCPIIP Fault Management

LODES (Large-internet Observation and Diagnostic Expert System) are an expert system for detecting and diagnosing problems in a segment of a local area network (Sugawara, 1992). Different LODES system copies, or instances, can monitor and manage different network segments. LODES is designed in such a way that LODES instances co-operate with each other as agents of a multi-agent system. Co-operation is necessary when it is not clear in which segment the cause of a problem is located, when a problem occurs in a part of the network monitored by more than one LODES agent, or when one agent needs additional information from another agent to perform its own tasks.

LODES were developed for TCPIIP local area networks (LANs) that consist of several constituent networks connected through routers. Each constituent network has its own LODES diagnostic system. LODES address connection establishment problems due to unintentional disconnections, slow transmission, and net-work congestion which arise in such networks.

An expert system approach was taken to overcome these difficulties in the diagnostic task. Furthermore, a distributed approach was chosen over a centralized approach to reflect natural physical and functional distribution of net-works, to localize private information, such as passwords, within the boundaries of separate administrative domains, and to increase performance.

The LODES system was primarily developed as a research testbed; however, the system has been tried on real equipment and laboratory-configured networks with some success.

Feature Interaction and the Negotiating Agents Approach

The negotiating agents approach was developed to detect and resolve certain kinds of feature interactions that occur in telecommunications systems (Griffeth, 1993). Features in a

telecommunications system provide packages of added functionality to basic communication services (e.g., call-forwarding and caller-ID). The operation of one feature may influence that of another feature. Sometimes such influences, called feature interactions, are intended. However, at other times, these interactions can be unexpected and undesired and need to be detected and resolved.

Features are a way for subscribers to tailor their use of telecommunications services to their specific needs and intentions. However, different parties to a call may have different needs and intentions, which lead to conflicts between the intentions and, analogously, to interactions between the corresponding features.

The negotiating agents approach recognizes that a significant sub set of feature interactions are the result of conflicting intentions of different subscribers, who are not necessarily party to the same call. These conflicts may arise over which medium and protocol to use for a call, over the use of shared resources such as terminals and bridges, over what information can be transmitted as part of a call, etc.

The negotiating agents approach uses an agent for each entity that may have an interest in how calls are set up and conducted in a telecommunications system (users, network providers, information providers, etc.). An agent is given information about the intentions of its owning entity and negotiates with other agents to detect and resolve conflicts. The negotiation mechanism was specifically designed for this application to search for win-win solutions and to deal with agents that are not prepared to disclose too much about their preferences. A DAI approach was chosen to separate user preferences and to build on DAI expertise in the area of automated negotiation processes.

The negotiating agents approach has been implemented and tested on top of a multimedia desktop conferencing research prototype.

DAI and Telecommunications: Where Do We Stand?

Although quite a bit of industrial activity in applying DAI technology to real-world domains has been in telecommunications (Bond, 1992; Durfee, 1991; Jennings, 1994), there are currently no fielded DAI systems in public or private telecommunications. We discuss the issues that have hindered the emergence of fielded DAI systems in telecommunications so far and paint a direction in which we expect real-world applications to come about in the next few years.

Problems with DAI Approaches

There are several reasons why DAI systems are slow to be fielded in mainstream telecommunication systems in spite of the clear rationale and need for their introduction.

One reason is the absence of adequate infrastructure for autonomous agent-based control in present-day communication systems. Another is that the modernization of public networks is a relatively slow process because backward compatibility must be maintained to meet high reliability and availability requirements. DAI adds distribution to the complexity of AI and may thus still be seen as too high a risk.

The technology is still emerging and is only beginning to provide a solid foundation, principled practices, and engineering methodologies required to produce mainstream applications. We note that the basic approach in all four examples in Section 11.3 was to consider a problem for which a co-operative agent solution appears to be the best approach and where there is no 'legacy' system to integrate. Such an approach is suitable for proof-of-concept experimentation and allows a co-operative solution to be built from the ground up. However, it is not conducive to fielded systems. We believe that DAI-based systems will appear along a different path.

Actually, the penetration of expert systems may offer a good predictor for the emergence of DAI-based applications. Good opportunities for the success of DAI in telecommunications will be in network management and operations support for public and private networks. Expert systems are slowly penetrating those areas. Our thesis is that they will provide the intelligent systems infrastructure and potentially the agents of future co-operative systems. Of course, many different AI and reasoning paradigms, not just rule-based reasoning, will provide the intelligence substrate for those mainstream expert systems. In this perspective, we consider the emergence of communication and knowledge sharing between these systems as requiring a DAI technology base that goes beyond basic co-ordination among rule-based inference engines and their knowledge bases.

The Road to Fielded Applications: An Example

Here is an example that illustrates how we believe that fielded DAI applications will emerge in telecommunications. A recent survey (Goyal, 1994) provides information on expert system deployment in various telecommunication domains. One such system, SSCFI (Special Service Circuit Fault Isolation; Goyal, 1994) is an example of advanced deployment of geographically distributed local intelligence.

It is an expert system that is currently being deployed in all the GTE telephone companies in the United States. It functions as an expert test technician that reads and interprets trouble reports on special service circuits; decides to conduct tests and interpret the results of those tests, using in the process a number of remote test and database systems; and, formally, routes the report to the appropriate repair group with the results of its analysis. The first important feature of SSCFI for this discussion is its autonomy. Besides a minimal administrative interface, SSCFI processes operate in the

background and have full control over the trouble report queues to which they are initially assigned. SSCFIs are, in a sense, our model of practical, narrow, but intelligent autonomous systems performing their tasks without direct human operational control. These tasks are not to present information to people, but to act within the context of a workflow system where field repair crews are at the receiving end.

The current evolution of SSCFI is pointing toward some form of homogeneous multi-agent task allocation system involving SSCFIs throughout the GTE regions. SSCFIs need fast local access to all the OSSs, database resources, test systems, and test points involved in testing circuits. To maximize throughput, these resources are locally available on their LANs. SSCFIs can do simple load balancing by spawning child processes to jointly handle test loads. The spawning is constrained by the availability of computing resources. DAI begins to come into the picture as load sharing at a national level between all SSCFIs is being considered to exploit time zone differences and sharing of computing resources across regions. Some ideas under discussion include using contracting schemes to have a local SSCFI request other SSCFIs to accept responsibility for testing circuits along with remote control of the resources required to perform those tests and to negotiate the conditions under which this is done.

Conclusion

The notion of intelligent agents is certainly quite pervasive today. A special issue of *Communications of the ACM* (ACM, 1994) shows how intelligent agents are being promoted as the basic building blocks of information systems. If agents are coming, co-operative agents cannot be far.

In telecommunications, requirements for intelligent agents are even more immediate especially since telecommunication networks are canonical distributed systems.

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An Intelligent Electronic Patient Record Management System (IEPRMS).

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ABSTRACT

Recent research states that using new and emerging technologies in the areas of telecommunications are widely used in healthcare sector. The system Intelligent Electronic Patient Record Management System (IEPRMS) is a centralized database contains the in-patient record. It was implemented using PHP & MYSQL combination. The database record contains the patient personal info, department lies-in, physician, tours, treatment and lab results. Since the patient enters the hospital the workflow starts as the reception user creates new record by entering the personal info and sends the record to assigned department; at this stage the nurse starts update the record by entering the physician comments, required treatment, and sends lab test when it is required. The procedure continues as long as the patient still in the hospital. At last when the patient recovered or died the International Classification of Diseases(ICD) inserted to the record and out or died date. In addition there are many supported tables that can be updated manually through independent pages by IT administrator. These tables like Physician names, medicines, lab tests, users and ICDs. As the system consists of different users and different user permissions. Also there are advance search that can help to make statistical reports and researches for the physicians. The system is considered time and cost effective to healthcare.

Keywords

Intelligent Electronic Patient Record Management System
(IEPRMS), multi-agent systems, artificial intelligence

Introduction

In the last decade the emerging technologies in Information and Communication technologies lead to very big advances in services for community, especially in healthcare sector. Generally, there are three types of medical care services which are: in-patient (i.e. hospitals), out-patient (i.e. clinics) and emergency. For in-patient hospitals there are two different

types: specialized hospitals (GIT Centers, Cardiac Centers, Cancer Centers, etc.), and general hospitals. However in Iraq, the first type is newly introduced, but the latter is already exist. As the hospitals are considered essential in healthcare infrastructure, so we choose it to enhance the services in it. The implemented system (IEPRMS) is the first system in Iraq (in general hospitals) which is work as database and workflow. It is helpful for management, patient health, research, and archiving. In management, it could be used for hospital director to see the performance of the physician, or statistical reporting. Also the physician can have the patient history in details from his previous records with less time. The physician can make their researches by using the advance search. Archiving and securing electronic records considered more reliable and trusted than paper-based records.

1.1 Aims and functionalities of system

The aim of this system is to design and implement a system which supports health care providers by its capabilities on treat the status of an in-patient to the hospital as shown in figure [1.1].

Functionalities of IEPRMS are:

- Efficiency and Reliability: dependability and Consistency execute the required functions of software.
- The possibility of developing a report for each patient case in hospital.
- Saves time with the system of EPRMS.
- To reduce health care costs.
- A secure database will be created by using MySQL according to the system needs.
- Reduce maintenance costs: maintenance costs will be reduced by a higher level language with easier database connection.



Figure 1.1: System architecture for IEPRMS

1.2 Project Scope

The scope of this system is to build a reliable web-based IEPRMS as shown in Figure 1.2. The current system is used to illustrate store patients information electronically rather working as a complete workflow[1].

However, requirements for implementing a public health approach to electronic patient record include long-term planning, targeting patients for improved care, and goal setting for outcomes of care [2] ,[3]. EPRMS has five users which were identified as: reception user, physician, nurse, lab user and admin and each one has collection of functions inside system. The reception user has the ability to register, login in and login out, add patient, search and, update / edit while the nurse is able to register, login in login out, and add tours (morning/ evening) physician comments, add medicine for each patient, request lab test, and search. The lab user has the ability to register, login in, login out, and add lab result. The physician is able to register, login in, login out, and search.

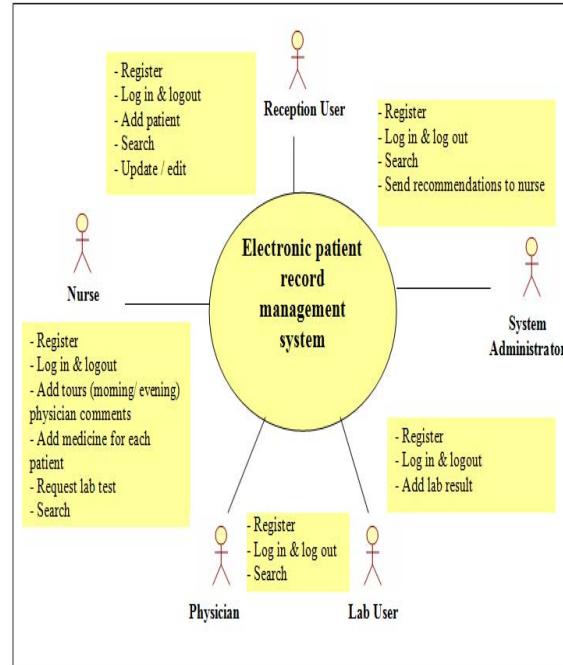


Figure 1.2: Scope of IEPRMS

2 System Method

The methodology which will be used during the design of the EPRMS and the analysis of system requirements will be discussed in details through this section. The system development lifecycle was divided into phases:

2.1 Data Flow Diagrams

One of the most widely used system analysis process models is the data flow diagram. A Data Flow Diagram (DFD) is a tool that depicts the flow of data through a system and the work or processing performed by that system. It is used to help understand the current system and to represent the required system. The diagrams represent the external bodies sending and receiving information [4].

2.2 Unstructured Interview

It is essential to success any system is to understand its requirements. In EPRMS, we had an interview with the health care providers such as physician, nurse and statisits department for gathering rich information about system requirements to design and build this system.

2.3 System Requirements Analysis

Requirement is a service that the user desires the solution to perform or display. These requirements should be flexible according to the system needs. However, it is necessary to understand both functional and non-functional requirements through the lifecycle of EPRMS [5].

Functional Requirements (FR)

These requirements are described as set of system requirements, such as:

- Add new patient record.
- The system sends patient record to the nurse to add a new patient.
- The system enables the nurse to search about specify patient.
- Archiving patient record electronically and centrally.
- The system enables the nurse to request a specific lab test.
- The system has ability to send lab results back to nurse or physician.
- The system enables the nurse or physician to search & research. Table 2-1 shows one of the functional requirements of EPRMS.
- The system enables the physician to check patient history by searching it easily.
- The system enables the reception user to close the record by entering the ICD, patient status and outdate.

Table 2-1: FR: Add new patient record

Descriptions	The system must allow the reception user to create new patient record
Rationale	The system enables the reception user to create new patient record which Includes the personal information of patient such as: name, address, contact info,...etc.

Non functional requirements

There are many non functional requirements of the EPRMS like updateable, security, compatibility, capacity, usability and maintainability, performance with database, for example the system interactive with database immediately as under a second, database searches, updates and retrieval the change to patient information must be fast.

2.4 Users Analysis

Five users were identified in EPRMS who are: physician, nurse, lab user, reception user and admin. Table: 2-2 illustrates role of one user[6].

Table: 2-2: Role of nurse user

User:	Nurse
Role:	<ul style="list-style-type: none"> ○ The nurse will access the system and update the morning and evening tours for the inpatients according to physician comments. ○ The nurse can send lab test request to Lab department. ○ The nurse can update the given pharmaciticulas that given to each patient.

3.1 System Design

At the design stage beings the decision-making on how to build and operate the system. On the other words, its purpose is to create a technical solution which satisfies the system functional requirements [7]. However Use Case Model [8], and Use Case Text were used to design the EPRMS.

Use Cases Model allows the definition of the system's boundary, and the relationship between the system and outside of the system [9]. In EPRMS, there are five users in the use case diagram. Each one has many functions in the system as shown in figure 3.1 while Use Case Specification /Text describes the functionality of the system counting event trigger and expected outputs.

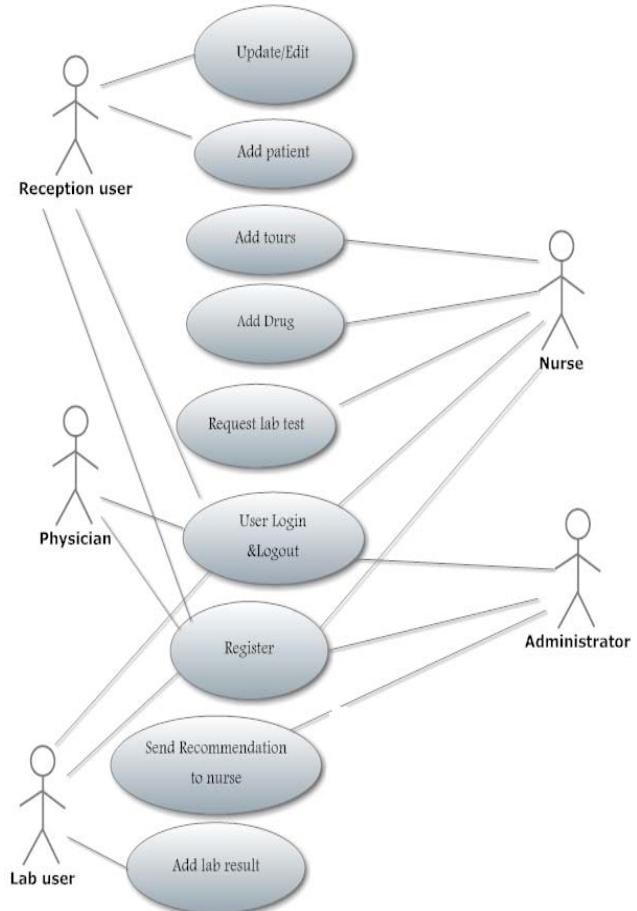


Figure (3.1): user's functions

In IEPRMS, the methodology of database design includes three main phases: conceptual, logical and physical design [10].

In IEPRMS, the conceptual design describes the relation and the connectivity between all components of the system.

While the logical data model which driven by the conceptual data model. It consists of specified classes that will become tables like:patient,tour,treatment,lab result,ICD,physicians,medicine,labtestlist, and users,while their attributes became fields, and the associations became relationships.

Lastly, the final phase in the database design of IEPRMS is to translate the logical database into a physical database. It will specify the system usability for instance screen layout.

3.3 System implementation tools

In IEPRMS, MySQL database was implemented in the design of system database, while PhpMyAdmin was used to create the database and wampserver, WAMP (Windows Apache MySQL PHP). The WAMP and MySQL use to manage database [11].

4 System Results

Partial of the results which produced during the EPRMS will be showed:

After the log in for the Administrator (IT or hospital manager), they can view the current in-patients (Statistical No., Name, Department, Hall, ICD)and can browse their used medicine and their physician comments .

5 System Testing and Future Work

5.1 System Testing

Usability testing is a technique used to evaluate the system; it is focused on how the users interact with the front end of the system. However user acceptance testing considers the final step before the end of the system.

In EPRMS the User Acceptance Testing was applied to validate that the system meets [12]. The final users in this testing were given a set of activities to follow in order to test the system. However if a new user with no previous knowledge was able to use the system tasks with simplicity then this would confirm a success. After this test, we found that diverse activities were user friendly.

However the hospital nominates two staff from each department to take training on the system. The training period was one week. Twenty percent of the nominees were familiar with windows operating system and internet browsing. The others have no interest or interaction with computers. After the training they find the software user friendly and they were able to use windows and browse internet.

5.2 Future Work

The future improvements to this project by adding the additional functionalities to EPRMS:

- ✓ Improve navigation of web.
- ✓ Add more detailed tour fields like (blood pressure, blood sugar, heart rate, etc).
- ✓ Add imaging related tables like (CT Scan images, MRI Images, etc).
- ✓ Connect the used medicine for the in-patient with the whole Pharmacy inventory.

6 Conclusion

This research has been presented the design and implementation of Intelligent Electornic Patient Record Management System (IEPRMS). Which is a centralized DB contains the in-patient record. The aim of this work was to provide reliable healthcare web-based system. It is enhance the provided services to patients by making their records available online and everywhere for physician to follow up the case easily with less effort, and their history would be available also. Hospital director and heads of departments can follow the physician work related to patients from diagnosis and follow up.

Securing and archiving the paper-based records is difficult and it can be stolen, burned or modified, so the need for such a system was very essential. Also it is considered time and cost effective to healthcare.

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A Novel Agent Oriented Methodology – Styx Methodology

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ABSTRACT

Agent-oriented software engineering is a promising new approach to software engineering that uses the notion of an agent as the primary entity of abstraction. The development of methodologies for agent-oriented software engineering is an area that is currently receiving much attention, there have been several agent-oriented methodologies proposed recently and survey papers are starting to appear. However the authors feel that there is still much work necessary in this area; current methodologies can be improved upon. This paper presents a new methodology, the Styx Agent Methodology, which guides the development of collaborative agent systems from the analysis phase through to system implementation and maintenance. A distinguishing feature of Styx is that it covers a wider range of software development life-cycle activities than do other recently proposed agent-oriented methodologies. The key areas covered by this methodology are the specification of communication concepts, inter-agent communication and each agent's behaviour activation—but it does not address the development of application-specific parts of a system. It will be supported by a software tool which is currently in development.

Keywords

Agent-based software engineering, methodologies for agent-oriented software development.

1. INTRODUCTION

Agent-oriented software engineering (AOSE) is a promising new approach to software engineering that uses the notion of an agent as the primary entity of abstraction. The agent-oriented approach is rapidly emerging as a powerful paradigm for designing and developing complex software systems. AOSE researchers hope that the use of the agent abstraction will provide a significant improvement to current software engineering practice, similar to the improvements gained from structured programming, the object-oriented approach and design patterns.

The development of methodologies for AOSE is an area that is currently receiving much attention, there have been several agent-oriented methodologies proposed recently (Elammarri and Lalonde) and survey papers are starting to appear (Iglesias et all). However there is still much scope for work in this area and the authors believe that the agent-oriented methodologies proposed so far can be improved. The rest of this paper is structured as follows, the new ideas that Styx introduces are discussed in section 2 and the scope of Styx is outlined in section 3. The Styx Agent Methodology itself is presented in section 4 and it is compared to other methodologies in section 5. Future work is discussed in section 6 and conclusions are drawn in section 7.

Towards a Novel Methodology

Software development has been identified as a difficult task, software has a high inherent complexity and its abstract, intangible nature adds further difficulties .Over the past two decades research in software engineering has improved the software development process significantly, nevertheless, many software projects are still late or over-budget. A key idea that has emerged from software engineering research is the use of software development methodologies, which are a set of procedures and methods to guide the software development process. The goal of developing and using such methodologies is to change software development from an ad-hoc practice to a well-structured engineering process that produces high-quality software within the constraints of limited resources and adhering to a predicted schedule.

Recent commercial systems have demonstrated that AOSE is potentially a powerful new software engineering paradigm. However these systems have been developed without the support of agent-oriented methodologies; current methodologies are yet to be widely adopted and may not have been sufficiently mature to be useful in the development

of these applications. For agent-oriented software engineering to become a widely accepted practice, as many agent researchers predict it will, it is important that mature tools and methodologies are developed.

Several agent-oriented methodologies have been recently described; High Level and Intermediate Models, Gaia, the ZEUS Methodology and Multiagent Systems Engineering. All of these offer approaches to the analysis and design of agent-oriented software systems. Ideas introduced in these methodologies have been drawn upon in the development of Styx, however there are several new ideas that distinguish Styx from those previously presented in the literature.

Styx covers a wider range of software development life-cycle activities than other methodologies, providing not only analysis and design models but also skeleton source-code for the implementation phase and support for the maintenance phase. It is designed so that a software tool can automate the transformations between analysis-level and design-level models and automatically generate skeleton source-code from the design-level models. This software tool will also informally verify the development process. Domain concepts that will be used in communication between agents are modeled at the analysis level, allowing a more complete model of inter-agent communication at the design level. Styx also utilizes the interaction protocols specified by the Foundation for Intelligent Physical Agents (FIPA) in order to support inter-agent communication.

2.1 Covering the Software Life Cycle

It is customary in the software engineering literature to prescribe a number of phases that constitute 'the software development life cycle'; an example is given in table 1. The software development life cycle covers the entire life of a software system, starting from gathering the initial requirements for the system, building models of the system, implementing and finally maintaining the system.

Current work on agent-oriented methodologies typically does not cover all phases of the software development life cycle. The first phase, gathering requirements, does not significantly change for agent-oriented software projects. Techniques for requirements gathering already exist, for example formalized specifications, use cases or user stories. These are generally not developed further for the agent-oriented approach. Note however that the requirements are interpreted using agent-oriented concepts in the analysis phase.

The analysis and design of agent-oriented systems is significantly different from analysis and de-sign of other types of software systems. Although

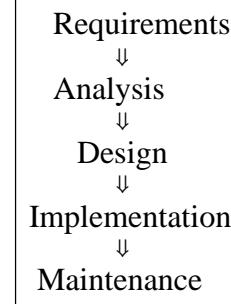


Table 1: A typical software development life cycle

Tools are often borrowed from object-oriented approaches; there are many differences between agents and objects that must be considered. This phase has received the most attention from agent-oriented methodology researchers and it forms a substantial part of the Styx methodology.

Implementation The implementation phase has received less attention; it is not supported in the methodologies reviewed in this paper. Since these methodologies are intended to be useful over a wide range of agent types and there are so many different types of agents, it is difficult for a methodology to be both widely applicable and also support the implementation phase.

To address this issue Styx introduces the idea of an abstract agent specification language. This is to be a text based language that is sufficiently generic that it can be mapped to a large proportion of agent-oriented software development frame-works and toolkits. In the ideal case these map-pings would be performed automatically, however in the case that an unsupported framework or toolkit is used a mapping could be achieved by hand or a new automatic mapping be developed.

The implementation phase of the software development life-cycle involves transforming the set of design level models into an executable implementation defined in some programming language. Supposing the ideal case, providing automated support for this phase would involve some form of automatic programming. However this is not generally feasible because including enough information in the design level models for a program to be automatically generated would make the design phase far too complex. To ensure that it remains focused on the task at hand, Styx does not attempt to provide support for developing application-specific parts of a system, but rather focuses solely on the agent-oriented aspects. The authors believe that the implementation phase can be best supported by providing a skeleton implementation of the agent-based aspects of a software system, leaving pro-

grammars to focus on the application-specific aspects of their system. Note that the generation of this skeleton implementation would be a two-step process; firstly the design models would be mapped into the abstract agent specification language, and then the abstract specification would be mapped to a particular implementation language, toolkit or platform.

Automatically generating such a skeleton implementation directly from the design-level models would require that they contain a sufficient amount of information about how the individual agents are structured and how they will behave. The Internal Agent Model and Conversation Model of the High Level and Intermediate Models methodology and the Services Model of the Gaia methodology all provide a table that loosely resembles a finite state machine. The authors believe that it would be feasible to automatically transform models such as these to some skeleton implementation.

Maintenance The longest phase of the software development life cycle is usually the maintenance phase. A well-documented development process is important for maintenance. However aside from providing such documentation there has been no support for maintenance in existing methodologies.

Documents outlining the analysis and design phases of system development form an important part of the support offered by Styx for the maintenance phase, as is true of other methodologies. However the skeleton source code generation proposed in the previous paragraph provides an additional area in which the maintenance phase needs to be supported. During a system's lifetime changes may be made to the analysis and design models, as it is likely that requirements will change over time and thus require modifications to these models. Styx provides a source-code skeleton to support the implementation phase, which is generated from these analysis and design models. Now since these models will change over the lifetime of the system it is important that the methodology provides some way of updating the implementation skeleton in response to such changes. Simply regenerating this skeleton would not provide sufficient support for this, as the skeleton will be fleshed out with application specific code during implementation. Thus an important feature of the proposed methodology is to be able not only to generate these skeletons but also to be able to update them with the application specific code in place.

2.2 Designing for Automation

Several parts of the High Level and Intermediate Models methodology appear to be partially automatable, however the authors believe that a methodology designed specifically to

be supported by computer software could be more automatable, especially by providing automatic techniques for the transformation between the design and implementation phases. A key feature of Styx is the software tool that supports this methodology.

Note that automatic programming is not the goal of this methodology; application specific aspects will be left to the designers of each system. This tool will provide support for drawing the various graphical models in the methodology, generate and maintain skeleton design models and skeleton implementation source code, and perform informal validation of the development process.

2.3 Roles as Agent Classes

Strength of the object-oriented paradigm is the ability to specify reusable classes of objects, rather than specifying individual objects, which promotes reusability and modularity. The Gaia methodology, as well as other work, uses roles in a similar manner for agent-based systems. Developing with roles means that one agent may be able to play several roles, or a single role may be played by more than one agent. Styx is strongly oriented towards developing reusable roles that are later used for the construction of agents.

2.4 Specifying Agent Message Content

It is non-trivial to develop a mapping between the content of agent communication language messages and the objects that the application specific parts of the system will work with. Neither of the methodologies proposed here address the specification of the content of agent message, however this has been included in the ZEUS methodology.

Styx incorporates a model at the analysis level which specifies the possible content of agent messages. This model uses the class diagram syntax of the Unified Modelling Language (UML). UML class diagrams have been chosen because they are a well-known modelling representation, and because of the increasing usage of the object-oriented paradigm in the professional software development community, both for application-specific coding and also for agent development toolkits and frameworks. Modelling message content as object classes makes the conceptual gap between application specific code and the content of agent communication language messages smaller. This idea draws upon recently published work.

2.5 Reusing FIPA Interaction Proto-cols

Current agent-oriented methodologies either do not specify the conversations that will occur between agents in detail (for example Gaia), or otherwise expect that the system designers will invent new conversation protocols for each agent system (for example High Level and Intermediate Models and MaSE). Specifying agent conversations is an important part of a design methodology that seeks to support the implementation phase, however it seems that reinventing conversation protocols for each agent system is often unnecessary. Styx will incorporate the specification of conversation protocols at the design level, but will draw these from

a well-known pool—the interaction protocols introduced in the forthcoming FIPA 2000 specifications

These cover a wide range of possible inter-agent interactions, from simple Request and Query protocols, to more complex Dutch Auction and Iterated Contract Net protocols. Although the complete documentation for these is not yet available, nevertheless based on the strength of previous versions of the FIPA interaction protocol specifications and on the wide range of proposed protocols the authors believe that these protocols will form a sound basis upon which to build this part of the methodology. Note that reusing these protocols does not restrict Styx to agent systems that are based on the FIPA specifications because, with some slight modification, the protocols could be used with different standards for message passing that exist in other types of agent system.

3 Scope of the Styx Agent Methodology

Styx is intended to be used in the development of collaborative agent systems. These are systems which tend to use static, coarse-grained agents and are typically used to solve problems more efficiently than a single centralised system. Problems may exceed the capabilities of a single centralised system because of resource limitations, the need to interoperate with multiple legacy systems or because a problem is inherently distributed, for example distributed sensor networks, distributed data sources, or distributed expertise.

Styx does not consider systems that contain a large number of roles—it is envisioned that applying Styx to a system that has significantly more than about twenty to thirty different roles would result in the analysis level models becoming too complex to give a clear, high-level overview of the system. However there is little restriction on how many agents can be instantiated from the roles defined from

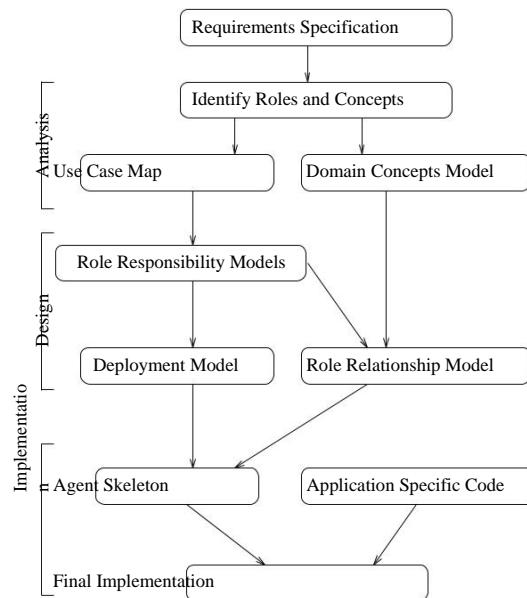


Figure 1: Overview of the Styx Agent Methodology

Styx, for example a system may contain hundreds of telephone agents instantiated from a single role.

It is assumed that agent systems developed using Styx will be implemented using some agent development toolkit or framework that is based on an object-oriented language³ and that application specific code will also be developed in the same object-oriented language.

Such notions as planning, scheduling, mobility and learning, which are commonly associated with agent systems, are not explicitly handled by Styx. It is assumed that support for these things would be provided either by the agent development toolkit or framework, or that they would be included by-hand in the application-specific parts of the system.

4 Overview of the Styx Agent Methodology

A schematic overview of Styx is presented in figure 1. Styx is briefly summarised in the next paragraph, and more complete descriptions of each part of the methodology are given in sections 4.1 to 4.6 with reference to a simple fruit-market scenario.

The analysis phase starts by identifying agent roles and domain concepts, followed by generating a high-level Use Case Map, which gives an overview of the entire system, and a Domain Concepts Model, which specifies what concepts will be used in the communication between agents. In the design phase Role Responsibility Models are generated for each component of the Use Case Map,

where each responsibility of a component is specified in more detail. The Role Relationship Model specifies how roles are related to each other and the concepts about which they will communicate. The Deployment Model maps the roles identified in the Use Case Map to agents. The implementation phase is supported by an Agent Skeleton and together with application specific code this forms the final implementation. Although it is not shown in the figure the maintenance phase will be supported by both the models detailed so far and also by changes in the analysis and design models being reflected in the implementation skeletons.

Fruit-Market Scenario A simple multi-agent fruit-market scenario will be used to demonstrate the proposed methodology. This involves buyers and sellers of fruit in an electronic marketplace. A seller can notify the marketplace that some fruit is for sale with a sale-order and buyers can notify the marketplace they want to buy fruit with a buy-order. The marketplace attempts to match buy- and sell-orders; and when a match is made it notifies the buyer concerned, who then sends payment details to the seller, who in turn sends delivery details for the order to the buyer. The actions of the buyer and seller agents are directed by human users, intended users are farmers who will sell fruit, supermarkets that will buy fruit and warehouses that will both buy and sell fruit. When placing an order with the marketplace, buyers and sellers name the type of fruit, specify a quality rating (A, B or C grade), the price per unit and the quantity. The marketplace assumes that buy orders can be filled by more than one seller, that sell orders can be split between buyers, and that all transactions are successful.

4.1 Use Case Map

The first step of the analysis phase is to create a high-level Use Case Map (UCM) for the system. Use Case Maps model possible processes in a system as paths which traverse various components of the system. Components are drawn as boxes, while paths are drawn as lines crossing various components. The start of a path is indicated by a solid circle, while the end point is indicated by a strong line. When a path crosses a component that component is assigned one or more responsibilities associated with the path. The Use Case Map is labelled with component names, responsibility names and other explanatory notes. These maps provide a highly condensed notion suitable for modelling the high-level behaviour of a system.

To develop the Use Case Map, the roles that agents may play are identified in the requirements specification and placed in the Use Case Map as components. Interactions between roles are then

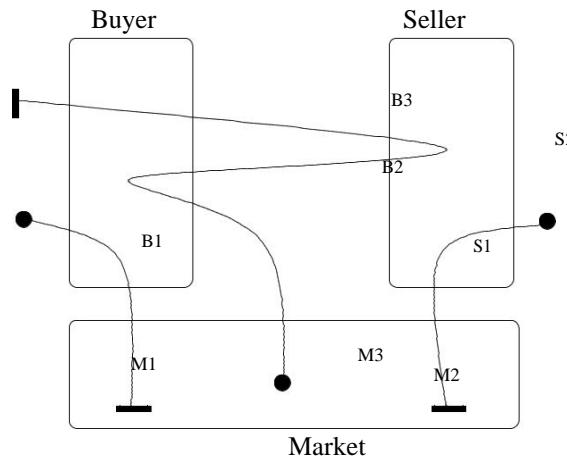


Figure 2: A UCM for the fruit-market scenario.

Label	Responsibility
B1	Post buy-order
B2	Send payment
B3	Receive fruit
S1	Post sell-order
S2	Receive payment and send fruit
M1	Receive buy-order
M2	Receive sell-order
M3	Match buy- and sell-orders and notify buyer

Table 2: Responsibilities for the fruit-market UCM

identified in the requirements specification and placed in the Use Case Map as paths. Finally when a path crosses a component, one or more responsibilities are assigned to that component. Thinking of components as agent roles and paths as interactions between agent roles means that the Use Case Map becomes more of an agent-oriented model, as opposed to the standard object-oriented interpretation outlined in Buhr's original work.

1. sample UCM is given for the fruit-market ex-ample in figure 2 and the responsibilities in this figure are expanded in table 2. This UCM was developed by first creating system components for each identifiable role in the requirements specification and then for each interaction between entities a path was drawn on the diagram and responsibilities were assigned.

4.2 Role Responsibility Model

Role Responsibility Models are created for each component of the analysis level UCM, and take the form of a table with four columns: responsibility, pre- and post-condition, and action. For each responsibility in the analysis level UCM, an entry is made in

the appropriate role's Role Responsibility Model. The pre- and post-conditions are in-formal statements that can be either true or false. These are listed to guide the implementation phase; the implementation-level action will be performed when the pre-conditions are true, and a correct implementation will achieve the post-conditions un-less it meets some error condition. One or more actions, which are simply named at this stage, are listed for each responsibility. These give some indication of the actions that are to be performed in order to achieve this responsibility. Several actions can be specified, allowing a responsibility to be bro-ken down into a number of steps at this level.

There are several keywords used in the Role Responsibility Model; the pre-condition message received, post-condition message sent and action sendMessage. These keywords will be used during the generation of skeleton source code to link the actions specified in the Role Responsibility Model with the agent interactions specified in the Role Relationship Model.

4.3 Role Relationship Model

The Role Relationship Model further elaborates the relationships between roles that are indicated by the analysis level Use Case Map; relationships exist where there is a path linking two components of the Use Case Map. Each relationship is assigned a type drawn from the interaction protocols specified in the forthcoming FIPA 2000 specifications [13] and an object from the Domain Concepts Model. The interpretation is that a conversation of the specified type will occur between the agents, where information is interchanged using the specified object.

A sample Role Dependency Model is shown in figure 4 for the fruit market scenario. This shows several 'information' dependencies, where one role makes some information available to another role. For example a Buyer would inform the Marketplace when it wishes to buy fruit, using a Buy-order object. Note that the 'information' dependency is used here as a place holder for the appropriate FIPA interaction protocols.

4.4 Deployment Model

The Deployment Model is the most simple model in this methodology. It specifies a many-to-many mapping between agents and roles which assigns roles to agents. This model specifies what agents will exist in the system, and what roles they will play. An example for the fruit-market.

4.5 Implementation Phase

The design-level models and the Domain Concepts model will form the basis for generating skeleton source code for the implementation phase. The generation of this skeleton implementation will be a two-step process, firstly the

design models will be mapped into the abstract agent specification language, and then the abstract specification would be mapped to a particular implementation language, toolkit or platform.

The Domain Concepts Model will map directly into a set of object class definitions that will be available to all agents. Programmers will be able to use these object classes for communication between agents without concern for how the object instances are mapped into a string based representation for the particular agent communication language encoding.

The Role Responsibility and Role Relationship Models will be used to generate skeleton code that takes care of inter-agent conversations and behaviour activation. The skeleton code will provide method stubs for each action specified in the Role Responsibility Model and these stubs will be filled in by programmers. The Role Relationship Model will be used to generate state-machine-based entities that take care of conducting the conversation appropriately and that activate the appropriate action methods when a certain message is received. When an action method is activated, it will be sup-plied with the instance of an object from the Do-main Concepts Model that arrived with the activating message. Programmers will be provided with methods to call when it is necessary to send a message from within application-specific code, these methods will have a formal parameter of the type specified in the Role Relationship Model (drawn from the classes in the Domain Concepts Model).

So far the source code skeletons for agent roles have been outlined, however these must be mapped to individual agents for the deployment of the sys-tem. This is specified at the design level in the Deployment Model, and at the implementation level this information is used to group roles into agents. How this occurs will depend largely upon the target agent development toolkit or framework.

5 Styx and other methodologies

There are several parallels between Styx and other recently proposed agent-oriented methodologies, however most of the ideas that are reused are given a significantly different interpretation and several new ideas are introduced.

Styx draws on three models that exist in the High Level and Intermediate Models methodology; how-ever Styx interprets the components of these models as roles rather than individual agents. The approach of using a Use Case Map at the analysis level was seen as a particularly good way of giving a high-level overview of the system in a single diagram, which details both the structural and the behavioural aspects. In contrast to the High Level and Intermediate Models methodology, Styx interprets the components of the Use Case Map as roles, rather than as individual agents.

The Role Responsibility Model is similar to the Internal Agent Model of the High Level and Inter-mediate Models methodology and by Gaia's Services Model. Representing the responsibilities of a role as a table is a useful way of specifying the actions that carry out the responsibility at a de-sign level, and since these tables resemble finite state machines they can be used to generate skele-ton source-code.

The Role Relationship Model is inspired by the Dependency Diagram of the High Level and Inter-mediate Models methodology, however new ideas have been introduced; relationships are defined us-ing FIPA interaction protocols in preference to ad-hoc dependency types, and information about dis-course objects is included. The Role Relationship Model is somewhat more complex than the original Dependency Diagram, however reusing FIPA inter-action protocols and using object classes specified at the analysis level allows a more complete model of agents' social behaviour than the combination of both the Dependency Diagram and the Conversation Model of the High Level and Intermediate Models methodology.

The Deployment Model is drawn directly from the Agent Model in the Gaia methodology. It is necessary to have a model of this type in a role-based methodology as the final products of the methodology are agents, not roles, and Gaia's Agent Model appears a particularly concise way of achieving this.

6 Future Work

The Styx agent methodology is still in a specification phase; many of the difficult problems have been left for future work. A key part of this work will be using Styx to develop examples of a variety of typical agent-based systems, ranging from process control systems, to distributed information systems, to more complex market-place applications than the simplistic fruit-market scenario. This will ensure that Styx is applicable to a wide range of problem domains, rather than being focused on a certain class of applications.

The specification of the text-based abstract agent specification language has not yet been completed. This will be 'boot-strapped' by identifying common concepts identified among current agent software development toolkits and frameworks. This work is perhaps one of the more important areas of Styx, as it will ensure that Styx is not only applicable to cur-rent frameworks and toolkits, but also that it will be applicable to future work. JADE [1], FIPA-OS [19] and JACK [6] are the current candidate implemen-tation toolkits to which mappings from the abstract specification language will be provided. The exact detail of how the abstract agent specification will be generated from the design-level models will depend on the specification

language that is developed, and is another item for future work.

It is not yet determined if specifying a single object class per relationship in the Role Relationship Model will be appropriate in all cases, for example a 'query' conversation may require one class of object to specify the query but another class for the results of the query to be made available. This problem could be overcome by specifying a single object that has fields for both the query and answer, but this would be more of a work-around than an elegant solution. This issue will be resolved once the FIPA 2000 specifications for interaction protocols have been released, and it may well be necessary to specify multiple object classes per relationship in the Role Relationship Model for certain interaction types.

7 Conclusions

Styx represents a new approach to agent-oriented software engineering that is more comprehensive in scope than many other methodologies. Styx will provide a software tool that automates much of the difficult work that currently goes into build-ing agent-based systems and will ensure that soft-ware development projects using an agent-based approach will be able to focus most of their ef-fort on developing application-specific code, rather than grappling with agent research issues. However there is a significant amount of work, both programming and research, to be completed before Styx is ready for widespread use.

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Performance evaluation of Efficient Data Dissemination Approach For QoS Enhancement In VANETs

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Abstract Vehicular ad hoc networks (VANETs) have seen tremendous growth in the last decade, providing a vast range of applications in both military and civilian activities. The temporary connectivity in the vehicles can also increase the driver's capability on the road. However, such applications require heavy data packets to be shared on the same spectrum without the requirement of excessive radios. Thus, e-client approaches are required which can provide improved data dissemination along with the better quality of services to allow heavy traffic to be easily shared between the vehicles. In this paper, an e-client data dissemination approach is proposed which not only improves the vehicle to vehicle connectivity but also improves the QoS between the source and the destination. The proposed approach is analyzed and compared with the existing state-of-the-art approaches. The effectiveness of the proposed approach is demonstrated in terms of the significant gains attained in the parameters namely, end to end delay, packet delivery ratio, route acquisition time, throughput, and message dissemination rate in comparison with the existing approaches.

Keywords VANETs, delay, QoS, Data Dissemination, Fuzzy sets

1 Introduction

Vehicular ad hoc networks (VANETs) comprise ground nodes moving in a particular topology over the road segment with an ability to interact with each other as well as with the road side units (RSUs). The RSU forms the infrastructure part of these networks. The intermittent connectivity between the vehicles allows these networks temporary connectivity between the vehicles using the IEEE 802.11p and are also capable of supporting other IEEE standards for inter-network communications [3] [4]. A sample VANETs network is illustrated in Fig. 1.

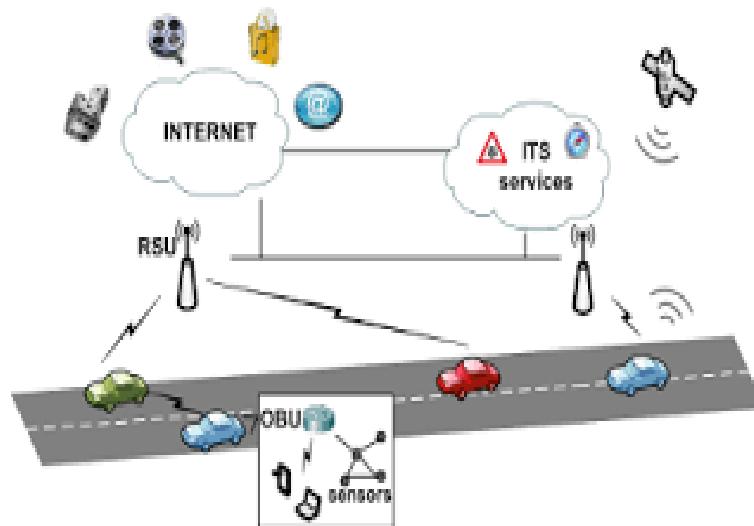


Fig. 1 An Illustration of the VANETs

One of the crucial tasks in these networks is the e-client delivery of data between the source and the destination along with the provisioning of QoS to end users [5] [6]. There exist a number of approaches and solutions which provide e-client data dissemination in these ad hoc formations, however, most of them are unable to provide QoS which is the demand of the current scenario as more heavy traffic is being demanded over these networks. Thus, data dissemination along with the provisioning of QoS to end users in VANETs is taken as a problem in this paper, and an e-client strategy is proposed to resolve it.

In this paper, a novel strategy for data dissemination along with the provisioning of the QoS over VANETs is presented. The proposed approach utilizes the features of the existing relay optimization algorithm and uses fuzzy logic to derive the functional dependency of the parameters. Then, the proposed approach uses the derived value of attraction to select the nodes to form a route between the source and the destination. The key highlights of the proposed approach include, selection of the appropriate routes with minimum route acquisition delay, high packet delivery ratio, high throughput and a low average end to end delay. The proposed approach is evaluated using the simulations and is compared with the existing state-of-the-art approaches.

The remaining part of the paper is structured as follows: Section 2 provides the insight to existing literature for data dissemination and quality of services over VANETs. Section 3 demonstrates the network model used for developing the proposed approach. Section 4 gives the details of the proposed approach, Section 5 evaluates the proposed approach in comparison with the existing solutions. Finally, Section 6 concludes the paper.

2 Related Work

Vehicular ad hoc networks have seen a tremendous shift in the approach towards the provisioning of QoS between the vehicles. This allows support of heavy traffic at a better data rate which causes bulk messages to be transferred between the vehicles, RSUs, and the central authority. A lot of work has been carried in the direction of data dissemination, but these approaches are not exactly e-client to provide real-time QoS.

In a work by Chang et al. [7], the authors have presented a comparative study on the EDF-CSMA and QoS-aware Hybrid Coordination Function (HCF) controlled channel access (HCCA) for improvement of data forwarding in VANETs. Their work is based on the real-time video forwarding over CSMA. The approach provides a better channel utilization in V2V networks. Al-Ani and Seitz [8] have worked in the ad hoc networks over the task of QoS by developing a routing scheme based on the properties of Ant Colony Optimization. Their proposed approach uses an estimation of QoS parameters to select optimally a route in dynamically changing topologies. Their work is completely based on the simulations and is not applicable to the real environment.

Rizzo et al. [9] carried a study on the architectural requirement of the dense traffic networks. The authors carried a study on the content-centric, software-defined network, and context aware network formation in vehicular

networks. The authors further investigated the requirement of tight QoS support by the vehicular networks. Kaur and Malhotra [10] have carried a study on the selection of an appropriate routing approach in Nakagami propagation model over VANETs. With varying densities and traffic size, the authors carried their analysis on the throughput, packet delivery ratio, routing load and end-to-end delay as network parameters.

QoS based data dissemination is another aspect of networking with VANETs. In an approach by Iadicicco [11], the authors focused on ETSI Geo networking standards to efficiently handle the traffic forwarding over VANETs. Their approach is suitable for urban scenarios. But, the test of practicality is not carried on the real-time traffic. In another work by Chaqfen and Lakas [12], the authors have provided a novel strategy for data dissemination in multi-hop VANET. Their approach relies on the traffic estimation to provide selective broadcast in vehicular networks. Their approach provides low overheads and high packet delivery ratio. Ali et al. [13] provided a strategy for cooperative load balancing in VANETs which uses a *xed* road layouts to provide dynamic data forwarding with tolerable delays. Their approach provides a workload balance among the junction-RSUs and edge-RSUs.

Mu'azu et al. [1] discussed an approach for QoS in VANETs which is analyzed in terms of throughput, connection duration, and packet-loss. They discussed the importance of the clustering approach for analyzing the importance of TCP and UDP in provisioning QoS in VANETs. Wahab et al. [14] introduced a new QoS-OLSR protocol for VANETs. Their protocol relies on the formation of the stable clusters which are capable of maintaining stable links even in the case of failures to provide an optimized QoS using the properties of the Ant Colony Optimization algorithms. Reduced communication overheads are the key task of their proposed approach. Zhao et al. [15] considered the two different aspects, namely, data pouring and buffering in VANETs to optimize the data rates. The authors provide an analytical model to identify the dissemination capacity of the network which can be further used to maximize the network parameters for better services.

The study and the literature presented above justifies the data dissemination and QoS provisioning as important aspects of the VANETs, and also provides an insight that further new approaches are required which can improve the quality of service using the relativity between the parameters rather than based on the absolute approaches to attain high data rates. Considering the issues in the existing approaches, a new data dissemination approach is proposed in the paper which not only estimates the network parameters but also enhance the QoS using a reliable Neuro-fuzzy model.

3. Proposed Approach

The proposed data dissemination approach is derived from the properties of the re y optimization algorithm. Further, in order to evaluate the attraction of the vehicles, fuzzy inference system is used to select the current value of attraction between the vehicles. This section of the paper presents the detailed procedure for the route selection, route maintainable, and rehabilitation on the basis of the network model derived in above section.

3.1 Route Selection

The route selection between the vehicles is based on the attraction value between each node to be selected as next for data transmission. The complete area around a node is divided into different zones based on the attraction value. The attraction value decreases with increase in the distance as well as an increase in the relative speed (opposite) between the two vehicles. These zones help to select the node with optimal attraction value towards the destination. A threshold zone is identified on the basis of the attraction value and any vehicle within this threshold zone can be selected as next hop providing a cycle is not formed during the vehicle selection. This is done to prevent a routing loop which is liable to occur in zone based data dissemination approaches. The diagram view of the zone around the vehicle based on the attraction value and the threshold zone is illustrated in Fig. 7. According to this figure, the vehicle can communicate with all vehicles except the vehicle with Id 'D''. This threshold can be set on the basis of the transmission rate (T_r) attained with an increase in the distance and a decrease in the radio range. T_r is accounted for the threshold zone with a value above which the packet drop in a network increases. Alternatively, this threshold value can be calculated on the basis of its average for all the rules, as shown in Fig. 2. In case no vehicle is available within the threshold value, two possible aspects are chosen for data transmission. One is to wait until a vehicle arrives in the threshold zone of the requested source, the second is to increase the threshold value provided that packet loss is not too high as shown in Fig. 8. Further, if power variation is allowed, vehicles can increase its radio range to cover nearby vehicles for possible transmission. The steps for the route selection are presented in Algorithm 1.

Algorithm 1 performs the same steps demonstrated in the network model and in the proposed approach for route selection. The algorithm is operated over each vehicle and is capable of selecting the route with high attraction value. This selection criterion also provides a reliable and robust route selection as nodes with most optimal values are selected for the formation of the routes between the source and the destination.

3.2 Route Rehabilitation

The route rehabilitation is performed during the continuous network operation of data dissemination between the vehicles. This phase helps in maintenance of the route once selected in the initial phase. This phase also allows selection of the alternative routes in case of failures or non-availability of the nodes. The steps for route rehabilitation are shown in Algorithm 2. The algorithm checks for the route by re-beacons over the same source and selecting the vehicles with the best attraction value which is not selected in the earlier route formation. If

Algorithm 1: Route Selection Based on the Attraction Value

- 1: Input: Vehicles and ROI
- 2: set a Threshold value
- 3: Divide the signal range into zones around a source
- 4: while Transmission is not completed do
- 5: Send beacon requesting for neighbors
- 6: calculate the attraction value between each available hop
- 7: arrange the vehicles in descending order of attraction value
- 8: if No Cycle Formed then
- 9: select the top vehicle
- 10: else
- 11: select the next best vehicle
- 12: end if
- 13: if No vehicle selected then
- 14: Increase the threshold value
- 15: Repeat steps 8 onwards
- 16: if still no vehicle selected then
- 17: Wait for a new vehicles arrival
- 18: end if
- 19: end if
- 20: check for continuous route towards destination
- 21: transmit

22: end while
23: exit and check for maintenance

Algorithm 2: Route Rehabilitation

1: Input: Vehicles and ROI, failed vehicles
2: check for current state of vehicles
3: while transmission halted do
4: Resend the beacon from the source
5: collect attraction value data from replies
6: check if the nodes available already selected as next hop
7: identify hops not used before
8: select the node with highest attraction value from the identified hops
9: form link and proceed
10: check the route
11: if route is OK then
12: break
13: end if
14: end while
15: exit and continue with transmission

No new vehicle with better attraction value is found, the network tries to continue with already selected vehicles by changing the parametric values.

The procedure of the route selection and rehabilitation allows selection of the optimal route between the source and the destination. The attraction proper-ties account for stabilized zone formation which enables quick selection of the next hop with minimum route acquisition time and lesser delay.

4.Results and Discussions

The proposed approach for the data dissemination was analyzed over simulations. At the initial level, the net-work parameters were determined for comparison with the A-STAR [19] and GyTAR [20].

4.1 Taxonomy of Parameters

In order to evaluate the proposed model and perform comparative analysis, following parameters were used:

Packet Delivery Ratio: It denotes the ratio of the successful delivery of the packets to the total number of packets transmitted.

- I. End-to-End Delay: In order to ensure the QoS, it is mandatory that the proposed approach should not cause much delay as it would cause serious loss of information to the end users. Thus, for evaluating this factor, end-to-end delay is computed which is the sum of the propagational delay, transmission de-lay, queuing delay and processing delay.
- II. Average Throughput: A network with better band-width utilization offers better QoS over the connected channel. Thus, with throughput closer to the offered bandwidth, the network provides a stable and reliable connectivity between the nodes. Here, average throughput is the number of bits actually transferred with respect to the time taken.
- III. Message Dissemination Rate: Message dissemination rate computes the number of messages transferred per second over the connected link. This metric allows the testing of the reliable connectivity between the network nodes along with the QoS.

4.2 Performance Evaluation

The proposed network approach for data dissemination was analyzed over an area of 5000x5000 sq.m. The number of vehicles approaches the ROI with an average speed of 50Kmph following a Poisson distribution. The number of RSUs was 10 per segment with a radio range of 500 m operating over the same spectrum with variable MAC for vehicular communication and infrastructure communications. The details of parameters configured for the simulations are shown in Table 1.

The proposed network was analyzed for the metrics defined in the taxonomy. Initially, the network was analyzed for the end to end delay vs. the number of vehicles. With number of vehicles entering into the ROI during the same instance, packet collision increases which cause more number of packets to be retransmitted, thus,

Table 1 Parameter Configurations

Parameter	Value	Description
A		
S	80 Kmph	Maximum Speed
	4.0	Pathloss
Time	500	Vehicle
	1000s	Distribution
MAC	IEEE 802.11 b	Simulation Time
MAC	IEEE 802.11 p	Wi-Fi standard
RSU	10 per segment	Road Side Units
R	500m	Radio Range
		Channel
Frequency	2.5GHz	Frequency

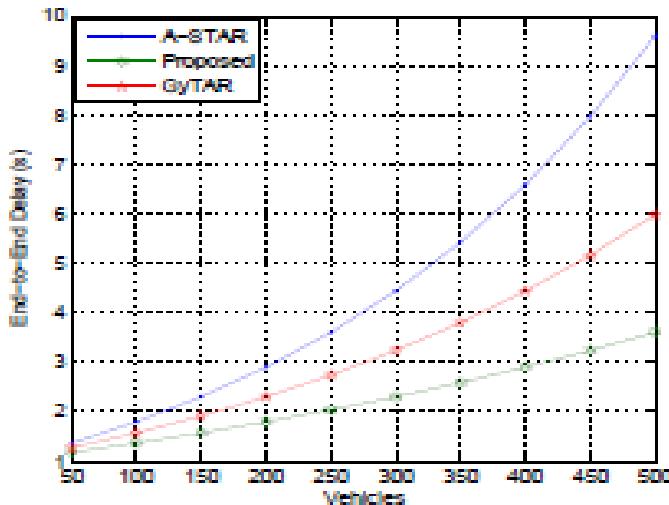


Fig. 2 End-to-End Delay vs. Vehicles

Increasing the end to end delay. Results show that the proposed model causes 60% less end to end delay than the A-STAR, and 30% less end to end delay than the GyTAR approaches. Although, the increase in a number of vehicles causes delays to increase, but this in-crease in delay is low enough that the proposed approach is not much affected by this. The plot for the end to end delay comparison vs. the number of vehicles is shown in Fig.

Next, the proposed model was compared for the packet delivery ratio (PDR) with the GyTAR and the A-Star. With number of vehicles, despite packet collision, number of packets is exchanged between the vehicles. This increase in PDR is observed more in the case of the proposed approach in comparison with the GyTAR and A-STAR. The proposed approach provided a PDR in the range of 60% to 96% with vehicles increasing from 50 to 500; whereas A-STAR provided PDR in the range of 58% to 68% and GyTAR provided PDR in the range of 58% to 77% over a same number of vehicles. Thus, with a requirement of the quality of services, it is always desired to have higher PDR which is provided by the proposed approach.

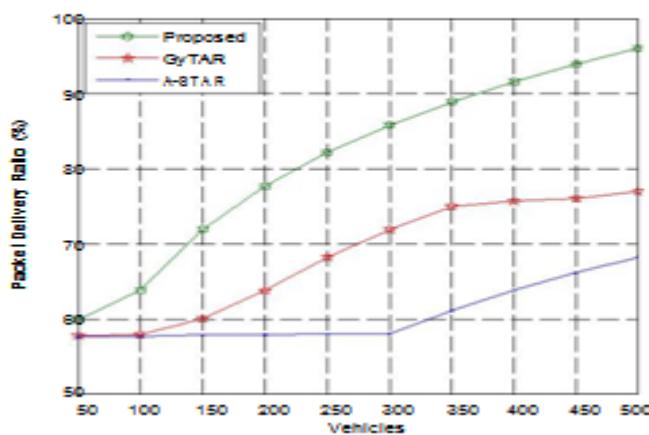


Fig. 3 Packet Delivery Ratio vs. Vehicles

Message dissemination rate is accounted for the pure packets transmitted between the vehicles. Although, packet delivery ratio increases with increase in the number of vehicles, but the useful messages shared between the vehicles gradually decreases with increase in the density of the vehicles. The proposed approach pro-vided 58% and 42% better message dissemination rate than the A-STAR and GyTAR, respectively, as shown in Fig.

The other metric for the measurement of the performance is the average throughput over the network. Throughput is directly related to the useful content shared between the vehicles. This useful content is analyzed in terms of the message dissemination rate which causes the throughput to follow the similar trend. On an average, the proposed approach provided 15% and

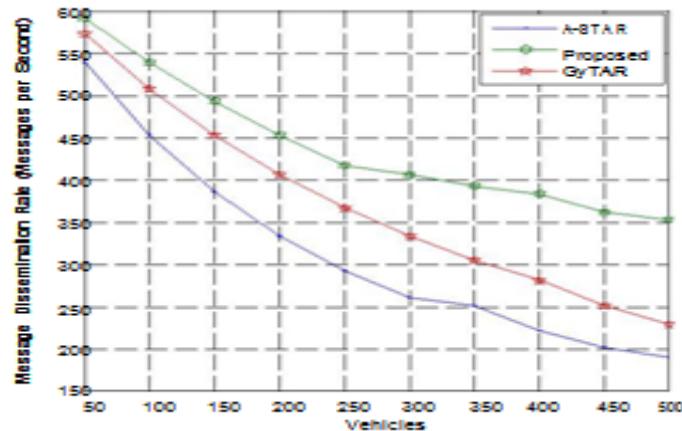


Fig. 4 Message Dissemination Rate vs. Vehicles

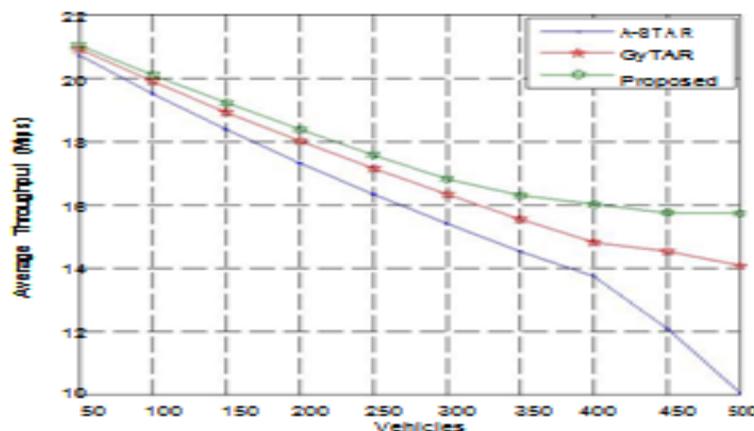


Fig. 5 Average Throughput vs. Vehicles

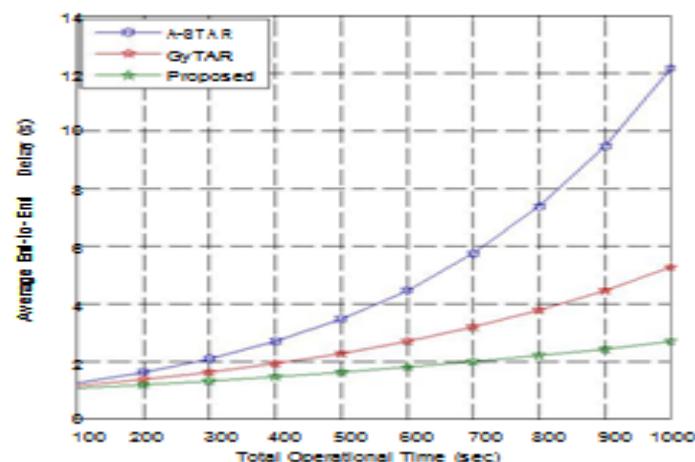


Fig. 6Average End-to-End Delay vs. Total Operational Time

10% better throughput than the A-STAR and GyTAR, respectively.

The quality of service over the network is completely based on the end to end delay observed during the complete network operations. A network with fewer delays accounts for the better quality of service. This allows the formation of a stable, reliable and an efficient client network. The complete results traced for the end to end delay over the proposed model show that the average values of the end to end delay were quite low than the other approaches as shown in Fig. 13. The graph shows that the average end to end delay was negligible in the case of the proposed approach, thus, provides the better quantity of service along with the data dissemination. The other detailed results are shown in Table 2.

5. Conclusion

Data dissemination is one of the key issues with the VANETs. Although, several approaches have been proposed over the years to provide efficient data dissemination, yet provisioning of the quality of services is still an issue with these networks. Considering this, a novel approach is proposed in this paper which utilizes the properties of grey optimization algorithm in collaboration with the fuzzy logic to provide efficient data dissemination. The proposed approach is capable of providing efficient data forwarding along with the improvement in Quality of Services in comparison with the existing approaches.

Compliance with Ethical Standards
Conflict of Interest: The authors declare that they have no conflict of interest.
Informed consent: Authors have studied the COPE guidelines and have made sure that the manuscript falls well under the standard rules for publication.

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Proactive Approach to Estimate the Re-crawl Period for Resource Minimization in Information Retrieval

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ABSTRACT

A news search engine is a software system that is designed to search news articles published in various news sites. We develop a near real time news search for Marathi and Hindi languages using the open source crawler, Nutch and the indexer, Solr. In this work, we in particular address the question of what architectural changes need to be done in Nutch and Solr to build a news search system which demands continuous updating on its crawl and index. We list all the challenges faced to have a near real time index for news search and provide solutions for the same. Our customized open source framework can be adapted to news search solution for any language.

We describe a methodology for maintaining freshness of the crawl by creating an incremental crawling architecture. We show how this architecture maintains crawl freshness through a case study of Marathi and Hindi news search. We propose a method of prioritizing URLs for fetching in a resource constrained scenario. We describe a technique to score a URL before it is fetched, based on its own features and features from its parent URLs that were crawled previously.

KEYWORDS

Re-Crawl, Fetch time estimation, proactive approach

1. INTRODUCTION

Crawling is a process of collecting documents from web and indexing them for retrieval. World Wide Web has a huge collection of documents that need to be processed and stored for a generic web search. There exists other search systems viz., enterprise search, focussed search, domain search, etc., that concentrate on a particular section of the web. The crawling infrastructure required to process the entire WWW is so high that the small scale/academic organizations cannot afford them. In most of the academic/small scale organizations, crawling infrastructure has constraints on availability of resources like processing power, bandwidth, memory, etc.

Even though the open source crawling frameworks helps in crawling the entire web, the resource constraints limit the number of documents being crawled. Resource constraints demands three major tasks for efficient retrieval:

1. Limit maximum number of URLs crawled in each depth
2. URL prioritization
3. URL scheduling

In the absence of any resource constraints, none of the above is required as we have enough resources to crawl any number of URLs at a time. Resource constraints force the crawler to fetch limited number of URLs in each depth. Hence, a demand to carefully choose the URLs for crawling in each depth exists. Also it highly recommended to decide the re-crawl period carefully so as not to overload the crawler. This case is prevalent in a news search engine. A news search engine is a software system designed to search news articles published in various sites. News gets added almost every minute (perhaps lesser) on different sites. It is cumbersome to manually go through each newspaper site and browse for relevant news. For obtaining news relevant to the users information need from different sources, a news search engine is required. Any news search engine is designed to fulfil 3 core objectives:

1. *Satisfying information need of user*: Satisfying information need of the user forms the primary objective of any search engine. The query can be news in any particular location or on recent event. A news search engine should be able to retrieve relevant news articles related to user's information need and rank them based on relevance and published date and time.
2. *One stop solution for all news articles*: News articles are available in different categories like sports, business, general, etc. A news search engine acts as a single repository of news from various sources and categories. This enables user to look for relevant news in a single location without manually browsing each site and search for relevant news articles.
3. *Multiple Perspectives of same news*: News can be looked at from different perspectives. Presenting all these views to the user is important. For e.g. some newspaper author may be biased towards a particular political party and praise them for their move while others can criticize them for their move.

In this work, we provide the solution for resource minimization in crawling by pro-actively choose the re-crawl period for every document in the search index. Also we evaluate the proposed method by building a news search for Marathi and Hindi.

2. RELATED WORK

While incremental crawling and scheduling helps in maintaining crawl up-to-date, it requires a lot of resources which may not be available in a small scale organization. In small organizations or academic institutions, resources available are limited which puts limit on the throughput of the crawler. In such a scenario, crawling important URLs first is required. Scheduling policies help in optimizing the bandwidth required for crawling by increasing the crawl period of pages which are not updated frequently. However, even within URLs, which have more frequency of updates, we need to have a priority on the URLs to be fetched first.

A lot of work exists on classifying URLs based on page content. Page content based classification can be helpful in deciding the next fetch interval of the URL. However, classification of URLs before fetching is required for prioritizing URLs in current depth.

There are many research contributions for prioritizing URLs during fetching. Some of them use purely URL based features, while some of them use parent information, contextual information, etc. Let us look at few of them.

Min-Yen Kan (2004) quantified the performance of web page classification using only the URL features(URL text) against anchor text, title text and page text, showed that URL features when treated correctly, exceeds the performance of some source-document based features.

Min-Yen Kan et al. (2005) added URL features, component length, content, orthography, token sequence and precedence to model URL. The resulting features, used in supervised maximum entropy modelling, significantly improve over existing URL features.

Fish search (Bra et. al., 1994), one of the first dynamic Web search algorithms, takes as input a seed URL and a search query, and dynamically builds a priority list (initialized to the seed URL) of the next URLs (hereafter called nodes) to be explored. As each document's text becomes available, it is analysed by a scoring component evaluating whether it is relevant or irrelevant to the search query (1-0 value) and, based on that score. A heuristic decides whether to pursue the exploration in that direction or not.

Shark search algorithm (Hersovic, 1998), a more aggressive algorithm, instead of binary evaluation of document relevance, returns a score between 0 and 1 in order to evaluate the relevance of documents to a given query, which has direct impact on priority list. Shark search calculates potential score of the children not only by propagating ancestral relevance scores deeper down the hierarchy, but also by making use of the meta-information contained in the links to documents.

Jamali et al. (2006) used the link structure analysis with the similarity of the page context to determine the download pages priority, while Xu & Zuo (2007) use the hyperlinks to discover the relationships between the web pages.

3. PROPOSED METHOD

News sites have different frequencies of updating. There are multiple RSS links within a site for different categories of news articles. Each of these links gets updated at different time intervals. Thus, in the process of crawling RSS links continuously, it is important to prioritize URLs based on update frequency. Continuous crawling of all URLs consume more resources as it fetches and parses pages which do not change frequently. This causes significant delay in re-fetch of remaining pages.

To prioritize URLs, we perform fetching of RSS links using an adaptive scheduler. The scheduler assigns lesser fetch intervals to URLs which get updated more frequently as compared to other URLs.

Following are the different parameters used in adaptive scheduler:

- Default Fetch Interval: We set the default fetch interval time for re-crawling a page as 3500 seconds. This ensures that the page after this period is expected to change by the crawler.
- Maximum Fetch Interval: The maximum amount of time after which the page becomes available for re-crawling. This value is set to 43200 seconds which amounts to 12hrs.
- Incremental Rate: After re-crawling a page, if the page found to be not modified, we need to increment the next fetch time for the page. This value (set to 0.4) indicates the rate at which increment of the next fetch time should take place.
- Decremental Rate: Rate at which the next fetch time of a page to be decided if the page being re-crawled now has been modified from the last time. This value is set to 0.2.
- Min-Max Interval: The next fetch time of a page should have a boundary values indicated by this interval.

To configure appropriate values for minimum fetch interval and maximum fetch interval we carried out few experiments. Initially we had set minimum interval as 20 seconds and maximum interval as 24 hours to study the rate of change of news articles. The value of 20 seconds is much less than the time taken to complete one crawl cycle. Since we target daily newspaper sites, we have kept the maximum interval as 24 hours.

3.1. Proactive Re-crawl Estimator

While crawling RSS links, we need to ensure that only initial set of seed URLs gets crawled every time. Any outlines from the RSS page should be discarded. To do so we set the property *update-additions* to *false*. But by doing so, the subdocuments generated after parsing the RSS page also gets discarded. The possible solutions to this problem are:-

3.1.1. Revert Update-Additions property

In this case, the documents generated after parsing won't be discarded. However, a lot of junk URLs may be added to the fetch list which may not be related to news increasing the bandwidth usage.

3.1.2. Different Crawl Container in Every iteration

Another way to approach the problem is to use a different crawl database during each crawl along with keeping *update-additions* to true. The advantages of using this method are:-

- Only the seed URLs gets crawled every time.
- No junk pages in crawl.

The disadvantage of this method is that proactive estimation requires information from the crawl database for setting the next fetch interval. This information is not available while doing a fresh crawl. Thus in this case, proactive estimation won't work.

3.1.3. New Filter

The third approach is to create a new filter which filters out non RSS URLs from the fetchlist. The main advantages of this method are:-

- No sub document is discarded.
- Only RSS links gets crawled. Hence crawl contains no junk/ad pages. Proactive estimation works properly as we use the same crawl folder for each crawl.

Clearly, the third solution is the best amongst all the solutions. However, just creating a new URL filter is not enough for achieving the above mentioned advantages. The new URL filter will be called while optimizing the crawl database module resulting in removal of documents generated (*i.e.*, news articles) after parsing. To avoid this, the architecture must be changed to call this filter only in Generator phase, while the rest of the filters can be applied to other phases.

The generator by default reads all the filters and run these set of filters in order at every phase of pipeline. If this property is empty then all URL filters available to the crawler are called. To enforce the generator to call only specific set of URL filters, we modified the module to specify the URL filters to be applied in generator. This ensures that only our filter gets applied in generator. This filter filters out non RSS links from the fetch list. Along with this parameter, we need to put the names of URL filters that need to be called by other modules of a crawler. The system configured by making the changes mentioned above is used directly for continuous crawling of news articles.

3.2. Algorithm

- RSS feeds that have changed from last fetch, decrease time for next fetch by a constant time DEC_TIME
- RSS feeds that have not changed from last fetch, increase time for next fetch by a constant time INC_TIME
- calculate delta = fetchTime - modifiedTime
- Sync the time of change, by shifting the next fetchTime by a fraction of the difference between the last modification time and the last fetch time.
- If the adjusted fetch interval is bigger than the delta, then fetchInterval = delta.

4. EXPERIMENTS AND RESULTS

4.1. Experimental Setup

To perform the experiments of continuous crawling of news pages, we collect huge collection of news sites for Hindi and Marathi. The total number of news sites covered in Hindi and Marathi are almost 40 and 20 respectively. For every URL in the list we pro-actively estimate the next fetch time based on the popularity and modification history of the page and in-turn minimize the resources consumed for continuous crawling of news data by a search engine.

4.2. Existing Systems

There are two existing systems that can be compared with the current algorithm

1. Periodic crawler: This is a fetching mechanism where the crawler fetches the pages periodically with fixed time interval. The drawback of this approach is that the latest documents uploaded in the web will not be crawled by our search engine till the interval is finished. Also, setting this interval is a tedious heuristic process.

2. Continuous crawler: This is a special case periodic crawler where the interval is set of zero. The advantage of this system is that all the documents are crawled without delay by the search engine but requires huge amount of resources as the crawling is done without any delay and repeatedly.

4.3. Results

The X-axis denotes consecutive crawls of a URL and Y-axis denotes the interval in minutes between x^{th} (current) and $x-1^{\text{th}}$ crawl. The actual modification time for any URL is not available to the scheduler. The scheduler tries to synchronize with the updation period iteratively by changing the fetch interval. The fetch interval is decreased or increased based on whether the page is modified or not respectively. We observe from the graph that after few crawls of a URL, the fetch interval oscillates between 50 to 90 minutes. This indicates that the modification frequency of the page is consistent and lies within this range.

To study the behaviour across all URLs we carried out experiments to find the average update frequency of each URL for Hindi and Marathi news search systems. For these experiments, we had set 20 seconds as lower bound for interval, while the upper bound was 24 hours as in the previous case.

Average fetch interval for Marathi news figure 1 shows the average fetch interval for each RSS link of Marathi news sites. We observed that most of the links had an average interval of 12 hours. This indicates that the links has a modification frequency close to 12 hours.

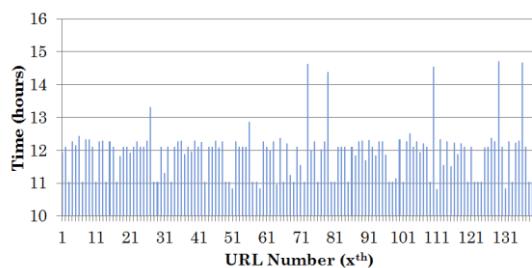


Figure 1: Average fetch interval for Marathi

Average fetch interval for Hindi news figure 2 shows the average fetch interval for each RSS link of Hindi news sites. We observed that Hindi news sites update more frequently than Marathi sites. Hindi news links have an average update period of around 1.2 hours. This study helps us in configuring the re-crawl period to a value such that the resource utilization is maximum.

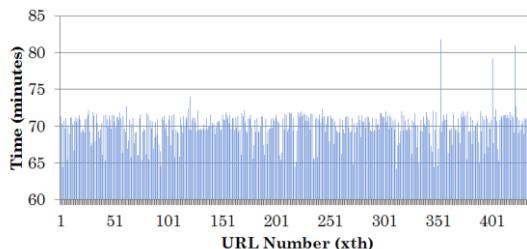


Figure 2: Average fetch interval for Hindi

5. CONCLUSIONS

We have attempted to solve the problem of incremental crawling. We have created a framework for continuous crawling of news articles to maintain freshness of the crawl. We in particular addressed the question of what architectural changes are needed to build a news search system which demands continuous updation on its crawl and index. We listed the challenges faced to have a near real-time index for news search and provided solutions for the same.

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GENE BASED SOFTWARE REFACTORING LOCATION IDENTIFICATION AND RECTIFICATION FOR SOFTWARE CODE QUALITY MAINTENANCE

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ABSTRACT

Software refactoring is the process of changing the inner structure of object-oriented software to enhance the quality of software code, especially in terms of maintainability, extensibility, and reusability while software outer performance remains unchanged. In order to improve software refactoring, several tools has been employed for code smell detection. However, these tools are inactive and human driven, hence it making software refactoring maintained by developer's inconsistency. A monitor-based instant refactoring approach failed to handle number of code smells and reduced software quality with more software cost. In order to improve the software code quality maintenance, Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique is introduced. Initially, the location of code bad smell (i.e. weak gene) is identified where the software code to be refactored through the local search and fitness calculation. Based on the fitness calculation, the weak and strong genes are identified. After that, refactoring Technique is applied to perform rectification of code bad smell such as duplication, longer parameter list, and temporary files in the identified location through the crossover and mutation operator. Therefore, the GSR-LIR technique helps to preserve the applied refactoring behavior. Then, the result of the refactoring on quality characteristics of the software is verified. Finally, consistency between the refactors' program code and other software artifacts are maintained in order to improve the quality of refactoring. Experimental results shows that the proposed SRLIR technique achieves better performance in terms of refactoring location identification accuracy, refactoring code consistency and refactoring quality compared to the state-of-the-art works.

Keywords: *Software refactoring, software quality maintenance, code smell detection, gene based refactoring, Location Identification, fitness, Rectification, crossover and mutation.*

1. INTRODUCTION

Software Engineering is the process of making to design, development, testing, implementation, and maintenance of software code in an efficient manner. Software quality is a significant issue in the growth of software application. There are several techniques applied to enhance the software quality. Refactoring is one of the methods to detect the code smell thereby improving the software quality. Software Refactoring is a technique of altering a software system but it not varies the external performance of the code. The application of refactoring

increases the code readability, maintainability, extensibility, Reduce complexity and software quality. The process of the refactoring is suggested as shown in figure 1.

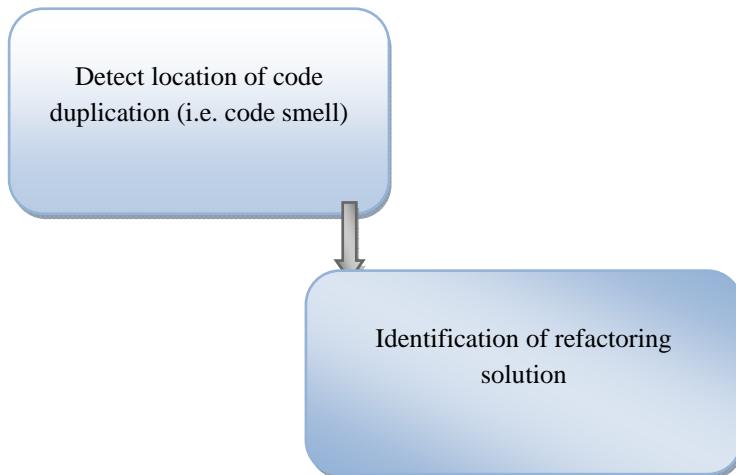


Figure 1 Process of software refactoring

As shown in figure 1, software refactoring process modifying the existing software code with no changes occurred in external activities. Refactoring changes the irrelevant code of the software source code. The benefit of Refactoring technique comprises better code readability and less complexity. This also increases the source-code maintainability and generates a more significant internal architecture to improve extensibility. The software code refactoring is also determined the computer bugs in the system by eliminating redundant levels of complexity. Software Refactoring is generally activated by detecting a code smell (i.e. bad smell). In computer programming code, refers to a few indications in the source code of a program that probably shows a deeper problem or technically incorrect basis. The benefit of the software refactoring is the Maintainability of the software code quality. It is easier to secure bugs since the source code is easy to read and its author is easily to seize. This is achieved by reducing large routines into a set of individually summarizing, well-named, single-purpose techniques.

A monitor-based instant refactoring framework was introduced in [1] to help the developers for solving the identified smells rapidly. However, it failed to handle more types of code smells and reduced the software quality. A refactoring algorithm based on weighted clustering was introduced in [2] which obtain the optimal functionality distribution from a system viewpoint. However, the software code quality maintenance was not improved at a required level. An Aspect-oriented programming (AOP) approach was designed in [3] for handling the maintainability of software. However, it provides criterion for restricted number of changes occurred. Dynamic and Automatic Feedback-Based Threshold Adaptation technique was introduced in [4] for improving the recall while containing the precision close to the target precision. However, it failed to perform more complex smell detection algorithm. A B-Refactoring technique of test code was introduced in [5] for partitioning a test case into a number of small test fragments. However, it does not investigate the reason of the various results due to the lack of historical test data. In [6], the association among the code smells and preservation efforts were analyzed with several linear regressions. However, it failed to maintain the consistency between program code and other software. A Parallel

Evolutionary algorithm (P-EA) was designed in [7] to provide more effective results on code-smells detection. However, the efficiency of the algorithm and system performance was not improved. A class-level software networks were introduced in [8] for improving the accuracy of bug prediction. But it failed for handling more open source projects. In [9], a new technique was introduced to refactor the package construction of object oriented software. However, it failed to develop a refactoring tool. An approach was introduced in [10] for automatically evaluating clones without altering the performance of the program. However, it was not considered search-based techniques to find exact location. Based on the above said limitations such as, lack of software quality, maintainability, failed to handle several code smells and inconsistency. In order to address such kind of issues, Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique is introduced.

The contribution of the research work is explained as follows. Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique is introduced to improve the software quality maintenance. At first, the gene population generation is carried out and identifies the location where the software code to be changed. Secondly, refactoring technique is applied to rectify the code smell. This helps to improve the software quality and reduces the inconsistency between the refactors program code and other software artifacts. The rest of the paper is organized as follows: In Section 2, Gene based Software Refactoring Location Identification and Rectification (GSRLIR) technique is explained with neat diagram. In Section 3 experimental settings is presented with detailed analysis of results explained in Section 4. In Section 5, introduces the background and analysis the related works. The conclusion of the research work is presented in section 6.

2. SOFTWARE REFACTORING

Software refactoring plays a significant role in order to improve software quality by altering the software inner formation. The major issue in software refactoring is to identify the code smells that require refactoring. However, the manual recognition methods are difficult to identify the code smells from large applications. Therefore, an efficient refactoring technique is introduced to detect code smells automatically. The examples of the different bad smells occurred while running the software code such as Code Duplication, long parameter list, temporary field, etc. Therefore, the refactoring is used to improve the quality of software code reliability, and maintainability.

2.1 Need for refactoring

Refactoring also increases software developer efficiency and increases code reuse continuous plan allows including more flexibility into the design, by adding an initially simple design. The process of refactoring is also used to contribute the developing states of the program code. Refactoring improves the plan of software program quality. The software code which is generally obtains more refactored code to perform the similar effects; therefore the Refactoring makes the code easy to understand. In most software development environments, someone else force to read the code so it becomes easy for others to understand. Refactoring helps for determining the bug's present in the software program and also helps to run a program in quicker manner.

2.2 GENE BASED SOFTWARE REFACTORING

The software refactoring is performed in order to improve the software quality maintenance and reduce the inconsistency while running the program code. The refactoring process is performed on the each part of the software code. With this objective, Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique is introduced to improve software code quality maintenance. The following sections are illustrates the GSR-LIR technique to improve the software quality rate.

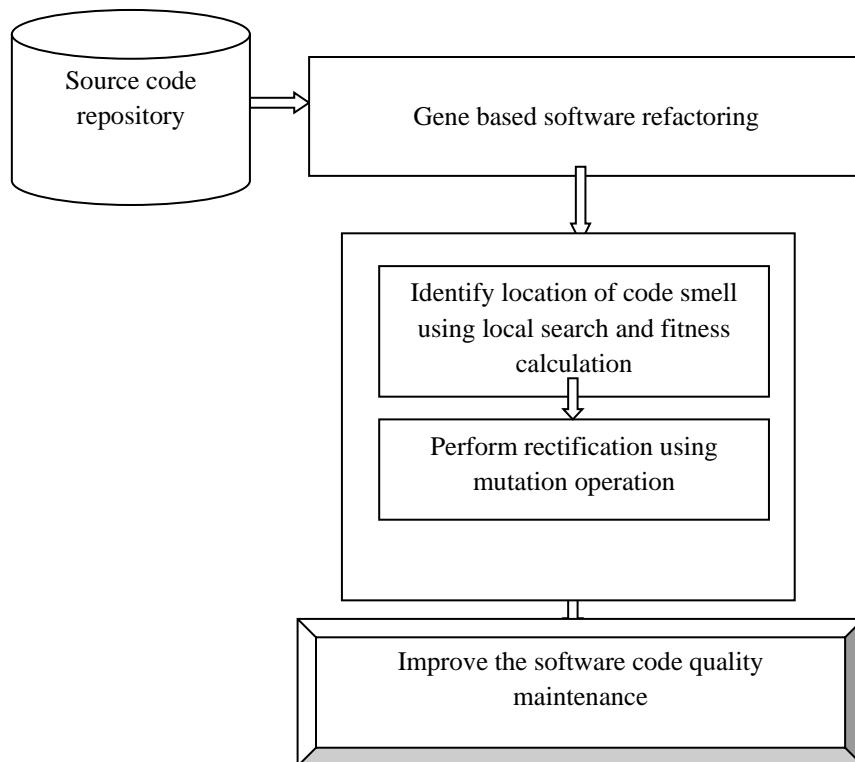


Figure 2 Processing diagram of the Gene based software refactoring location identification and rectification

As shown in figure 2, processing diagram of the Gene based software refactoring location identification and rectification is described. The proposed Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique performs two processing such as identifies the location of code smell where the software code to be refactored through the local search and applied the refactoring technique to perform rectification process. Initially, each software code is placed inside a gene to perform refactoring process. The refactoring process determines which refactoring is needed in an identified location. Then, it ensures the applied refactoring preserve behaviors. The result of refactoring on software quality characteristics is verified. Finally, preserves the consistency between refactors program code and other software artifacts. The brief description of GSRLIR technique is explained in the following sections.

2.2.1 Identify the location of software code smell

Initially, all the software codes are placed inside a gene to generate the initial population. Each member of this population initiates a better solution based on fitness calculation. At first, the gene population is generated

arbitrarily. Then the Local search is applied in GSR-LIR technique to determine exact location of code bad smell among a number of codes of lines in the source code. After that, every iteration the best individuals (i.e. gens) are selected and the worst ones are altered with new ones generated from the fitness value. Then the local search finds the exact location of code smell where the software code to be refactored. In general, every gene contains more than one neighbor solution, the choice of which gene is selected based on the information about the neighborhood of the existing one; hence the process is called as local search. The information about the neighborhood is identified through the fitness calculation. The fitness is measured to select the high quality (i.e. best) and weaker (i.e. low quality) in order to perform software refactoring. Therefore, the weaker gene is called as code smell. The gene based technique determines the program code qualities of both of good and weak genes. Therefore, the fitness function is measured as,

$$\text{weight } (W_t) = \text{Min } \{\text{good code quality}\} - \text{Max } \{\text{bad code quality}\} \quad (1)$$

From (1), $\text{weight } (W_t)$ is the optimal weights of gene are determined hence the range is large as possible. From the range, the middle point as a threshold to decides whether a gene is a weaker or strong quality.

$$\text{Fitness } (F) = \begin{cases} W_t < T_h, & \text{weaker gene} \\ W_t > T_h, & \text{stronger gene} \end{cases} \quad (2)$$

From (2), If the quality of a gene is calculated with the optimal weights (W_t) is less than the threshold value, then the gene is judged to a weaker gene, and refactoring is suggested so that the gene is transformed using an appropriate refactoring technique. Based on fitness calculation, the code smell is identified where the refactoring is needed. In addition, the crossover process is carried out to generate the code of the first gene is compared with the similar code of the second gene in order to produce the new offspring. Finally, the mutation process is used to alter the duplication code in software program.

Selection

The selection operator in gene based software refactoring is performed for selecting the two parent genes from an initial population along with their fitness function values which has the higher ability to produce a new generation for performing the crossover operator.

Crossover

The crossover operation used chromosome of the different parent gene from individual generation to the next generation. Let us consider one-point crossover that randomly generated. The first indicates that the elements of two parents chromosomes are require to be exchanged, while residual chromosomes are unchanged. Let us consider two parent gene (i.e. G1, G2) with chromosomes $G1 = a_1, a_2, a_3, a_4, a_5, a_6, a_7$, and $G2 = b_1, b_2, b_3, b_4, b_5, b_6, b_7$. Then the offspring is generated as follows,

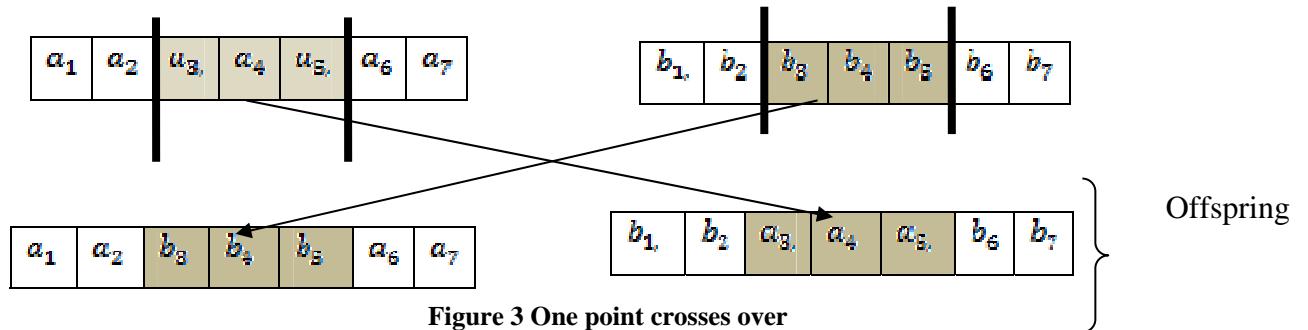


Figure 3 One point crosses over

Figure 3 shows the one point crossover of generating the new population by recombination process. A crossover point is chosen according to the selected chromosomes. Parts of the chromosomes are swapped after and before the crossover point to generate the offspring by using parent chromosomes. The newly generated chromosomes are used for performing the mutation operation where the code rectification is needed. The rectification process is performed in next subsection.

2.2.2 Gene based Rectification using Mutation

A mutation is a process of performing the stable rectification in the program sequence that makes up a gene. Once the cross over is completed, the gene is subjected to mutation operation alters the chromosomes to select the higher fitness value. During the mutation, the refactoring techniques are applied in to rectify the code smell in GSR-LIR technique. The various refactoring process are composing method, moving the feature between the objects, organization of data and simplifying the conditional expression. The composing method includes extract Method, Replace Temp with Query, Split Temporary Variable, Remove Assignments to Parameters. The moving method consists of Move field, Extract Class and Inline Class. Then the data organization process includes replacing the Code type with Class, replacing Array with Object, change Record with Data Class, and replacing record with Data Class. The conditional expressions are eliminating Control Flag, Introduces Null Object and Introduces Assertion. These refactoring methods are employed to rectify the code smell inside the source program code. Then the GSRLIR technique ensures the applied refactoring preserves behavior.

The gene rectification operation aims to maintain the good chromosomes for altering the code smell. The generated offspring are included into the population and the least chromosomes with low fitness (i.e. code) values are removed from the population. Once the offspring populations are generated through the crossover operator, the offspring is mutated with the probability (P). This helps to ensure genetic range from one generation to the next ones. Then the random number (r) is generated and compared with the mutation probability (p). If the mutated probability (p) is greater than the random number (r), then the mutation is performed otherwise the software code remains unchanged.

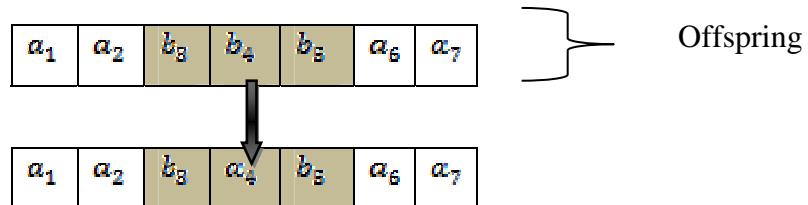


Figure 4 Mutation operation

Figure 4 shows the mutation process to rectify the code with the help of above said refactoring technique. As shown in figure, the chromosome value of the gene b_4 is corrected with the exact chromosome of a_4 . Mutation is in the population, a randomly interchanging the code for creating the new offspring to increase the fitness value. If the new offspring is failed to satisfy the limitations like fitness threshold, it is removed and the iterations gets repeated till it improve the quality characteristics of the software. The mutation operation avoids the local minimum and it searches for the global optimal solution. As a result, the reliability between the refactors program code and other software objects are preserved. The flow diagram of the gene based refactoring technique is obtained as follows,

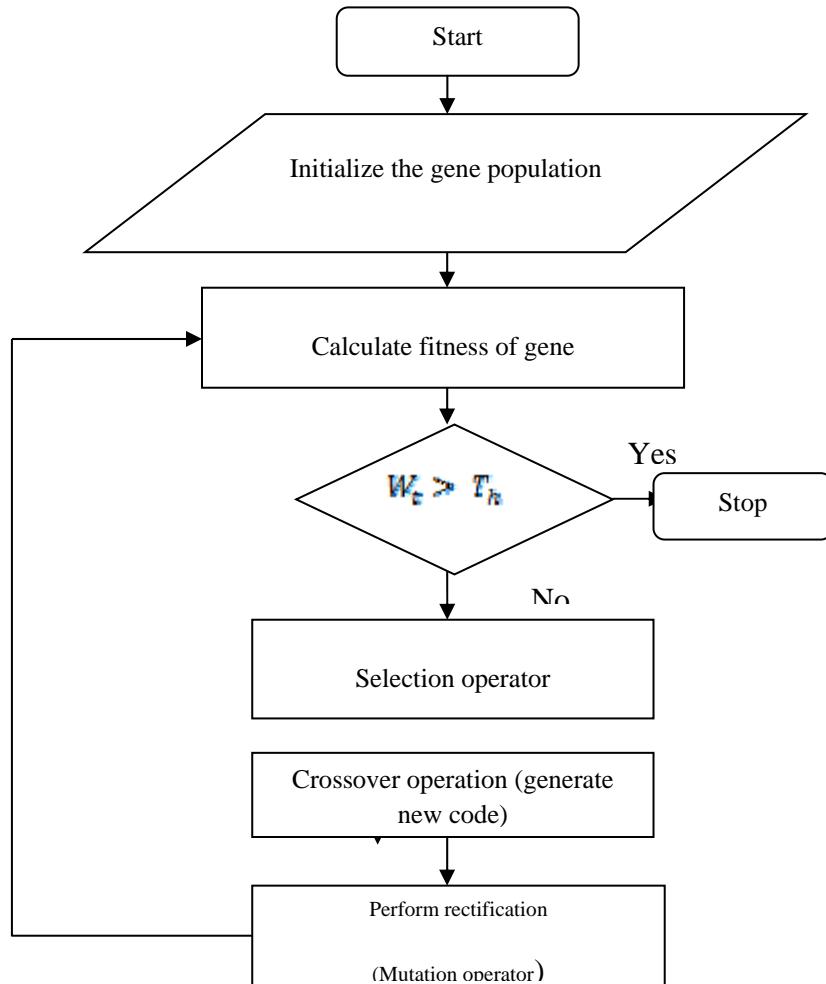


Figure 5 Flow Diagram of gene based software refactoring

Figure 5 shows the flow diagram of the GSRLIR technique performs efficient refactoring that detects the location where the refactoring is needed and rectifies the code smell with appropriate refactoring technique. The gene based software refactoring is performed effectively to alter the software code for maintaining the quality. Initially, the gene population generation is carried out and then the fitness is measured based on assigning the weight of each gene and their neighboring gene through the local search. If the measured weighting value is higher than the threshold value, then the number of iteration has been stopped otherwise the best fitness value is computed through the selection, crossover and mutation. The algorithmic description of the Gene based software refactoring location identification and rectification technique is explained as follows,

Input:	No. of genes (i.e. software code), Two parent gene with chromosomes	
G1 = <	a₁, a₂, a₃, a₄, a₅, a₆, a₇, > and G2 = <	b₁, b₂, b₃, b₄, b₅, b₆, b₇, >
Output :	Improved refactoring quality	
Step 1: Begin		
Step 2:	Initialize the gene population	
Step 3:	Calculate fitness of each individual gene using (2)	
Step 4:	if ($W_g > T_h$) then	
Step 5:	Number of iteration has been completed	
Step 6:	Else	
Step 7:	Select the low quality gene	
Step 8:	Perform crossover generates new chromosome	
Step 9:	Rectify the refactoring code using mutation	
Step 7:	Terminate the algorithm until the specified condition is satisfied or else go to Step 3.	
Step 8:	End	

Figure 6 Gene based software refactoring location identification and rectification algorithm

Figure 6 shows the Gene based software refactoring location identification and rectification algorithm to improve the software code quality maintenance. Generate the initial gene population to identify the best gene and weaker gene through the local search of the fitness value calculation. The fitness is measured based on the weighting function of minimum good code quality and maximum bad code quality. Based on fitness calculation, the strong gene and weaker gene are separated with the specified threshold value. If the fitness is greater than the threshold value, the iteration gets stopped otherwise perform selection process. Based on selection, the weaker gene (i.e. code smell) is identified and it's rectified through the refactoring technique to improve the quality of refactoring. Quality of refactoring is verified through the crossover to generate the new chromosome. Finally, the mutation is performed where the code rectification is performed. This process is repeated until the entire gene is verified. This helps to improve the consistency among the refactors software program code and other software objects.

3. EXPERIMENTAL EVALUATION

The proposed Gene based Software Refactoring Location Identification and Rectification (GSRLIR) technique is experimented using JAVA programming code with SchoolMate dataset. The SchoolMate dataset is the open-source programs. The SchoolMate consists of brief solution related to elementary, middle and high schools. It processed with four domains, namely, administration, teachers, students and parents, where the administration domain manages both the classes and users of the SchoolMate whereas the teachers' domain manages the details about assignments and grades. Information regarding students' domain is accessed with information is also be verified by the parents' domain. The GSR-LIR technique experimented against the existing monitor-based instant refactoring framework [1] and weighted clustering algorithm [2]. The experiment is conducted on the factors such as refactoring location identification accuracy, refactoring code consistency and refactoring quality.

4. RESULTS AND DISCUSSION

Analysis of Gene based Software Refactoring Location Identification and Rectification (GS-RLIR) technique is compared with existing monitor-based instant refactoring framework [1] and weighted clustering algorithm [2]. The analysis is carried out on the factors such as refactoring location identification accuracy, refactoring code consistency and refactoring quality. The performance is evaluated according to the following metrics with the help of table and graph values.

4.1 Impact of Refactoring Code location identification accuracy

Refactoring Code location identification accuracy is used to identify the location of code smell from the source code where the refactoring is applied. It is defined as the difference between number of source code lines and the incorrect code lines are identified in the source program. The mathematical formula for accuracy is defined as follows,

$$RCLIA = \frac{\text{No.of source code lines} - \text{Identified the no.of codes lines are incorrect}}{\text{No.of source code lines}} * 100 \quad (3)$$

From (3), where **RCLIA** is the Refactoring Code Location Identification Accuracy which is measured in terms of percentage (%).

Table 1 Tabulation for Refactoring location identification accuracy

Source code (KB)	Refactoring Code location identification accuracy (%)		
	GSRLIR	Monitor-based instant refactoring framework	Weighted clustering algorithm
2	71.68	60.45	50.45
4	75.44	65.78	55.61
6	78.10	68.46	60.14
8	82.36	72.15	66.45
10	86.10	75.89	70.42
12	90.46	82.23	73.65
14	92.75	85.98	75.54
16	94.58	88.24	78.65
18	95.34	90.25	79.10
20	96.12	91.65	83.58

Table 1 show the Refactoring Code location identification accuracy based on the size of source code (KB). While increasing code size, the Refactoring Code location identification accuracy gets increased in all the methods such as GSRLIR technique, Monitor-based instant refactoring framework [1] and weighted clustering algorithm [2]. The input as a source code and the size is 2KB which contains 10 lines of code. From the source code lines, numbers of incorrect code lines location are detected for applying the refactoring. The location detection accuracy is increased using GSR-LIR technique than the other existing methods.

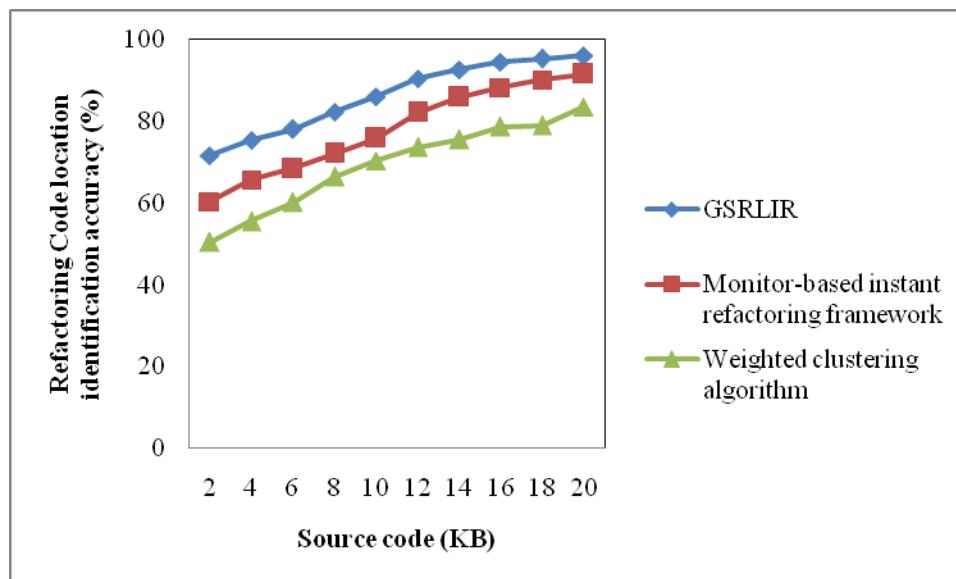


Figure 7 Measure of Refactoring Code location identification accuracy

Figure 7 illustrates the experimental results of the Refactoring Code location identification accuracy for each source code size. The source code is varied in the range of 2KB to 20KB for experimental purpose. From the figure, while increasing the size of source code, comparatively accuracy gets improved using GSR-LIR technique. This is because, gene based refactoring technique is applied to identify the location where the refactoring is applied to improve the refactoring quality. In GSR-LIR technique, initially gene population is generated randomly. Then the stronger gene and weaker gene and their location are identified through the local search of the fitness value measurement. Based on fitness threshold value, the weaker gene location is identified to apply the refactoring technique. The local search in GSR-LIR technique identifies the neighboring solution to detect the location of code smell. This challenge in software code is rectified the code smell for maintaining the consistency. Therefore, GSRLIR technique improves Refactoring Code location identification accuracy. The percentage of accuracy is obtained 11% and 26% using GSRLIR technique compared to existing Monitor-based instant refactoring framework [1] and weighted clustering algorithm [2] respectively.

4.2 Impact of refactoring code consistency

Refactoring code consistency is measured based on the amount of time taken to rectify the code without changing the external behaviors. The mathematical formula for Refactoring code consistency is measured as follows.

$$RCC = N * \text{time (rectify the code)} \quad (4)$$

From (4), where **RCC** denotes refactoring code consistency, **N** is the number of incorrect code lines and time for rectifying the one code by applying the software refactoring technique. It is measured in terms of millisecond (ms). Lower the software code rectification time, more efficient the method is said to be.

Table 2 Tabulation for Refactoring code consistency

Source code (MB)	Refactoring code consistency (ms)		
	GSR-LIR	Monitor-based instant refactoring framework	Weighted clustering algorithm
2	10.32	20.15	28.72
4	16.24	30.42	35.14
6	22.10	42.47	49.18
8	36.56	54.39	68.32
10	44.89	63.56	85.56
12	53.38	79.61	97.17
14	67.13	87.46	106.45
16	83.14	107.83	118.54
18	96.73	117.34	127.63
20	112.45	128.41	143.34

Table 2 shows the results analysis of refactoring code consistency using GSR-LIR technique and existing Monitor-based instant refactoring framework [1] and weighted clustering algorithm [2] are presented. When the software code size is increased, the statistical analysis implies that there occurs a stable increase in the time taken for rectifying the software code which is technically incorrect. The code rectification time gets reduced and increased the consistency using GSR-LIR technique than the existing methods.

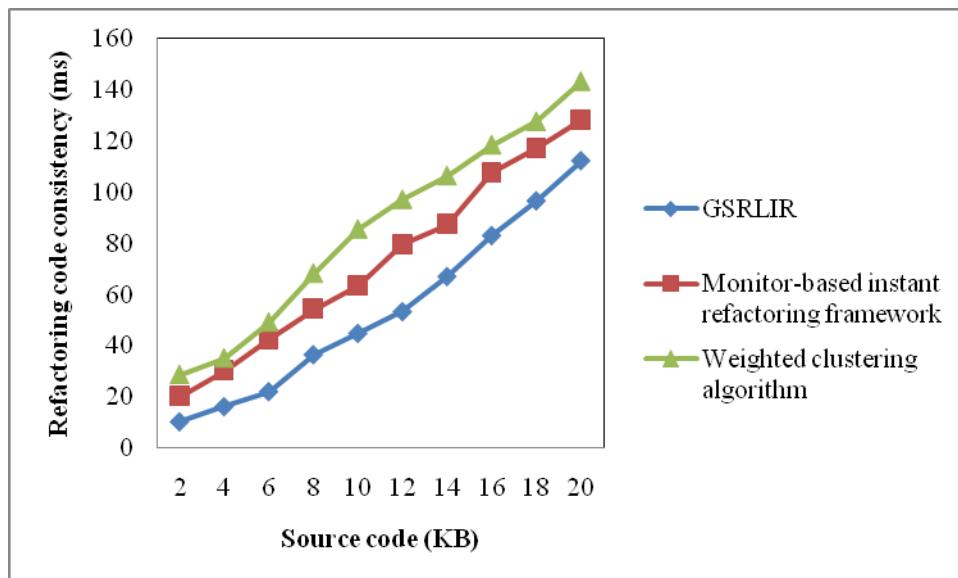


Figure 8 Measure of Refactoring Code consistency

Figure 8 show the measure of Refactoring Code consistency in terms of time with respect to size of the source code from 2KB to 20KB. While increasing the source code, the time gets gradually increased. But comparatively, the GSRLIR technique reduces the rectification time than the existing methods [1] [2]. This is because; the proposed GSRLIR technique manages the consistency between refactors program code and other software objects. The rectification process is carried out in GSRLIR technique using gene based approach. Initially, the weaker gene (i.e. software code) is identified through the fitness calculation. Then, the rectification is performed through the application of refactoring method. Through the crossover operation two parent's chromosomes are exchanged to generate the newly generated chromosomes. Then the code duplication is rectified through the newly generated chromosomes with the help of mutation operation. The mutation is performed for rectifying the technically incorrect code without changing the external behavior. This process is repeated until the entire software code is verified to improve the quality. Therefore, the minimum time is used to improve the consistency between the refactors program code and other software objects. The incorrect code rectification time is reduced by 31% and 42% compared to existing Monitor-based instant refactoring framework [1] and weighted clustering algorithm [2] respectively.

4.3 Impact of refactoring quality

Refactoring quality is defined as the ratio of difference between the number of code lines and incorrect codes lines that are correctly refactored to the total number of code lines in the source code (KB). The formula for refactoring quality is expressed as,

$$RQ = \frac{\text{No.of code lines} - \text{No.of incorrect code lines are correctly refactored}}{\text{No.of erroneous code lines}} * 100 \quad (5)$$

From (5), RQ is the Refactoring quality and it is measured in terms of percentage (%).

Table 3 Tabulation for Refactoring quality

Source code (KB)	Refactoring quality (%)		
	GSR-LIR	Monitor-based instant refactoring framework	Weighted clustering algorithm
2	69.45	59.53	51.36
4	73.10	63.45	54.63
6	78.65	65.87	57.68
8	82.12	67.48	61.69
10	85.45	69.12	63.89
12	86.75	73.65	68.12
14	88.36	76.98	70.13
16	90.45	80.65	72.63
18	92.47	83.20	78.46
20	94.85	86.36	80.64

Table 3 describes the refactoring quality with respect to size of source code in terms of KB. From the source code file, the numbers of identified incorrect code lines are accurately refactored through the software refactoring technique. The proposed gene based software refactoring technique improves the refactoring quality than the existing Monitor-based instant refactoring framework [1] and weighted clustering algorithm [2].

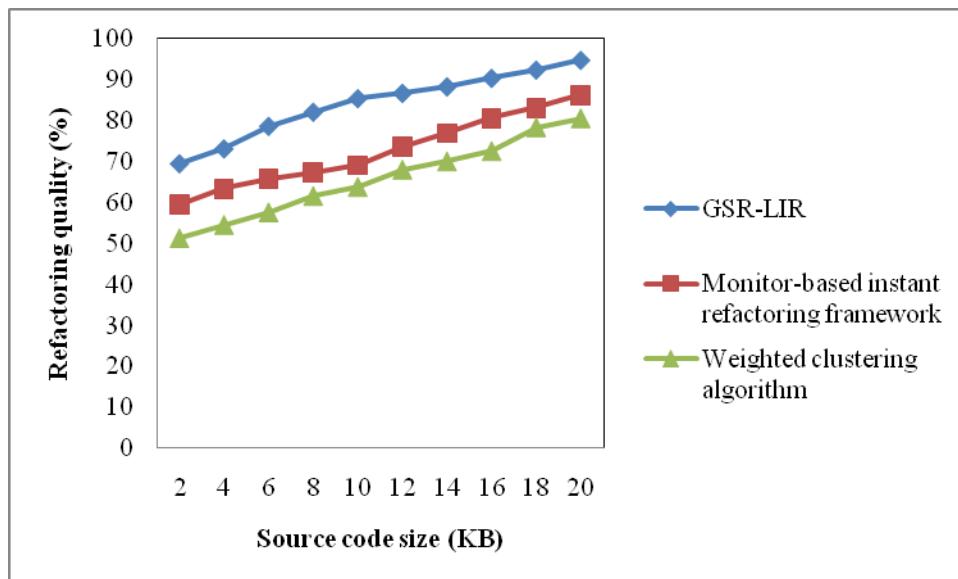


Figure 9 Measure of refactoring quality

Figure 9 depicts the impact of refactoring quality versus source code size using three methods. As shown in figure, the proposed GSRLIR technique provides improved performance result of refactoring quality than the two existing methods [1][2]. While increasing the size of the source code program, the refactoring quality gets increased using all three methods. This is due to application of gene based refactoring location identification and rectification technique. Initially, each software code lines are placed inside the gene. After that, the gene which has the strong quality and low quality is separated through the fitness function of local search for identifying the location to perform refactoring. Certain fitness threshold is fixed to identify the correct code and code smell from the source code. The weight of the gene is measured to identify the technically incorrect code. From that, the weaker genes are selected to perform efficient refactoring in order to perform rectification process through the mutation operation. In Mutation process, a randomly swapping the code creates the new offspring to increase the fitness value. This helps to improve the effect of the refactoring on quality uniqueness of the software. The quality of refactoring improves the code readability, maintainability, extensibility and complexity. Therefore, the GSRLIR technique improves refactoring quality by 9%, 18% when compared existing Monitor-based instant refactoring framework [1] and weighted clustering algorithm [2] respectively.

Therefore, Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique improves the code smell location detection accuracy and reduces the rectification time to maintain the software code quality.

5. RELATED WORKS

Software Refactoring [11] process used for improving the quality and permits developers to restore code without handling existing source code and starting again. Duplicate fragment of the code was detected in [12] using clone detection algorithm designed for UML domain approaches. However, the weighing similarity effects with the

size of the code fragments were not improved the accuracy of clone detection. This problem is addressed in gene based refactoring technique through the fitness measure.

The program dependence graph (PDG) was introduced in [13] to detect the code clones but failed to expand tools for detecting exact bugs in programs. The GSR-LIR technique effectively identifies the code smell (i.e. weaker gene). A traditional tree-based clone detection algorithm was designed in [14] by using more information regarding the variable slices. However, it failed to analyze the feasibility of making automated clone deletion. Therefore, the code duplication is identified through the local search of neighboring solution. An efficient clone detection was presented in [15] through three various tools and examine the impact of clone refactoring on different software quality parameters. However, the refactoring of clones failed to eliminate the new code smells and reduces the software quality. The gene based refactoring technique identifies the more code smell and improves the quality.

An Optimal Batched refactoring plan Execution methodologY (OBEY) was introduced in [16] to attain best batched refactoring plan execution. However, the OBEY does not improve the effects of refactoring plans for avoiding improper refactoring decisions. The gene based software refactoring technique performs gene rectification process and interchanging the code exclusive of affecting the external behavior. In [17], identifies the class attributes that express the information about the maintenance of that class to facilitate and develops a collection of metrics. However, the quality and maintainability of the software metrics was not considered. The proposed gene based refactoring technique improves the software quality code maintenance through the improvement of refactoring quality analysis.

A Methodbook technique was developed in [18] to detect refactoring ability and eliminate the bad smell from source code. But this technique was not used better refactoring tools. This problem is addressed in GSR-LIR technique to improve quality of refactoring. The association between complexity of software and maintenance costs was introduced in [19]. But it failed to reduce the costs of software maintenance. This problem is addressed in GSR-LIR technique to improve the quality of software code maintenance. A consistency-maintenance operation was defined in [20] that automatically forecast a code clone through copy-and-paste operations. However it stills hard to accurately forecast the consistency-maintenance. The GSR-LIR technique improves the consistency between the refactors' program code and other software objects to improve the quality. As a result, an efficient Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique improves their performance result and improves the software code quality maintenance.

6. CONCLUSION

Software code quality maintenance is a complex problem in software engineering to improve the performance of the framework. Therefore, an efficient Gene based Software Refactoring Location Identification and Rectification (GSR-LIR) technique is developed for software code quality maintenance. Initially, the location of code smell is identified through the fitness measurement through the optimal weight value of each gene. With the optimal weight value, the gene location is identified with threshold value and it selects which gene needs to be refactored. Based on the fitness value, the low quality gene is rectified through software refactoring technique

without changing the external behavior through the crossover and mutation operator. Therefore, code duplication, long parameter list, and temporary files are rectified to improve the software quality. This GSRLIR technique helps to guarantees the refactoring preserves behavior. Finally, the refactoring process improves consistency and improves the software quality code maintenance. Experimental evaluation is conducted with the open-source program as schoolmate dataset to measure the effectiveness of the proposed (GSR-LIR) technique in terms of Refactoring Code location identification accuracy, Refactoring Code consistency and Refactoring quality with respect to differing software project code size and source lines of code. The results analysis shows that GSR-LIR technique improves Refactoring Code location identification accuracy, Refactoring quality and Refactoring Code consistency with minimum time than the state-of-art methods.

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Analysis of Cholesterol Quantity Detection and ANN Classification

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Abstract

In the present day automation, the researchers have been using microcomputers and its allies to carryout processing of physical quantities and detection of Cholesterol in blood and bio-medical Images. The latest trend is to use FPGA counter parts, as these devices offer many advantages in comparison with Programmable devices. These devices are very fast and involve hardwired logic. FPGA are dedicated hardware for processing logic and do not have an operating system. That means that speeds can be very fast and multiple control loops can run on a single FPGA device at different rates. In this paper, an attempt is being made to develop a prototype system to sense the Cholesterol portion in MRI image using modified Set Partitioning in Hierarchical Trees (SHIPT) wavelets transformation and Radial Basis Function (RBF). An each stage of Cholesterol detection are displayed on LCD monitor for clear view of improved version of MRI image and to find Cholesterol area. The performance parameters have been measured in terms of Peak Signal to Noise Ratio (PSNR), and Mean Square Error (MSE).

Keywords: median filter, FPGA, Radial basis function ANN, cholesterol detection, and SHIPT Wavelet

1. Introduction

The History of centrifuge method has evolved since bygone days starting from the crudest method involving egg beaters, and manual rotating mechanisms involving spring. Later the improved versions employed electrically driven motors to achieve the centrifuge mechanism. Of late due to the tremendous improvement in power electronic technology, the centrifuge with precision control has been used. This paper involves a mechanically indigenously designed centrifuge to avoid vibrations and achieve the required goal with precision by incorporating power electronic control that spins the centrifuge at variable speeds [1-5]. The system also uses a FPGA module interfaced to 12 bit ADC (successive approximation type) to get the voltage levels by suitable sensors built in the mechanical set up. A LCD panel is also interfaced to FPGA to record the values of Cholesterol RBC and WBC count, which are obtained by judiciously implemented software. A hit and miss method was used by conducting several experiments to determine the best fit to select the haematocrit (Capillary). Finally we arrived at the conclusion that a capillary with the dimension of 2mm (dia) and 100mm (length) was selected. The table 1 shows a series of experiments performed on the centrifuge assembly to critically evaluate the counts of RBC and WBC depending upon the speed of the motor. From the table it is identified that the counts of RBC and WBC are acceptable when the centrifuge speed is about 10,000 rpm. Hence a dc motor having the capability to rotate at this speed is selected [6-7]. The count values of Cholesterol, RBC and WBC are classified using Radial Basis function (RBF) Artificial Neural Network [8]. A common characteristic of most of images is that the neighbouring pixels are correlated, that is, image contains the redundant information. Therefore most important task is to find a less correlated representation of image. The fundamental components of compression are reduction of redundancy and irrelevancy. Redundancy reduction aims at removing duplication from the image. Irrelevancy reduction omits parts of the signal that will not be noticed by the signal receiver namely the Human visual system (HVS). In general, three types of redundancies can be identified: Spatial redundancy, Spectral redundancy and temporal redundancy. In still image, the compression is achieved by removing spatial redundancy and spectral redundancy.

The lifting scheme wavelets transformation has been used for to extract features of MRI image in terms of energy and average levels in [10]. The level set segmentation has adapted for accurate segmentation and compared with different level set function such as Re-initialization, GDRLSE1, GDRLSE2, GDRLSE3 and RD in medical images

to segment required features in [15]. The multilayer perceptron ANN architecture is adapted for supervisor training to classify different features for kidney US images in [16]. The empirical law and RBF ANN are calculated exact values of Cholesterol, RBC and WBC values and displays on LCD and The entire setup was built by using add on cards for each section i.e., ADC 12 bit AD574, FPGA XC6S40t and LCD DEM 16216. A dc motor (12V, 3.3 A) capable of running at a speed of 10,000 rpm along with drive card was used to get the desired result. [13]. the rest of the paper is organized as follow: The basic of Non Sub Sampled Contour let Transform (NSCT) is described in section 2. Section 3 depicts robust estimation of NSCT coefficients at the finer scale of unknown HR image whereas section 4 explains the global constraint and removal of edge artefacts using soft edge smoothness prior. Through simulation on variety of images, the validation of the proposed algorithm is reported in section 5.

2. Methodology

Fig1 shows the overall block diagram of proposed method. It consists of the cholesterol image data base, image preprocessing, SHIPT wavelet processing and ANN classification. The 100 MRI cholesterol images are collected from different hospitals of different patients and are stored in database. One of the image is taken from the database and is subjected to cholesterol detection and the median filter has been used to improve the quality of the MRI image.

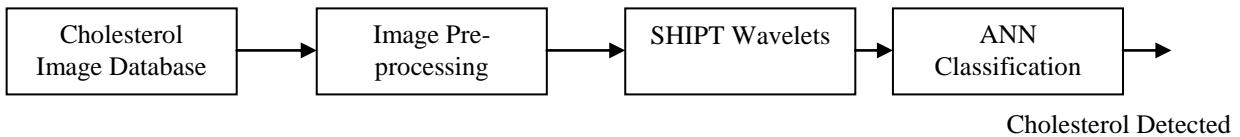


Fig.1.Block Diagram of proposed method

2.1 Modified Set Partitioning in Hierarchical Trees (SHIPT)

The SPIHT coder is a powerful image compression algorithm that produces an embedded bit stream from which the best reconstructed images in the mean square error sense can be extracted at various bit rates. The perceptual image quality, however, is not guaranteed to be optimal since the coder is not designed to explicitly consider the human visual system (HVS) characteristics. Extensive HVS research has shown that there are three perceptually significant activity regions in an image: smooth, edge, and textured or detailed regions. By incorporating the differing sensitivity of the HVS to these regions in image compression schemes such as SPIHT, the perceptual quality of the images can be improved at all bit rates. Previous work to improve the visual quality of embedded coders has applied just noticeable distortion thresholds for uniform noise in different subbands to weight the transform coefficients but no distinction made between coefficients belonging to different activity regions inside a subband. In this paper, the differing activity regions are used to assign perceptual weights to the transform coefficients prior to SPIHT encoding. The image to be compressed is transformed into frequency domain using wavelet transform. In wavelet transform the images are divided into odd and even components and finally the image is divided into four levels of frequency components. The four frequency components are LL, LH, HL, HH, and then the image is encoded using SPIHT coding. Then the bit streams are obtained. The obtained are decoded using SPIHT decoding. Finally inverse wavelet transform is taken and the compressed image will be obtained.

SPIHT algorithm depends on 3 concepts as follow

- Ordered bit plane progressive transmission
- Set partitioning sorting algorithm
- Spatial orientation trees.

Of these three concepts we are using Spatial Orientation Tree concepts in our thesis and the brief description of that is as follows.

2.1.1 Spatial Orientation Tress

Normally, most of an image's energy is concentrated in the low frequency components. Accordingly, the variance decreases as we move from the highest to the lowest levels of the subband pyramid. Moreover, it has been observed that there is a spatial self-similarity between sets, and the coefficients are expected to be better magnitude-ordered if we move downward in the pyramid following the same spatial orientation. For example, large low-activity areas are expected to be

identified in the highest levels of the pyramid, and they are imitated in the lower levels at the same spatial locations. A tree structure, defines the spatial relationship on the hierarchical pyramid. Fig 5. Shows how our spatial orientation tree is defined in a pyramid constructed with recursive four-subband splitting. Each node of the tree represents to a pixel and is identified by the pixel coordinate. Its direct descendants (offspring) correspond to the pixels of the same spatial orientation in the next finer level of the pyramid. The tree is defined as each node has either no offspring (the leaves) or four offspring, which always form a group of 2 x 2adjacent pixels. The pixels in the highest level of the pyramid are the tree roots and are also grouped in 2 x 2adjacent pixels. The following sets of coordinates are used to present the new coding method:

$$L(i, j) = D(i, j) - O(i, j).$$

$O(i, j)$: set of coordinates of all offspring of node (i, j) ;

$D(i, j)$: set of coordinates of all descendants of the node

H : set of coordinates of all spatial orientation tree roots (nodes in the highest pyramid level)

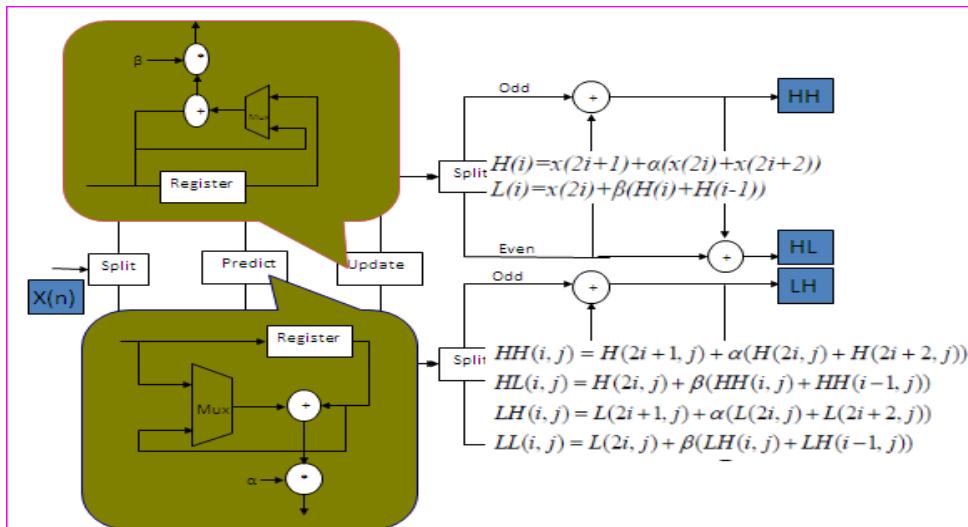


Fig. 2. Logical Block diagram of Modified SHIPT

Four different cases of inter level dependencies can be recognized: (1) A subband has within the same relative position child subbands which are on a coarser scale (parental conflict, type 1); example is the sub tree of T2 and child subbands C1, C2, C3, C4, Fig. 2(b). (2) A subband has within the same relative position child subband that is on the same scale; example is the sub tree of T2, Fig. 2(b). (3) A subband has within the same relative position child subband that is on a immediately finer scale; example is the sub tree of T3 (NP-natural parent-child relation), Fig. 2(b). (4) Relative position of subband overlaps with the relative position of a child subband that is on a scale more than one level finer (parental conflict, type 2); example is the sub tree of T1, Fig. 2(b) [14]. Wavelet analysis of an image can be viewed in the frequency domain as partitioning into a set of subbands, where each partitioning step is obtained by applying the 2D wavelet transform. One level of 2D wavelet transform results in four sets of data (wavelet coefficients), that correspond to four 2D frequency subbands. For these four subbands, if the original image data is on the zero decomposition level (scale), we use the following notation on k^{th} decomposition level: HH_k (high-high or diagonal details), HL_k (high-low or horizontal details), LH_k (low-high or vertical details), LL_k (low-low or approximation). LL_k subband is also called image approximation as it represents image on a lower scale, while to other subbands we refer as to image details. Wavelet decomposition is dyadic in a case when only the LL_k subband is further transformed. It results in a new set of subbands: HH_{k+1} , HL_{k+1} , LH_{k+1} , LL_{k+1} . Dyadic decomposition used in image compression will thus generate hierarchical pyramidal structure, as shown in Fig. 1. If the dyadic decomposition of N levels is performed (N times transforming the low-low subband) the result will be $3N + 1$ subbands. The W_P decomposition is a generalization of wavelet dyadic decomposition, where further wavelet transform on detail subbands is possible, potentially producing up to $4N$ final subbands. A Single wavelet packet decomposition thus provides a multitude of choices from which the best representation with respect to a design

objective (e.g. compression efficiency) can be found.

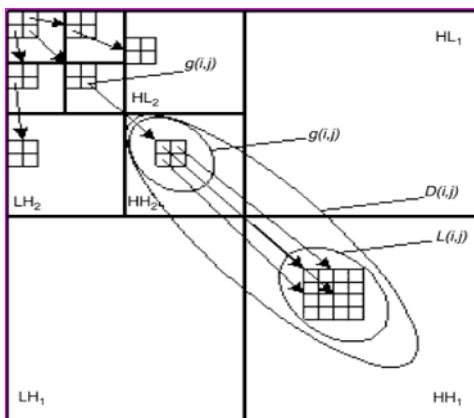


Fig. 2(a). Spatial orientation tree

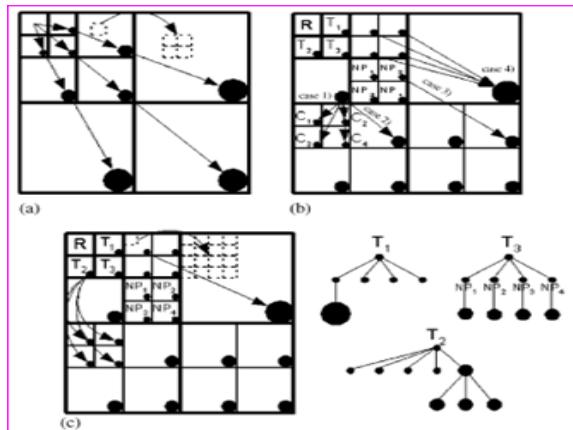


Fig. 2(b) Examples of parent–child assignments: (a) wavelet decomposition tree, (b) wavelet packet trees and inter-level dependencies, (c) parent–child assignments after resolving the parental conflicts.

3. Radial Basis Function (RBF)

The radial basis function (RBF) network is a special type of neural networks with several distinctive features [15]. Since its first proposal, the RBF network has attracted a high degree of interest in research communities. A RBF network consists of three layers, namely the input layer, the hidden layer, and the output layer. The input layer broadcasts the coordinates of the input vector to each of the units in the hidden layer. Each unit in the hidden layer then produces an activation based on the associated radial basis function. Finally, each unit in the output layer computes a linear combination of the activations of the hidden units. How a RBF network reacts to a given input stimulus is completely determined by the activation functions associated with the hidden units and the weights associated with the links between the hidden layer and the output layer.

RBF Algorithm:

Input: a set of training samples $S = \{s_1, s_2, \dots, s_n\}$;

Parameter values of k_1, k_2 , and m^\wedge listed in Table 2; parameter value of β .

Output: an SGF network.

Begin

For each class of training samples

{

Let S_j be the set of class- j training samples and construct a kd-tree for S_j ;

For each $si \in S_j$ {

Let $1 \leq k_1 \leq s^\wedge, s^\wedge, \dots, s^\wedge$ be the k_1 nearest training samples of the same class as si ;

$$\text{Compute } \bar{R}(s_i) = \frac{m+1}{k_1} \left(\frac{1}{k_1} \sum_{h=1}^{k_1} \|s_h - s_i\| \right) \text{ and compute } \sigma_i = \beta \frac{\sqrt{\prod_{h=1}^{k_1} \|s_h - s_i\|^2}}{\sqrt[m]{(k_1 + 1) \Gamma(\frac{m}{2} + 1)}}$$

}

Compute the approximate value of $\lambda = \sum_{h=-\infty}^{\infty} \exp\left(-\frac{h^2}{2\beta^2}\right)$

Construct an SGF sub-network with the following output function:

$$f_j^{\hat{m}}(j) = \frac{1}{|S_j|} \sum_{s_j \in S_j} \left(\frac{\beta}{\lambda \cdot \sigma_i} \right)^{m^{\hat{m}}} \exp \left(-\frac{\|v - s_i\|^2}{2\sigma_i^2} \right)$$

}

End

4. Results

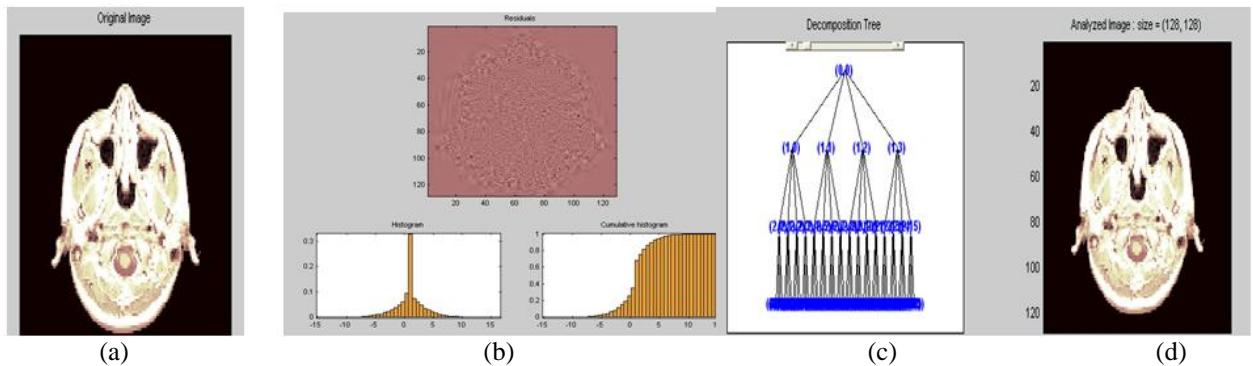


Fig.3. (a) Input MRI Image (b) Histogram Image (c) SHIPT Tree (d) Output of SHIPT

The MRI is taken as input and applied to histogram equalization to extract foreground image and plotted in histogram graph. This is applied to SHIPT DWT for three level decomposition and decomposed image is as shown in Fig.3 (d). The proposed work which is shown in simulation is implemented in real time on FPGA using Verilog HDL language. The database available is converted to image pixels and stored in memory using MATLAB. The data is processed by FPGA processor and connected to monitor for displaying each stage output as shown in the Fig.4. The first stage is input image from database and it is input to pre-processing techniques and its output is show in second stage. The 3rd, 4th and 5th images in Fig.2 are SHIPT, ANN and region based segmentation outputs, in the 5th image, red portion enmarks presence of Cholesterol in the input image.

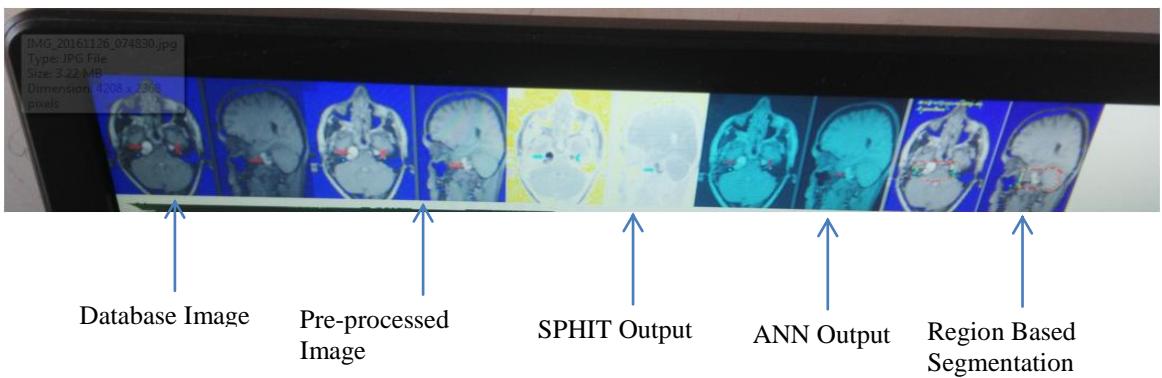


Fig.4. Elarged version of hardware implementaton results

Discussion

The experimental set up realized by FPGA platform gives precise results and complies with the results obtained by standard equipment. The cost of the set-up is very economical and can be further slashed on mass production. The system can be made handy and economic if the Whole hardware can be compiled into ASIC design, and can be a

promising instrumentation for the physicians working in the rural areas as the system requires power available from a battery source. Since the power source is derived from the 12V battery, it is safe to handle. The power consumption of the entire set up is in the order of 200 Watts. The battery used requires to be charged once in a fortnight to be efficiently used.

Table1. PSNR and MSE COMPARISON

Source Image	Bi-cubic Interpolation		SR via J. Yang et. al ²²		Proposed Approach		
	PSNR	MSE	PSNR	MSE	PSNR (dB)	MSE	Compression efficiency
Test Image I	25.8325	0.8835	27.2115	0.9108	58.4	0.379	87.2%
Test Image II	31.2447	0.9233	32.9040	0.9500	51.4	0.448	91.2%
Test Image III	21.7285	0.8148	22.5101	0.8539	62.9861	0.477	94.6%

The proposed algorithm produces more natural result than previous work. Here an attempt is being made to develop a prototype system to sense the Cholesterol, RBC, WBC from blood sample and detection of Cholesterol in the medical image which finds the counts of cholesterol, RBC and WBC using empirical law. Modified Set Partitioning in Hierarchical Trees (SHIPT) wavelets transformation and Radial Basis Function (RBF) are used for image processing. The count values of Cholesterol, RBC, WBC and Images are classified using Radial Basis function (RBF) Artificial Neural Network as shown in simulation Fig.5. The count values of Cholesterol, RBC and WBC are displayed on LCD and Cholesterol image will be displayed on monitor to find Cholesterol area. The performance parameters have been measured in terms of Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE) and Compression Efficiency.

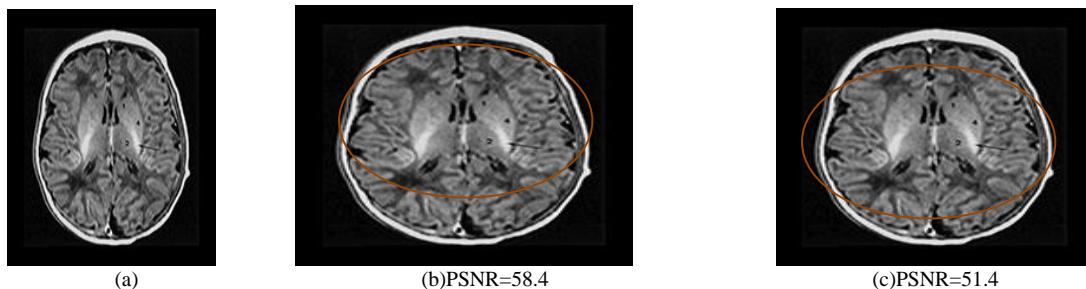


Fig. 5. (a) MRI image, Wavelet results using (b) J Yang et. al, (c) proposed algorithm

Conclusion

The author enhanced the existing research work is to produce accurate MSE, PSNR and SNR values for Cholesterol detection which is compatible with standard protocol has been proposed in this paper and also incorporated the previous work of test medical images in terms on PSNR and MSE. The extracted features are successfully classified in terms of counter vales and the system has produced accurate parameters count values and the count values are near to standard medical expert's count results. The RBF ANN has generated reports for all three parameters values as text file and also displayed on monitor.

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A COMPARISON OF ARTIFICIAL NEURAL NETWORK AND MULTIPLE REGRESSION ANALYSIS IN MODELING GDP IN NIGERIA.

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ABSTRACT

This research work is the application of artificial neural network (ANN) and statistical method of multiple regression analysis in predicting GDP in Nigeria collected from C.B.N annual statistical bulletin 2014 covering from year 1979 to 2014. GDP representing economic growth as a function of macroeconomic variables. Evident from the analysis shows that the independent variables are highly correlated with the dependent variable of GDP, excepting the inflation rate having a negative correlation value of approximately 0.4. However, the value of the goodness of fit (R^2) is given as 0.812 (81.2%).

Based on the values of R^2 , MSE and RMSE and for comparison of efficiency between ANN and regression analysis, it was discovered that ANN model outperforms regression analysis significantly and thus achieve a better fit and forecast.

Keywords: *GDP, Inflation rate, Consumer price index, Exchange rate, Regression, ANN.*

1.0 INTRODUCTION

The study of macro- economic variables such as exchange rate, inflation rate and consumer price index play a vital role in forecasting of Gross domestic product in Nigeria economy.

GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

The monetary value of all finished goods and services produced within a country's borders in a specific time period, GDP is usually calculated on an annual basis. It also includes all of private and public consumption, government outlays, investments and exports less imports that occur within a defined territory.

The GDP in Nigeria is growing at the average of 6.48% in the third quarter of 2012 over the previous quarter and going by the information provided by the National Bureau of Statistics. In the past, Nigeria GDP rate average about 6.8% getting to all the time rise of about 8.6% in December, 2010 and a poor showing of about 4.5% was recorded in march, 2009.

Nigeria is being regarded as the most developed economies in Sub-Saharan Africa after South-Africa and hence, over 90% of the foreign trade earnings come from the petroleum industry and which eventually account for about 80% of the budget revenues. More importantly, agricultural sector still accounts for the source of revenue for about two-third of the population and over 50% of Nigeria live below the poverty line. This state of affairs is largely accounted for by the high rate of corruption, mismanagement of public funds and poor state infrastructure that are prevailing in the country and this in fact created a serious problem for future development.

In recent years, Nigerians have experienced some moderate growth with the discovery of petroleum in 1958 commercial quantity by the colonial administration and the country has emerged as a major oil exporter and most of her reserves are located in Niger-Delta region of the country. But the country over reliance on the oil sector, which is capital intensive in nature, ignore the need to diversified the economy and probably return back to the agricultural sector from which the country derived substantial part of her revenue before the emergence of the petroleum sector in the country. But with the introduction of Structural Adjustment Program (SAP), coupled with the need to allow for private participation in the ³⁹² <https://sites.google.com/site/ijcsis/> ISSN 1947-5500 economy, it is interesting to note that Non-oil sector have witnessed a tremendous growth in recent years

and the sector recording about 9.1% growth rate and agricultural sector contributed about 51.1% of the non-oil sector (Mordi and Nwawudu, 2010). But it needs to emphasise that building, services, health and education equally played critical role in the countries grow drive.

The growth of the non-oil sector was driven by government reform and the expansion of the private sector. The Program of structural Adjustment Program further entails deregulation of the economy and this impact positively on the non-oil sector and in fact, it can safely be argued that Nigeria heavy dependence on the oil sector as a major source of earning is however, driven by the non-oil sector, most especially agricultural sectors.

The recent upsurge in research activities into artificial neural networks (ANN) has proven that neural networks have powerful pattern classification and prediction capabilities.

Widrow, B. etal (1994) shows that ANN s have been successfully use for variety of tasks in many field of business, industry and sciences. Chung etal(2007), A neural network is able to work parallel with input variable and consequently handle large set of data quickly. The principal strength with the network is ability to find patterns. ANNs provide the promising alternative tool for forecasters. The inherently non linear structure of neural networks is particularly useful for capturing the complex underlying relationship in many real world problems. Neural networks are more versatile method for forecasting applications in that, not only can they find non linear structure in a problem, they can also model linear processes for example, the capabilities of neural networks or modelling linear time series has been studied and confirmed by a number of researchers. (Hwang, H.B, Medeiros,M.C. etal and Zhang,, G.P 2001).

One of the major application areas of ANNs is forecasting. Forecasting has a long history and important of this is reflected by the diversity of its applications in difference disciplines ranging from business to engineering. The ability to accurately predict the future is fundamental to many decision processed in planning, scheduling, purchasing, strategy formulation, policy making, supply change operation and stock price.

Forecasting is an area where a lot efforts have been invested upon. Yet, it is still an important active field of human activities at the present time and continue to be in the future. Armstrong, J.S (1998). Provided a survey of research needs for forecasting. Forecasting has been dominated by linear method for many decays.

Linear method are easy to develop, implement and they are also relatively simple to understand and interpreted. However, linear models have serious limitation in that they are not able to capture any non linear relationship in the data. Qing, C.etal (2005). Their study uses artificial neural networks to predict stock prices movement for firms traded on shanghais stock exchange. They compare the predictive power using linear model from financial forecasting to be predictive power of univariate and multivariate neural networks model. The result shows that neural networks outperform the linear models.

Artificial neural Network (ANN) non-linear models have been widely used for resolving forecast problems (Altum, Bilgil, and Fidan, 2007; Hill, o' Connor, and Remus, 1996; Tseng, Yu, and Tzenf 2002). The ANN model attempts to duplicate the processes of the human brain and nervous system using the computer. While this field originated in biology and psychology, it is rapidly advancing into other areas including business and economics (Chiang Urban and Baldridge, 1996, Enke and Thawornwong, 2005; etc.). The theoretical advantage of ANNs is that relationships need not be specified in advance since the method itself establishes relationships through a learning process. Also, ANNs do not require any assumptions about underlying population distributions. A lot of research has been done to compare the performances of ANN and traditional statistical models.(Kumar, 2005, Pao, 2006, Wang and Elhag, 2007, Zhang, 2001 etc.). Most researchers find that ANN can outperform linear models under a variety of situations.

The primary objectives are to examine and analyze the use of artificial neural network as a predicting tool. To examine the ability of artificial neural network in the prediction of GDP representing Nigeria's economic as a function of macro-economic variables including exchange rate, inflation rate and consumer price index. Accuracy of the artificial neural network will be compared against the traditional prediction technique of multiple linear regression analysis. The data on macro-economic variables were collected from CBN annual statistical bulletin 2014 covering from year 1979 to 2014. The rest of the paper is organized as follows. Section 2 present materials and methods. Section 3 presents empirical results of a comparative study of ANN and linear regression models and final section contains the conclusions.

2.0 MATERIALS AND METHODS

2.1 The Neural Network Model

There is a large amount of interest for the use of neural networks in forecasting. Maliki, S.O, et al (2011).

The true power and advantage of neural network lies in the ability to present both linear and non-linear relationships directly from the data being modelled. Traditional linear models are simply inadequate when it comes to model data that contains non-linear characteristics. In this research work, a neural network is selected among the main network architectures used in engineering. The basis of the model is neuron structure, Sharda, R. and Patil, R. (1990) as depicted in Fig. 2.1 below. These neurons act like parallel processing units. An artificial neuron is a unit that performs a simple mathematical operation on its inputs and initiates the functions of biological neurons and their unique process of learning. In figure 2.1

$$\text{let } v_k = \sum_{j=1}^m x_j w_{kj} + b_k$$

The neuron output will be $y_k = f(v_k)$

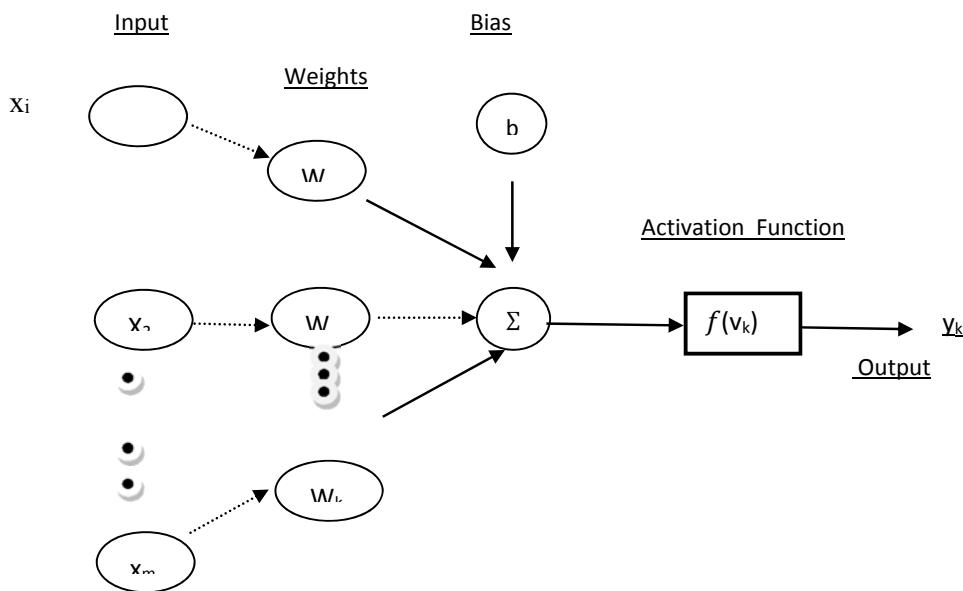


Fig. 2.1: Mathematical Structure of ANN

For the analysis the ANN algorithm built into SPSS 20 software was used. The algorithm implements automatically the multi layer perception (MLP) neural network with a gradient descent learning.

2.2 Learning By Gradient Descent Error Minimization.

The perception-learning rule is an algorithm that adjusts the network weights W_{mn} to minimize the difference between the actual outputs y_{ki} and the target outputs t_{ki} . This difference can be quantified by sum squared error function, summed overall output unit (i) and all training patterns (m).

$$E(w_{mn}) = \frac{1}{2} \sum_{k=1}^m \sum_{i=1}^n (t_{ki} - y_{ki})^2$$

The aim of network learning is to minimize the error by adjusting the weights w_{mn} . Consider the gradient of E.

$$\nabla E(w) = \nabla E(w_1, \dots, w_n) = \left[\frac{\partial E}{\partial w_0}, \frac{\partial E}{\partial w_1}, \dots, \frac{\partial E}{\partial w_n} \right]$$

And the training rule becomes

$$\Delta w = -\eta \nabla E(w)$$

This implies that

$$\Delta w_i = -\eta \frac{\partial E}{\partial w_i} \text{ and the weight update is given as before}$$

$$w_i \leftarrow \dots \dots \dots + \Delta w_i$$

Note: The perception training rule can be proved to converge, if training data is linearly separable and η sufficiently small. To understand the gradient descent, this can be modelled by simple linear unit.

$$Z = w_0 + w_1 x_1 + \dots + w_n x_n$$

The interest in learning w_i 's that minimize the square error

$$E(w_1, \dots, w_n) = \frac{1}{2} \sum_{j \in D} (t_j - z_j)^2$$

Where D is the set of training examples. E defines the loss function we intend to minimize. We derive the gradient descent minimization as follows.

$$\frac{\partial E}{\partial w_i} = \frac{\partial}{\partial w_i} \frac{1}{2} \sum_j (t_j - z_j)^2$$

$$\begin{aligned}
&= \frac{1}{2} \sum_j \frac{\partial}{\partial w_i} (t_j - z_j)^2 \\
&= \frac{1}{2} \sum_j 2(t_j - z_j) \frac{\partial}{\partial w_i} (t_j - z_j) \\
&= \sum_j (t_j - z_j) \frac{\partial}{\partial w_i} (t_j - w \cdot x_j) \\
\frac{\partial E}{\partial w_i} &= \sum_j (t_j - z_i)(-x_{i,j})
\end{aligned}$$

2.3 Statistical Technique

Regression methods is one of the most widely used statistical techniques. Mendenhall and Beaver (1994). Multiple regression analysis is a multivariate statistical techniques used to examine the relationship between a single dependent variable and a set independent variable. The objective of the multiple regression analysis is to use independent variables whose values are known to predict the single dependent variable. The effect of independent variable on the response variable is express mathematically as:

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_m x_m + \epsilon_i$$

where y is the dependent variable, $x_1, x_2, x_3, \dots, x_m$

are independent variables, $\beta_0, \beta_1, \beta_2, \beta_3, \dots, \beta_m$ are regression parameters (unknown) and ϵ_i is the random error term. To estimate the unknown regression parameters $(\beta_0, \beta_1, \beta_2, \beta_3, \dots, \beta_m)$, the method of least square can be applied.

2.4 Model Specification

Multiple regression model attempted to look at the effect or the relationship between a dependent variable and independent variables. With regard to this study, the dependent variable of interest is Gross Domestic Product (GDP) and the independent variables are inflation rate, exchange rate, consumer price index. The model specified is therefore:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \epsilon_i \text{ let } GDP = y,$$

inflation rate = x_1 , Exchange rate = x_2 and Consumer prize index = x_3

$GDP = \beta_0 + \beta_1 \text{inflation rate} + \beta_2 \text{Exchange rate} + \beta_3 \text{Consumer prize index}$ And

$\beta_0, \beta_1, \beta_2, \beta_3, > 0$

2.5 Factors for Comparison Of Two Methods

Since we are considering two prediction models, namely, neural network and regression, we compare the results obtained for their individual prediction, find out which model is more efficient, and accurately predict better. This is done using the following statistical performance measures:

Coefficient of determination (R^2)=

$$\frac{\sum_{t=1}^n (\hat{y}_t - \bar{y})^2}{\sum_{t=1}^n (y_t - \bar{y})^2}$$

$$\text{Mean square error (MSE)} = \frac{1}{n} \sum_{t=1}^n (y_t - \hat{y}_t)^2$$



$$\text{Root means square error (RMSE)} = \sqrt{\frac{1}{n} \sum_{t=1}^n (y_t - \hat{y}_t)^2}$$

3.0RESULT AND ANALYSIS

The analysis below shows the result of two methods and the model created by linear regressions and neural network methods and comparison of model's results using the above mentioned factors.

3.1

Computer output for regression analysis

Table 1:

Correlations

Pearson Correlation	Correlations				
	GDP	Inflation rate	Exchange rate	Consumer price index	
	GDP	1.0000	-0.038	0.488	0.543
	Inflation rate	0.38	1.000	-0.322	-0.285
	Exchange rate	0.488	-0.322	1.000	0.941
Consumer price index	0.543	-0.285	0.941	1.000	

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	std. Error of the Estimate
1	.7058 ^a	0.812	.247	151521.260520

a. Predictors: (Constant), Consumer price index, Inflation rate, Exchange rate

Table 3: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
1	(Constant)	59777.464	60624.701		-.986
	Inflation rate	-1240.291	1612.599	-.119	.769
	Exchange rate	353.779	1128.751	.137	-.313
	Consumer price index	1923.107	1179.708	.706	1.630

a. Dependent Variable: GDP

From Table 1, Table 2 and Table 3, the regression equation that can be developed is thus:

$$GDP = 59777.464 - 1240.29 \text{Inflation r.} + 353.779 \text{Exchange r.} + 1923.107 \text{Consumer P.I}$$

The model is thus interpreted as follows. The constant value of 59777.464 is the intercept which represent total output of Nigeria economy in terms of its GDP. On the other hand, the coefficient of inflation rate, exchange rate and consumer price index which are -1240.29, 353.779 and 1923.107 respectively implies how much or the magnitude which GDP would change (increase) per unit change in independent variables which shows that there is a positive relationship between GDP and macro-economic variable given the data for the period under consideration. Furthermore, R and R² which indicate the multiple correlation and coefficient of determination respectively. The R (0.7058) shows that there exist strong positive relationship between GDP and inflation rate, exchange rate and consumer price index. The R² value of 0.812 means the proportion of variation in GDP is explained by the independent variable. This means independent variable accounted for 81.2% of the changes in GDP with regard to the data for the period under review.

3.2 Computer Output for Artificial Neural Network Analysis.

Multilayer perception

Table 4: Processing Summary

	N	Percent
Sample	Training	28
	Testing	8
Valid	36	100.0%
Excluded	0	
Total	36	

Table 5: Parameter Estimates

Predictor	Predicted	
	Hidden Layer	Output Layer
	H(1:1)	GDP
Input Layer	(Bias)	6.768
	Inflationrate	-.642
	Exchangerate	1.047
	Consumerpriceindex	-4.063
	Hidden layer 1 (Bias)	4.292
	H(1:1)	-4.554

— Synaptic Weight > 0
— Synaptic Weight < 0



Hidden layer activation function: Hyperbolic tangent

Output layer activation function: Identity

Table 6: Model Summary

	Sum of Squares Error	.236
	Relative Error	.017
Training	Stopping Rule Used	1 consecutive step(s) with no decrease in error ^a
	Training Time	0:00:00.00
Testing	Sum of Squares Error	.035
	Relative Error	.037

Dependent Variable: GDP

Error computations are based on the testing sample.

Table 7: Independent Variable Importance

	Importance	Normalized Importance
Inflationrate	.088	10.8%
Exchangerate	.100	12.4%
Consumerpriceindex	.812	100.0%

3.3 COMPARISON OF PERFORMANCE

Table 8 below shows the summary of results obtained for the statistical and neural network model for the prediction of GDP as a function of macro-economic variable in Nigeria. The predicting abilities of the two models were accessed using coefficient of determination (R^2), Mean square error (MSE) and Root mean square error (RMSE).

Table 8: The compare of two methods

Model	R ²	MSE	RMSE
Regression	0.812	15152.260	389.36
Artificial neural network	0.878	0.035	0.1871

The result clearly shows that Artificial neural network model have lowest MSE, RMSE and highest R² values. These indicate that the non-linear models generate a better fit and predict GDP in Nigeria than the regression model.

4.0 CONCLUSION

The main objective of this research paper was to examine and analyse the use of artificial neural network as a predictive tool and to compare it with the traditional prediction technique of multiple linear regression analysis. The comparison of the outcomes of the ANN models with the multiple regression models outperforms multiple regressions significantly. These results clearly, establish that ANN model performs better than multiple regression models in capturing the underlying structure of the non-linear process and accurately predict the GDP as a function of macro-economic variables.

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International Journal of Computer Science and Information Security

IJCSIS 2017-2018

ISSN: 1947-5500

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Track A: Security

Access control, Anonymity, Audit and audit reduction & Authentication and authorization, Applied cryptography, Cryptanalysis, Digital Signatures, Biometric security, Boundary control devices, Certification and accreditation, Cross-layer design for security, Security & Network Management, Data and system integrity, Database security, Defensive information warfare, Denial of service protection, Intrusion Detection, Anti-malware, Distributed systems security, Electronic commerce, E-mail security, Spam, Phishing, E-mail fraud, Virus, worms, Trojan Protection, Grid security, Information hiding and watermarking & Information survivability, Insider threat protection, Integrity
Intellectual property protection, Internet/Intranet Security, Key management and key recovery, Language-based security, Mobile and wireless security, Mobile, Ad Hoc and Sensor Network Security, Monitoring and surveillance, Multimedia security ,Operating system security, Peer-to-peer security, Performance Evaluations of Protocols & Security Application, Privacy and data protection, Product evaluation criteria and compliance, Risk evaluation and security certification, Risk/vulnerability assessment, Security & Network Management, Security Models & protocols, Security threats & countermeasures (DDoS, MiM, Session Hijacking, Replay attack etc.,) Trusted computing, Ubiquitous Computing Security, Virtualization security, VoIP security, Web 2.0 security, Submission Procedures, Active Defense Systems, Adaptive Defense Systems, Benchmark, Analysis and Evaluation of Security Systems, Distributed Access Control and Trust Management, Distributed Attack Systems and Mechanisms, Distributed Intrusion Detection/Prevention Systems, Denial-of-Service Attacks and Countermeasures, High Performance Security Systems, Identity Management and Authentication, Implementation, Deployment and Management of Security Systems, Intelligent Defense Systems, Internet and Network Forensics, Large-scale Attacks and Defense, RFID Security and Privacy, Security Architectures in Distributed Network Systems, Security for Critical Infrastructures, Security for P2P systems and Grid Systems, Security in E-Commerce, Security and Privacy in Wireless Networks, Secure Mobile Agents and Mobile Code, Security Protocols, Security Simulation and Tools, Security Theory and Tools, Standards and Assurance Methods, Trusted Computing, Viruses, Worms, and Other Malicious Code, World Wide Web Security, Novel and emerging secure architecture, Study of attack strategies, attack modeling, Case studies and analysis of actual attacks, Continuity of Operations during an attack, Key management, Trust management, Intrusion detection techniques, Intrusion response, alarm management, and correlation analysis, Study of tradeoffs between security and system performance, Intrusion tolerance systems, Secure protocols, Security in wireless networks (e.g. mesh networks, sensor networks, etc.), Cryptography and Secure Communications, Computer Forensics, Recovery and Healing, Security Visualization, Formal Methods in Security, Principles for Designing a Secure Computing System, Autonomic Security, Internet Security, Security in Health Care Systems, Security Solutions Using Reconfigurable Computing, Adaptive and Intelligent Defense Systems, Authentication and Access control, Denial of service attacks and countermeasures, Identity, Route and

Location Anonymity schemes, Intrusion detection and prevention techniques, Cryptography, encryption algorithms and Key management schemes, Secure routing schemes, Secure neighbor discovery and localization, Trust establishment and maintenance, Confidentiality and data integrity, Security architectures, deployments and solutions, Emerging threats to cloud-based services, Security model for new services, Cloud-aware web service security, Information hiding in Cloud Computing, Securing distributed data storage in cloud, Security, privacy and trust in mobile computing systems and applications, **Middleware security & Security features:** middleware software is an asset on

its own and has to be protected, interaction between security-specific and other middleware features, e.g., context-awareness, **Middleware-level security monitoring and measurement:** metrics and mechanisms for quantification and evaluation of security enforced by the middleware, **Security co-design:** trade-off and co-design between application-based and middleware-based security, **Policy-based management:** innovative support for policy-based definition and enforcement of security concerns, **Identification and authentication mechanisms:** Means to capture application specific constraints in defining and enforcing access control rules, **Middleware-oriented security patterns:** identification of patterns for sound, reusable security, **Security in aspect-based middleware:** mechanisms for isolating and enforcing security aspects, **Security in agent-based platforms:** protection for mobile code and platforms, Smart Devices: Biometrics, National ID cards, Embedded Systems Security and TPMs, RFID Systems Security, Smart Card Security, Pervasive Systems: Digital Rights Management (DRM) in pervasive environments, Intrusion Detection and Information Filtering, Localization Systems Security (Tracking of People and Goods), Mobile Commerce Security, Privacy Enhancing Technologies, Security Protocols (for Identification and Authentication, Confidentiality and Privacy, and Integrity), Ubiquitous Networks: Ad Hoc Networks Security, Delay-Tolerant Network Security, Domestic Network Security, Peer-to-Peer Networks Security, Security Issues in Mobile and Ubiquitous Networks, Security of GSM/GPRS/UMTS Systems, Sensor Networks Security, Vehicular Network Security, Wireless Communication Security: Bluetooth, NFC, WiFi, WiMAX, WiMedia, others

This Track will emphasize the design, implementation, management and applications of computer communications, networks and services. Topics of mostly theoretical nature are also welcome, provided there is clear practical potential in applying the results of such work.

Track B: Computer Science

Broadband wireless technologies: LTE, WiMAX, WiRAN, HSDPA, HSUPA, Resource allocation and interference management, Quality of service and scheduling methods, Capacity planning and dimensioning, Cross-layer design and Physical layer based issue, Interworking architecture and interoperability, Relay assisted and cooperative communications, Location and provisioning and mobility management, Call admission and flow/congestion control, Performance optimization, Channel capacity modeling and analysis, Middleware Issues: Event-based, publish/subscribe, and message-oriented middleware, Reconfigurable, adaptable, and reflective middleware approaches, Middleware solutions for reliability, fault tolerance, and quality-of-service, Scalability of middleware, Context-aware middleware, Autonomic and self-managing middleware, Evaluation techniques for middleware solutions, Formal methods and tools for designing, verifying, and evaluating, middleware, Software engineering techniques for middleware, Service oriented middleware, Agent-based middleware, Security middleware, Network Applications: Network-based automation, Cloud applications, Ubiquitous and pervasive applications, Collaborative applications, RFID and sensor network applications, Mobile applications, Smart home applications, Infrastructure monitoring and control applications, Remote health monitoring, GPS and location-based applications, Networked vehicles applications, Alert applications, Embedded Computer System, Advanced Control Systems, and Intelligent Control : Advanced control and measurement, computer and microprocessor-based control, signal processing, estimation and identification techniques, application specific IC's, nonlinear and adaptive control, optimal and robot control, intelligent control, evolutionary computing, and intelligent systems, instrumentation subject to critical conditions, automotive, marine and aero-space control and all other control applications, Intelligent Control System, Wiring/Wireless Sensor, Signal Control System. Sensors, Actuators and Systems Integration : Intelligent sensors and actuators, multisensor fusion, sensor array and multi-channel processing, micro/nano technology, microsensors and microactuators, instrumentation electronics, MEMS and system integration, wireless sensor, Network Sensor, Hybrid

Sensor, Distributed Sensor Networks. Signal and Image Processing : Digital signal processing theory, methods, DSP implementation, speech processing, image and multidimensional signal processing, Image analysis and processing, Image and Multimedia applications, Real-time multimedia signal processing, Computer vision, Emerging signal processing areas, Remote Sensing, Signal processing in education. Industrial Informatics: Industrial applications of neural networks, fuzzy algorithms, Neuro-Fuzzy application, bioInformatics, real-time computer control, real-time information systems, human-machine interfaces, CAD/CAM/CAT/CIM, virtual reality, industrial communications, flexible manufacturing systems, industrial automated process, Data Storage Management, Harddisk control, Supply Chain Management, Logistics applications, Power plant automation, Drives automation. Information Technology, Management of Information System : Management information systems, Information Management, Nursing information management, Information System, Information Technology and their application, Data retrieval, Data Base Management, Decision analysis methods, Information processing, Operations research, E-Business, E-Commerce, E-Government, Computer Business, Security and risk management, Medical imaging, Biotechnology, Bio-Medicine, Computer-based information systems in health care, Changing Access to Patient Information, Healthcare Management Information Technology. Communication/Computer Network, Transportation Application : On-board diagnostics, Active safety systems, Communication systems, Wireless technology, Communication application, Navigation and Guidance, Vision-based applications, Speech interface, Sensor fusion, Networking theory and technologies, Transportation information, Autonomous vehicle, Vehicle application of affective computing, Advance Computing technology and their application : Broadband and intelligent networks, Data Mining, Data fusion, Computational intelligence, Information and data security, Information indexing and retrieval, Information processing, Information systems and applications, Internet applications and performances, Knowledge based systems, Knowledge management, Software Engineering, Decision making, Mobile networks and services, Network management and services, Neural Network, Fuzzy logics, Neuro-Fuzzy, Expert approaches, Innovation Technology and Management : Innovation and product development, Emerging advances in business and its applications, Creativity in Internet management and retailing, B2B and B2C management, Electronic transceiver device for Retail Marketing Industries, Facilities planning and management, Innovative pervasive computing applications, Programming paradigms for pervasive systems, Software evolution and maintenance in pervasive systems, Middleware services and agent technologies, Adaptive, autonomic and context-aware computing, Mobile/Wireless computing systems and services in pervasive computing, Energy-efficient and green pervasive computing, Communication architectures for pervasive computing, Ad hoc networks for pervasive communications, Pervasive opportunistic communications and applications, Enabling technologies for pervasive systems (e.g., wireless BAN, PAN), Positioning and tracking technologies, Sensors and RFID in pervasive systems, Multimodal sensing and context for pervasive applications, Pervasive sensing, perception and semantic interpretation, Smart devices and intelligent environments, Trust, security and privacy issues in pervasive systems, User interfaces and interaction models, Virtual immersive communications, Wearable computers, Standards and interfaces for pervasive computing environments, Social and economic models for pervasive systems, Active and Programmable Networks, Ad Hoc & Sensor Network, Congestion and/or Flow Control, Content Distribution, Grid Networking, High-speed Network Architectures, Internet Services and Applications, Optical Networks, Mobile and Wireless Networks, Network Modeling and Simulation, Multicast, Multimedia Communications, Network Control and Management, Network Protocols, Network Performance, Network Measurement, Peer to Peer and Overlay Networks, Quality of Service and Quality of Experience, Ubiquitous Networks, Crosscutting Themes – Internet Technologies, Infrastructure, Services and Applications; Open Source Tools, Open Models and Architectures; Security, Privacy and Trust; Navigation Systems, Location Based Services; Social Networks and Online Communities; ICT Convergence, Digital Economy and Digital Divide, Neural Networks, Pattern Recognition, Computer Vision, Advanced Computing Architectures and New Programming Models, Visualization and Virtual Reality as Applied to Computational Science, Computer Architecture and Embedded Systems, Technology in Education, Theoretical Computer Science, Computing Ethics, Computing Practices & Applications

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ISSN 1947 5500
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