INTERNATIONAL INSTITUTE OF EDUCATIONAL RESEARCH & DEVELOPMENT

International Conference on Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering

(ICNSMDAIME-20)

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Editorial:

We cordially invite you to attend the International Conference on Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering (ICNSMDAIME-20), which will be held in Istanbul, Turkey on August 27th-28th, 2020. The main objective of ICNSMDAIME-20 is to provide a platform for researchers, students, academicians as well as industrial professionals from all over the world to present their research results and development activities in Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering. This conference provides opportunities for the delegates to exchange new ideas and experience face to face, to establish business or research relations and to find global partners for future collaboration.

These proceedings collect the up-to-date, comprehensive and worldwide state-of-art knowledge on Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering. All accepted papers were subjected to strict peer-reviewing by 2-4 expert referees. The papers have been selected for these proceedings because of their quality and the relevance to the conference. We hope these proceedings will not only provide the readers a broad overview of the latest research results on Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering but also provide the readers a valuable summary and reference in these fields.

The conference is supported by many universities and research institutes. Many professors played an important role in the successful holding of the conference, so we would like to take this opportunity to express our sincere gratitude and highest respects to them. They have worked very hard in reviewing papers and making valuable suggestions for the authors to improve their work. We also would like to express our gratitude to the external reviewers, for providing extra help in the review process, and to the authors for contributing their research result to the conference.

Since June 2020, the Organizing Committees have received more than 40 manuscript papers, and the papers cover all the aspects in Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering. Finally, after review, about 10 papers were included to the proceedings of ICNSMDAIME-2020.

We would like to extend our appreciation to all participants in the conference for their great contribution to the success of International Conference 2020. We would like to thank the keynote and individual speakers and all participating authors for their hard work and time. We also sincerely appreciate the work by the technical program committee and all reviewers, whose contributions make this conference possible. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard work.

Acknowledgement

IIERD is hosting the International Conference on Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering this year in month of August. International Conference on Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering will provide a forum for students, professional engineers, academician, and scientist engaged in research and development to convene and present their latest scholarly work and application in the industry. The primary goal of the conference is to promote research and developmental activities in Nanotechnology and Smart Materials, Design Artificial Intelligence, Manufacturing and Engineering and to promote scientific information interchange between researchers, developers, engineers, students, and practitioners working in and around the world. The aim of the Conference is to provide a platform to the researchers and practitioners from both academia as well as industry to meet the share cutting-edge development in the field.

I express my hearty gratitude to all my Colleagues, Staffs, Professors, Reviewers and Members of organizing committee for their hearty and dedicated support to make this conference successful. I am also thankful to all our delegates for their pain staking effort to travel such a long distance to attain this conference.

Dr. Simpson Rodricks
President
International Institute of Education, Research and Development (IIERD)

CONTENTS

A Framework for Ann-Based Oder Sensing System: An Electronic Nose Approach

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Abstract:-- **Odor Sensing and electronic noses has formed into a vital part of our lives with numerous uses of it. From detecting food spoilage, to diagnosis of diseases, it has been developed and tested in various fields and industries for specific purposes. This research work proposes a machine learning based e-nose system that has been developed for detection of various types of odors for a general purpose. The system can be trained on any odor using various e-nose sensors of various types. Artificial Neural Network is employed as its Machine Learning algorithm along with an OMX-GR semiconductor gas sensor for collecting odor data.The system was trained and tested with three different types of odors collected through a standard data collection method and then purified which in turn had a result varying from 93% to 100% accuracy.**

Index Terms: artificial neural network (ANN), electronic nose (e-nose), back propagation, OMX-GR sensor

I. INTRODUCTION

The headway of innovation in the previous couple of decades showed all methods for solace and openness. For example, the cell phones that we had once that used for voice communications are now changed to smart phones and the methods of interacting with a these devices using a traditional keyboard has now been complimented by touch, and even through voice commands.

These advances have had the specialists and researchers chip away at various ways and techniques to add more approaches to communicate with computers and by one means or another give it more “senses”. This vision has prompted advancement of different sorts of sensors through which computers can interact with users and the environment around them. Improvements have been made in the fields of different sorts of connections, for example, touch/pressure, measuring temperature and notwithstanding giving computers a "vision" through cameras and image recognition. These developments and advancements have enabled different applications in many industries.

One of these "senses" has been empowering the computer to "smell" or distinguish odors. Envision being on a video call with a companion over another country and having the capacity to smell what perfume they are wearing. Or, then again being able to not just take pictures and keep them as recollections yet additionally smell the places and events. Or, on the other hand strolling through a Virtual world with a capacity to recognize what it smells like.

The endeavors of researchers in this field led to development of an odor-sensing electronic nose first introduced in 1982 [1] which utilized a multi-sensor array of gas sensors combined to classify odors by the detection of different gases present. Since then until now over a period of over three decades, much advancement have been made in the hardware technology of electronic noses with more sensors being introduced and many being created for very specific purposes such as detection of leakage in natural gas factories, analyzing amount of carbon dioxide in an environment. Though less as compared to special purpose sensors, there have been developments in general purpose sensors consisting of a wider array of different types of sensors as well.

Human’s sense of smell was utilized in food factories and many other industries to differentiate spoiled from unspoiled food and in other applications. This approach can be unreliable at times due to the limitations of the range of odors a human nose can detect. An alternate that is used are dogs but the cost of their training is high and they have a short life span.

As humans, our sense of smell is very important and we rely on it for various tasks and functions some of which are daily activities and others which can be more important. Despite the importance of this sense, our sense of smell is usually limited both in its capabilities and can be influenced by external factors such as flu, our surroundings and other factors. Our human sense of smell can also only

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detect a limited number of gases due to which must be facilitated by adding compounds to different gases for humans to be able to detect it [2].

These limitations of human olfactory system make it difficult to rely on humans for the job of odor detection in Industries. Moreover, the odor detection of dangerous gases, even though possible by humans, may be fatal. An alternate approach is to train and utilize dog for odor sensing. This too has limitations as it is expensive to train dogs, and their life span is short and limited. These limitations have led to the development of electronic noses which try to mimic the human olfactory system. Electronic noses have proved their significance in various fields of health and industries and have been used as sensors for detection of food spoilage and in diagnosis of various diseases and much more [2]. Despite advances in the hardware of electronic noses, there hasn't been much attention paid to the software side of electronic noses.

This research aims to develop a general purpose Artificial Neural Network that can be used in various kinds of application from differentiating between markers, detecting food spoilage and diagnosing diseases.

II. MODELS OF THE OLFACTORY SYSTEM

The objective of a great part of the examination with respect to the olfactory framework is to see how singular smells are recognized. Numerous analysts have created numerical models of the olfactory framework. These models regularly incorporate recreations of the neurobiological data preparing frameworks (biological neural networks). The olfactory data is handled in both the olfactory bulb and in the olfactory cortex. Figure 1 demonstrates the fundamental data preparing structures inside the brain. The olfactory cortex performs design grouping and acknowledgment of the detected smells. Once recognized, scent data is transmitted to the hippocampus, limbic framework and the cerebral cortex. The connection to the hippocampus explains why odor can sub-consciously evoke memories. Conscious perception of the odor and how to act on the odor takes place in the cerebral cortex [2]. The mammalian olfactory system uses a variety of chemical sensors, known as olfactory receptors, combined with signal processing in the olfactory bulb and automated pattern recognition in the olfactory cortex of the brain.

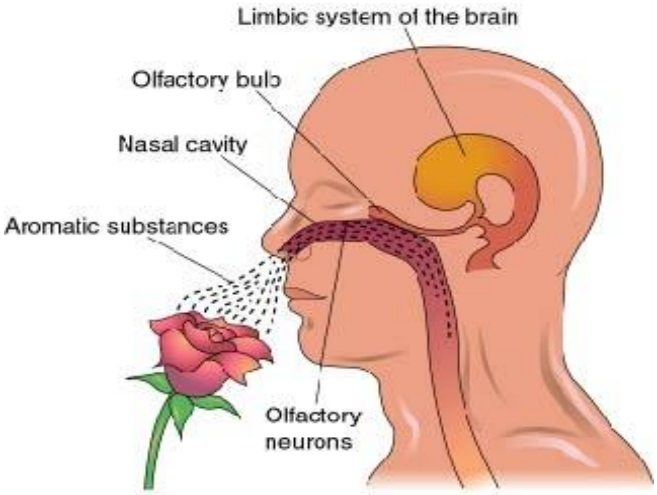

Figure 1: The major processes of the olfactory system

III. ELECTRONIC NOSES

Electronic noses [3], [4] and [5], are being created as frameworks for the automated recognition and characterization of smells, vapours and gasses. The two principle parts of an electronic nose are the odor detection framework and the computerized pattern recognition framework. The odor detection framework can be an array of several different sensing elements (e.g., chemical sensors), where each element measures a different property of the sensed odor, or it can be a single sensing device (e.g., spectrometer) that produces an array of measurements for each odor, or it can be a combination of both chemical sensors and a spectrometer. By showing a wide range of smells to the sensor array, a database of signatures is developed. This database of marked odor signatures is utilized to train the pattern recognition system. The objective of this preparation procedure is to arrange and configure the recognition system to deliver extraordinary mappings of every odor so that an automated distinguishing proof can be executed [6].Albeit every sensor is intended for a particular chemical, each reacts to a wide assortment of chemical vapours. , On the whole these sensors react with one of a kind signature to various chemicals. Amid the preparation procedure, different chemicals with known blends are exhibited to the system.

IV. ARTIFICIAL NEURAL NETWORKS AND ELECTRONIC NOSES

ANNs are widely used to utilize and examine different data representation methods such as complex data and pattern recognition. These techniques are indicating promising outcomes in chemical vapor recognition. Figure 2 illustrates an electronic nose prototype with the help ANN to identify odors from several common chemicals.

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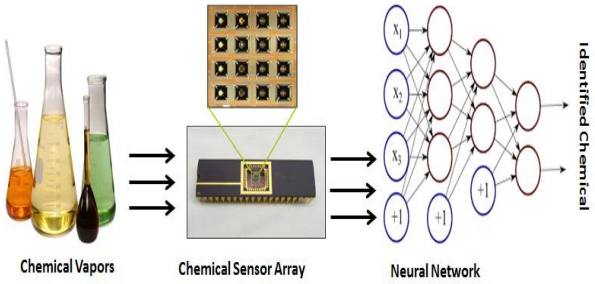

Figure 2: Electronic nose Prototype Using ANN

V. RELATED WORK

Reviewing related works in the field of electronic nose and its use in odor sensing shows that various smell sensors have been used for the different purposes alongside different methods of analysis which were mainly statistical in nature and not artificially intelligent. Moreover, the trend of using custom smell sensors is also seen, with many being developed for very specific purposes to detect specific odors only. An overview of this is given in the following paragraphs.

Research Paper: Lung cancer identification by the analysis of breath by means of an array of non-selective gas sensors [7]. ***Smell Sensor Used:***LibraNose. ***Method/Algorithm for Odor Sensing:*** Partial Least Squares Discriminant Analysis. ***Accuracy:***94%.

Research Paper:Use of an electronic nose to diagnose bacterial sinusitis [8]. ***Smell Sensor Used:***Cyranose 320. ***Method/Algorithm for Odor Sensing:***Support Vector Machine. ***Accuracy:*** 74%

Research Paper:Predicting Type 2 diabetes using an electronic nose-based artificial neural network analysis [9]. ***Smell Sensor Used:***Custom Smell Sensor. ***Method/Algorithm for Odor Sensing:***Artificial Neural Network. ***Accuracy:*** 92%.

Research Paper:Detecting quality of indoor-air using electronic nose [10] . ***Smell Sensor Used:***Custom Smell Sensor. ***Method/Algorithm for Odor Sensing:***Fuzzy Logic Pattern Recognition. ***Accuracy:***90%-100%.

Research Paper:Application of ANN with extracted parameters from an electronic nose in cigarette brand identification [11]. ***Smell Sensor Used:***Cyranose 320. ***Method/Algorithm for Odor Sensing:***Artificial Neural Network. ***Accuracy:***80-100%

Research Paper:An electronic nose system to diagnose illness [12]. ***Smell Sensor Used:***Fox 2000. ***Method/Algorithm for Odor Sensing:***Statistical Analysis. ***Accuracy:***80.6%.

Research Paper:An investigation on electronic nose diagnosis of lung cancer. Lung Cancer [13]. ***Smell Sensor Used:***Custom Smell Sensor. ***Method/Algorithm for Odor Sensing:***Partial Least Squares Discriminant Analysis. ***Accuracy:***85.7%.

Research Paper:Electronic nose prediction of a clinical pneumonia score: biosensors and microbes[14]. ***Smell Sensor Used:***Custom Smell Sensor. ***Method/Algorithm for Odor Sensing:***Statistical Analysis. ***Accuracy:*** less than 50%.

Reviewing the aforementioned researches, this research uses a general-purpose sensor in form of OMX-GR and Artificial Neural Network for analysis due to its ability of being trained and being general purpose.

VI. DATA SAMPLING

A handheld OMX-GR odometer sensor (Figure 3) is used in this research study to collect data samples for three different materials: White Board Marker, Muscle Cream and Herbal Inhalant (these materials are used because of their strong smell). The sensor includes two semiconductor gas senor with thecapability to detect a variety of odors from combustible gases. This sensor measures odor with different strength and classifications. The odor strength range from 0 to 999 and a classification feature range from 0 to 89. Additionally the sensor supports two types of sampling measurement modes: real-time sampling and memory samplings.

Figure 3: OMX-GR Odometer Sensor and the Materials used for Data Sampling

During this phase of the research work we measured approximately 1800 data representing the odor classification and strength of three different materials. For each material 15 data samples are collected in an interval of 20 seconds each. Table 1 describes a sample of data collected for each material representing the odor classification and strength of the material.

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White Board Marker	Muscle Cream	Herbal Inhalant
88,564	65,143	69,528
88,574	65,142	69,528
88,585	65,142	69,528
89,585	65,142	69,528
89,595	65,142	69,528
89,595	65,142	69,528
89,595	65,142	69,527
89,595	65,142	69,527
89,585	65,142	69,527
89,585	65,142	69,527

Table 1: Sample data representing the classification and strength of odors measured

Table 2 describes the range of the classification and strength of the entire data collected.

White Board Marker			Muscle Cream		Herbal Inhalant	
Sample #	Class	Strength	Class	Strength	Class	Strength
1	89-89	889-906	65-66	138-152	71-72	481-502
2	89-89	857-906	64-65	138-152	71-71	502-522
3	89-89	826-873	64-66	143-157	70-71	522-524
4	88-88	640-769	65-66	147-157	69-70	525-526
5	88-88	650-694	65-66	138-147	69-69	526-527
6	87-88	592-650	65-65	138-142	69-69	526-527
7	88-89	564-595	64-65	148-162	68-69	510-523
8	88-89	535-574	65-65	162-163	68-68	510-511
9	88-88	508-544	65-65	157-162	68-68	510-511
10	88-88	446-476	65-66	162-167	68-68	511-511
11	87-88	412-446	65-66	162-167	68-68	511-511
12	86-87	387-412	64-65	152-162	68-68	511-511
13	88-89	703-729	64-65	148-162	68-68	511-511
14	88-89	611-691	65-66	162-167	67-68	493-512
15	88-88	553-611	65-66	158-167	67-68	493-494
All Data	86-89	387-906	64-66	138-167	67-72	481-528

Table 2: The range of the measured odor classification and strength

In the second phase of the data collection process, all of the 15 samples of the data for the three materials were graphed to identify the similarities and the overlapping of the samples before feeding it to the ANN. These similarities and overlapping is illustrated in Figure 4.

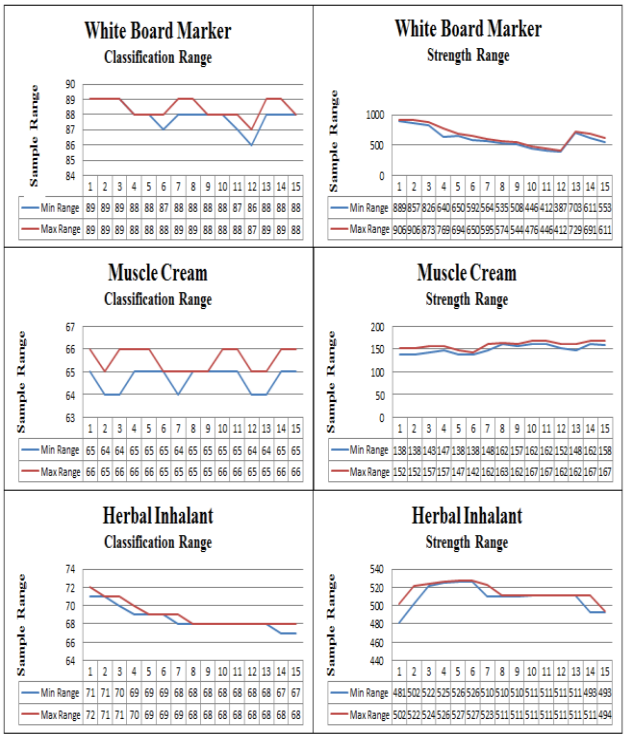

Figure 4: Similarities and overlapping of the odor data samples for each material

VII. METHODOLOGY AND RESULTS

The two main components of an electronic nose are the sensing system and the automated pattern recognition system. In this research study, the sensing system is a pair of semiconductor gas sensor to classify odors. This is a popular simplified handheld OMX-GR odor meter used as a tool for odor analysis to enable the indication of relative strength and odor classification numerically by comparing odor gases and purified air. The sensor produced an array of measurements for three different materials (White Board Marker, Muscle Cream and Herbal Inhalant). Each material vapor presented to the sensor array produced a signature or pattern characteristic of the vapor as shown in table 1. To generalize the ANN, the data is divided into three sets: training set 50%, validation set 25% and testing set 25%.

A backpropagation supervised learning technique is used and resulted with 0.0999 training error, 0.05312 validations and 0% testing. A total of 3178 epoch was used. Figure 6 shows the setup to use sigmoid function as a nonlinear with S shape curved function. The figure then illustrates the training graph and main results generated after feeding the data to the ANN program.

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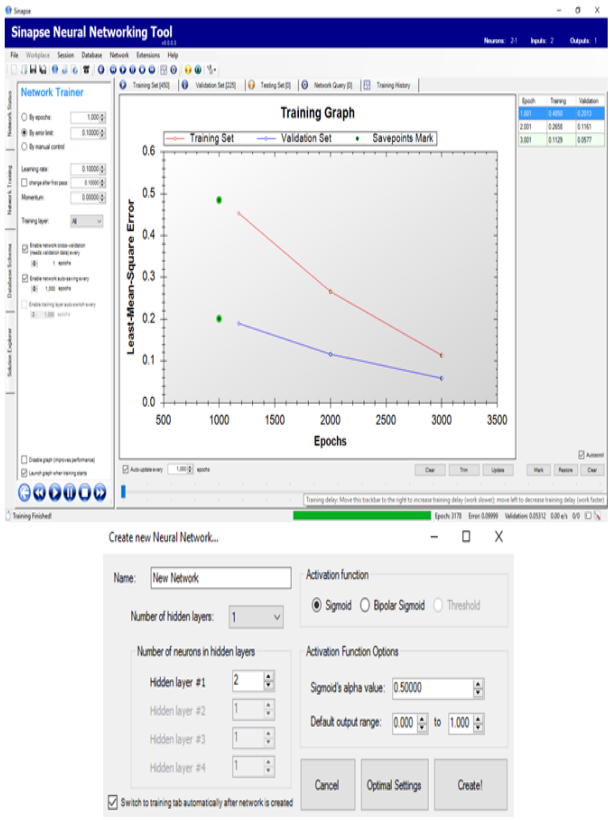

Figure 6: Setups and Results

VIII. CONCLUSION

Over past decades, the e-nose has significantly developed, despite the tendency to ignore the sense of smell in the artificial intelligence techniques. This study proposed a system with an e-nose combined with the ANN, which is considered the core of the system, to process and analyze the data and obtain a recognition pattern in order to obtain the best results similar to the human nose function. Although it is true that analyzing what has been learned by an artificial neural network is difficult, it is much easier to do so than to analyze what has been learned by a biological neural network. Furthermore, our research is exploring learning algorithms for neural networks which are gradually uncovering generic principles which allow a learning machine to be successful. The supervised learning used back propagation, and the best architecture of the ANN was determined to be a 2:6:1 ratio with a 1.72729 training error, 0.77849 validations, and 0.03% testing. The proposed system achieved very high performance and a low amount of error, with a high efficiency. Additionally, it acquired low cost tools to achieve the entire system.

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Diagnosis of lesion with statistical method of Anova1 & two ways for multi-MRI images with format. Dicom

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Abstract: **-- This paper deals with real time surface detection for image processing and analysis. We propose an appropriate analysis method with analysis of variance two ways to detect all surfaces of images in accuracy time. The results indicate that Anova_2 converge to the solution in accuracy time in comparison with Anova_1 for linear model.**

Index Terms—Anova, 1,;Anova 2; Statistical; Regression.

I. INTRODUCTION

Segmentation means division of an image into several connected regions. Basically, it could define a region as a group of connected similar pixels, or a set of connected pixels surrounded by discontinuities (edges). Split and merge uses the first approach. Many methods are used in surface detection in image processing and analysis. They are classified into two groups depending on time execution: accuracy time (real-time execution), and non-accuracy time (non-real-time execution). One of methods in image detection is analysis of detection (Anova). Anova is a hypothesis test method. It has two techniques: one way Anova (Anova_1), two way Anova (Anova_2). ANOVA_1 is a hypothesis test in which only one categorical variable or single factor is considered. It is a technique which enables us to make a comparison of means of three or more samples with the help of F-distribution. It is used to find out the difference among its different categories having several possible values.[1-2]

The null hypothesis (H0) is the equality in all population means, while alternative hypothesis (H1) will be the difference in at least one mean.

Anova_1 is based on the following assumptions:

1. Normal distribution of the population from which the samples are drawn.
2. Measurement of the dependent variable is at interval or ratio level
3. Two or more than two categorical independent groups in an independent variable.
4. Independence of samples.
5. Homogeneity of variance of the population.

Anova_2 is a hypothesis test wherein the classification of data is based on two factors. For instance, the two bases of classification for the sales made by the firm are first on the basis of sales by the different salesman, and second by sales in the various regions. It is a statistical technique used by the researcher to compare several levels of the two independent variables involving multiple observations at each level. ANOVA examine Two way affected by two factors on the continuous dependent variable. It also studies the inter-relationship between independent variables influencing the values of the dependent variable.[1-2]

- Assumptions of two-way ANOVA:[1-2]

1. Samples are drawn for distribution of population.
2. Measurement of dependent variable at continuous level.
3. Two or more than two categorical independent groups in two factors.
4. Categorical independent groups should have the same size.
5. Independence of observations
6. Homogeneity of the variance of the population

II. BACK GROUND

2.*1 ANOVA1 the Analysis of Variance*

a. Regration analysis of variance

The relationship between two variables is the dependent 'one' and the independent 'operation'. [3-5]

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b. Fitted Regretion Line

Equation (1) presents the true regression line which is usually never known. However, the regression line can be estimated where estimating the coefficients β_1 and $\beta_0$for an observed data set. [6-7]

$$E(Y) = \beta_0 + \beta_1 x \quad (1)$$

Equation (2) represents the actual values of y which are assumed to be the sum of the mean value, E(Y) and a random error term ε.

$$Y = E(Y) + \epsilon = \beta_0 + \beta_1 x + \epsilon \quad (2)$$

The least square estimates, $\beta o\, \beta o$ and $\beta_1 \beta_1$ are obtained from using the following equations:

Equations (3), (4) represent the least square estimates $\beta_1$and βo respectively:

$$\hat{\beta}_1 = \frac{\sum_{i-1}^{n} y_i x_i - \frac{\left(\sum_{i-1}^{n} y_i\right)\left(\sum_{i-1}^{n} x_i\right)}{n}}{\sum_{i-1}^{n} (x_i - \bar{x})^2} \quad (3)$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} \quad (4)$$

Where $\bar{x}$ is the mean of all predictor variable calculated using equation (5), and $\bar{y}$ is the mean of all observed values calculated using equation (6):

$$\bar{x} = (1/n) \sum_{i-1}^{n} x_i. \quad (5)$$

After know $\beta_1 \beta_1$ and $\beta \beta o$, the fitted regression line will be written as:

$$\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x \quad (6)$$

Where the difference between the corresponding observed value, y_i and the fitted value, $\bar{y}_i$ is called the residual e_i:

$$e_i = y_i - \hat{y}_i \quad (7)$$

c. Calculation of the statistique F_0

The statistic F_0 test the significance of regression is calculated as follows:[6-7]

$$F_0 = \frac{MS_R}{MS_E} \quad (8)$$

Where: MSR is the regression mean square and MSE is the mean square error.

To calculate the statistic F_o, it must study the following six models [3][4][5]

c.1 Total Sum of Squares (SS_T) model

The SS_T is obtained using the equation (9):

$$SS_T = \sum_{i-1}^{n} (y_i - \bar{y})^2 = \sum_{i-1}^{n} y_i^2 - \frac{(\sum_{i-1}^{n} y_i)^2}{n} \quad (9)$$

c.2 Sum of Squares regression (SS_R) model

The SS_R, can be obtained using the equation(10):[5]

$$SS_R = \sum_{i-1}^{n} \hat{y}_i^2 - \frac{(\sum_{i-1}^{n} y_i)^2}{n} = \hat{\mathbf{y}}' \hat{\mathbf{y}} - (\tfrac{1}{n}) \mathbf{y}' \mathbf{J} \mathbf{y} = \mathbf{y}' \left[\mathbf{H} - (\tfrac{1}{n}) \mathbf{J} \right] \mathbf{y} \quad (10)$$

c.3 Sum Squares Error (SSE)operation

The SS_E is obtained using the equation (11):

$SSE=SS_T-SS_R$ (11)

c.4 The total Mean Squares (MS_T) model

The (MS_T) are obtained by dividing the SS_T with their associated degrees of freedom. The number of degrees of freedom associated with SS_T is n-1 since there are an 'n' observations, but one degree of freedom is lost in the calculation of the sample mean ȳ.

$$MS_T = \frac{SS_T}{n-1} \quad (12)$$

c.5 The regression mean square (MS_R) model

The number of freedom degrees associated with the SS_R, is k. so, There are k+1 degrees of freedom associated with a regression model with k+1 coefficients $\beta_0,\beta_1,..\beta_k$. However, one degree of freedom is lost because the deviations ($\hat{y}_i$-ȳ)$(\hat{y}_i - \bar{y})$, are subjected to the constraints that they must sum to zero $\sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2$

The MS_R is obtained using the equation (13):

$$MS_R = \frac{SS_R}{k} \quad (13)$$

Since there are n observations in all, The number of degrees of freedom associated with the error sum squares is: n-(k+1), , but (k+1) degrees of freedom are lost in obtaining

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the estimates of $\beta_o, \beta_1, \beta_2 \ldots . \beta_k \beta_o, \beta_1, \beta_2 \ldots . \beta_k$ to calculate the predicted values $\tilde{y}_i \tilde{y}_i$. [5-7]

c.6. The Mean square Error (MS_E)model

The MS_E is obtained using equation (14):

$$MS_E = \frac{SS_E}{n - (k+1)} \quad (14)$$

The MS_E is an estimated of the variance ($\tilde{\sigma}^2 \tilde{\sigma}^2$) of random error terms.

2.2 Anova 2 two ways

The ANOVA 2-way is probably the most popular layout in our Design and Experiments. To begin with, we have to define a factorial experiment.[1]

An experiment that uses every combination of factor levels as treatments is called *a* factorial experiment.

a.1. two-way factorial experiment Model

In a factorial experiment the factor A at *a* levels and factor B at *b* levels.

The model for the general layout can be written as:

$$y_{ijk} = \mu + \tau_i + \beta_j + X_j + \varepsilon_{ijk}$$

$$y_{ijk} =$$

$$\mu + \tau_i + \beta_j + X_j + \varepsilon_{ijk}$$

$$i = 1,2,..a; \quad j = 1,2..b; \quad k = 1,2 \ldots r$$

Where :

- is the overall mean response,
- $_i$ is the effect due to the *i*-th level of factor A,
- $_j$ is the effect due to the *j*-th level of factor B and

γ_{ij} is the effect due to any interaction between the *i*-th level of A and the *j*-th level of B.

Due to any interaction between the *i*-th level of A and the *j*-th level of B.[1]

a.2. Fixed factors and effects models

We consider the levels of factor A and B chosen for the experiment to be the only levels of interest in the experimenter. The factors A and B are said to be fixed factors and the model is a fixed-effects model. When an AxB factorial experiment is conducted with an equal number of observations per treatment combination, the total (corrected) sum of squares is partitioned as:

SS(total)= SS(A) + SS(B) + SS(AB) + SSE (15)

where :AB represents the interaction between A and B. For reference, the formulas for the sums of squares are:

$$SSA = rb \sum_{i=1}^{a} (\bar{y_i} - \bar{y})^2 \qquad SSA = rb \sum_{i=1}^{a} (\bar{y_i} - \bar{y})^2$$

(16)

$$SS(B) = ra \sum_{j=1}^{b} (\bar{y_i} - \bar{y})^2 \quad (17)$$

$$SS(AB) = r \sum_{j=1}^{b} \sum_{i=1}^{a} (\overline{y_{ij}} - \bar{y}_i - \bar{y_j} + \bar{y})^2 \quad (18)$$

$$SSE = \sum_{k=1}^{r} \sum_{j=1}^{b} \sum_{i=1}^{a} (y_{ijk} - \bar{y}_{ij})^2 \quad (19)$$

c.3.The breakdown of the total corrected of mean sums squares

The table ANOVA result can be used to test hypotheses about the effects and interactions. The table (I) shows the resulting ANOVA for an *a* x *b* factorial experiment.

TABLE I. ***ANOVA RESULT FOR AN A X B FACTORIAL EXPERIMENT.***

Source	SS	Df	MS	F
Factor A	*SS*(A)	(*a*- 1)	*MS*(A) = *SS*(A)/(*a*-1)	$F=MS_A/MS_E$
Factor B	*SS*(B)	(*b*- 1)	*MS*(B) = *SS*(B)/(*b*-1)	$F=MS_B/MS_E$
Interaction AB	*SS* (AB)	(*a*-1)*(*b*-1)	*MS*(AB)= *SS*(AB)/(*a*-1).(*b*-1)	$F=MS_{AB}/MS_E =SS_{AB}/(a-1)*(b-1)$
Error	*SSE*	(*n* - *ab*)	MS_E= SS_E/(*n* - *ab*)	
Total (Corr-ected)	SS (Total)	(*n*- 1)		

III. EXPERIMENTAL

3.1 *Algorithm*

In this part, we use a general algorithm which can let us applied the defined methods in image treatment. -We read a pathological and normal images with format "Dicom"

-We apply ANOVA 1 way.

-We apply ANOVA2 ways.

-We compare between the both techniques in order to achieve the best technique that gives the best accuracy time for surface detection in multi images.

For the test, we have used a computer which has these identifications:

- Model : SONY (RSOL-VAIO)
- Processor : Intel(R) core™ i5-3210M.CPU @2.55ghz
- Memory (RAM) : 4.00 Go
- Operating system : windows 7_ 64bits.
- Matlab® 13 (R2013a).

Let's explain in more detail:

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The anatomical model used to generate simulated brain MRI data consist of a set of 3-dimensional "fuzzy" tissue membership volumes, one for each tissue class (white matter, grey matter, cerebrospinal fluid, fat...). The voxel values in these volumes reflects the proportion of tissue present in that voxel, in the range [0, 1]. The volumes are defined at a 1mm isotropic voxel grid in Talairach space, with dimensions 181x217x181 (XxYxZ) and start coordinates -90,-126,-72 (x,y,z).

In addition to the fuzzy tissue membership volumes, a discrete anatomical model is provided which consists of a Class label (integer) at each voxel, presenting the tissue which contributes the most to that voxel (0=background , 1CSF, 2=grey matte, 3white matter, 4=Fat, 5=muscle/skin, 6=skin, 7=skull, 8=glial matter,9=connective,10=MS lesion).

Brain web Simulated MRI Volumes for Brain with Multiple Sclerosis Lesions select the desired simulated volume using the switches (see figure1). These simulations are based on an anatomical model of a brain with MS lesions, which can serve as the ground truth for any analysis procedure.

In this pre-computed simulated brain database (SBD), the parameter settings are fixed to 3 modalities, 5 slice thicknesses, 6 levels of noise, and 3 levels of intensity non-uniformity. You can also request simulations done with arbitrary parameters from the BrainWeb custom MRI simulations interface.

The voxel values in each image are magnitude values, rather than complex, real or imaginary.

We apply the algorithm of ANOVA1 ways in our data. The results of ANOVA1 techniques for multi-frames are shown in figure4, and the duration of execution time is shown in figure5.

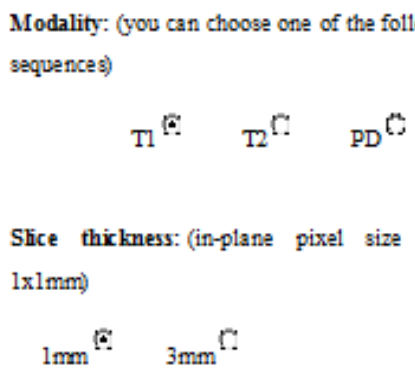

Figure1. Switches for desired simulated MRI volume[9]

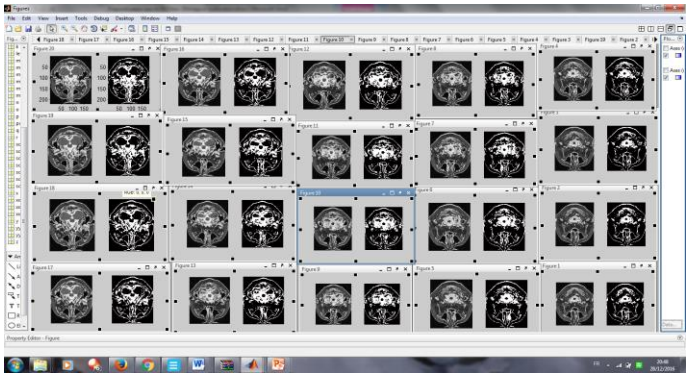

Figure2. Results of ANOVA 2 techniques for multi-frames(20frames) in T2

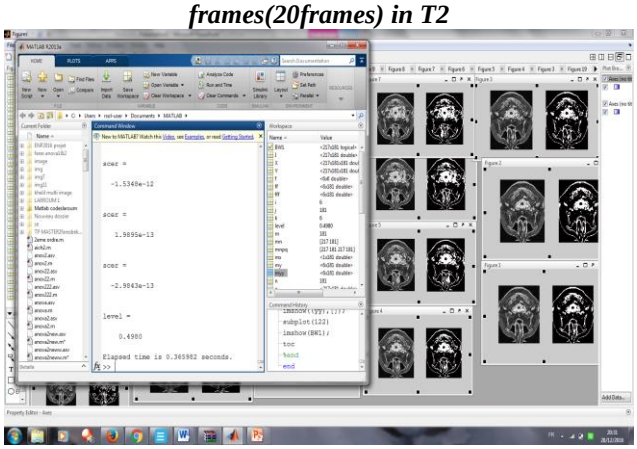

Figure3.Elapsed time of ANOVA2 in T2 for multi-frame

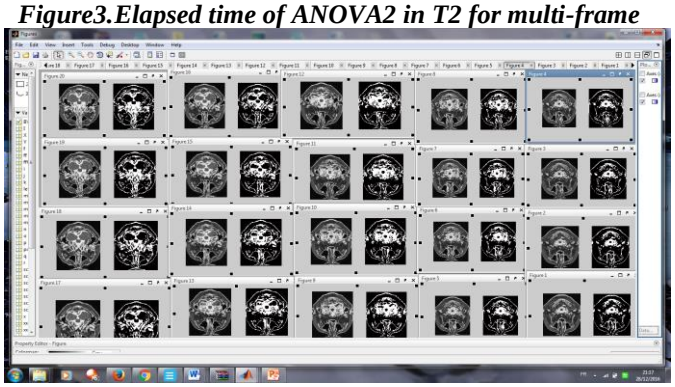

Figure4.Results of ANOVA 1 techniques for multi-frames in T2

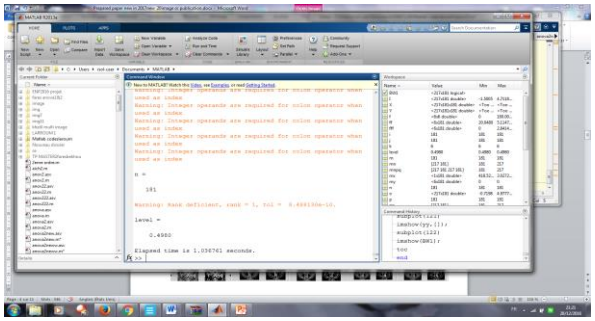

Figure5.Elapsed time of ANOVA1 in T2 for multi-frame

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IV. DISCUSSION

In the both figures (2) and (4) in relaxing time T2 Anova1 and Abova2 detect the disease in the same precision but with accuracy in ANOVA2 (0.36s) in front of ANOVA1(1.036s).see figures and (3)(5).

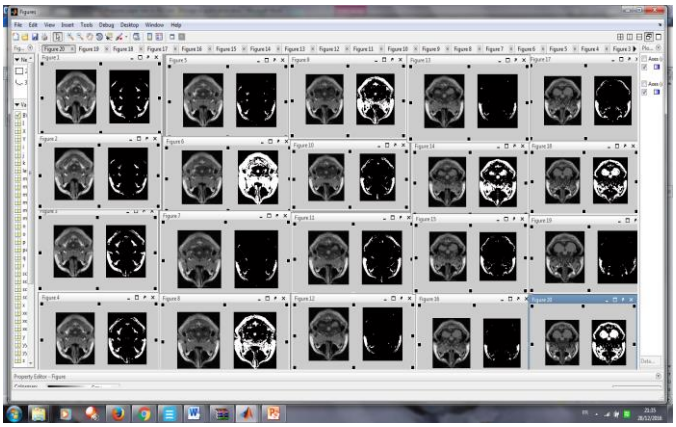

Figure6.Results of ANOVA 2 techniques for multi-frames in T1.

Figure7. Elapsed time for ANOVA2 inT1

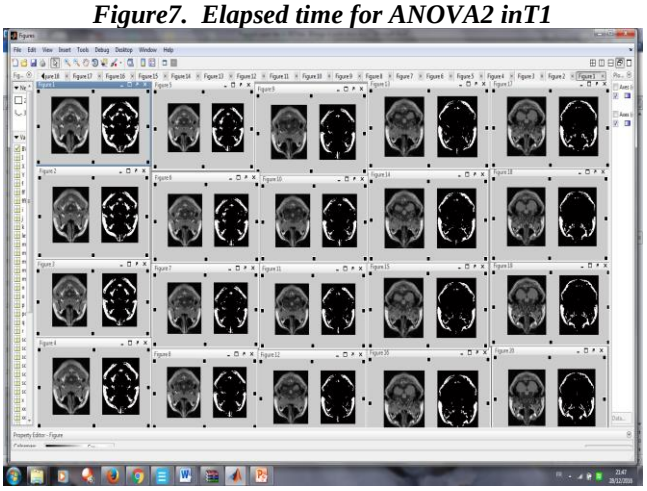

Figure8. Detection multi-images inT1 for ANOVA1

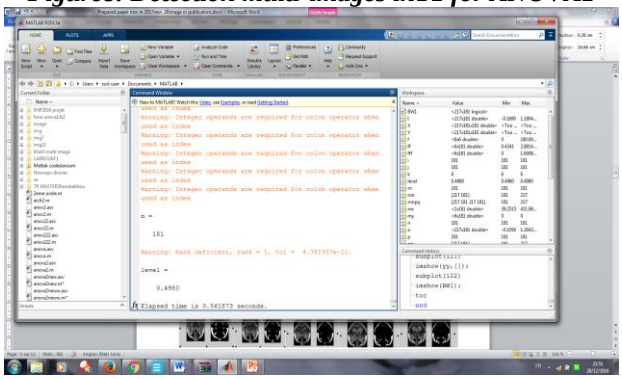

Figure9.Time of execution of ANOVA1 in T1

We apply the algorithm on 20 images compressed with mnc (image dicom) detected with ANOVA 2 for time: T1. The results of ANOVA 2 techniques for multi-frames are shown in figure6, and the duration of execution time is shown in figure7. We apply the algorithm on 20 images compressed with mnc (image dicom) detected with ANOVA 1 for time: T1. The results of ANOVA1 techniques for multi-frames are shown in figure8, and the duration of execution time is shown in figure9.

○ ***Discussion***

In the time T1 & from the both figures (6) and (8) ANOVA2 detect frames better and with accuracy 0.35seconds (figure8.) in front of ANOVA1 0.56second (figure9.) where its result is worse.

IV. CONCLUSION

In this paper, we have applied two linear resolution methods to extract the place of diseases for MR images .Our results indicate that the statistical method with Anova2 converges to the solution in accuracy time in comparison with the ANOVA1 way where it couldn't detect well frames with relaxation time T1.

So the time of execution is very important to clarify the best method of detection.

As perspective we proposed to compeer Anova with network ANN.

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Data Management for Multidisciplinary Mechatronic Systems

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Abstract: -- **This paper contributes to the development of computer-based support for the concept development phase of the design of mechatronic systems. The complexity of the data management aspects of the product models can be significant throughout the design process. Functional modeling concerns functional description of the design intention. Port modeling is an important aspect of the design process, especially for data management. This paper investigates the modeling capabilities of the System Modeling Language SysML for modeling the functional level interfaces of interconnection. It helps as well in the complexity reduction of the design data management.**

Keywords — Data management, functional model, SysML, mechatronic system, interface modeling.

I. INTRODUCTION

Many types of data related to mechatronic products are created throughout their design development process, and they need to be managed. Product models are used for the support of product data management (PDM), in which all the pertinent information is accessed, stored, served, and reused by stakeholder [1]. The huge volume of data involved in product models at different level of detail throughout the design process poses a big challenge. Computer-based tools used for the support of product data have been developed, typically, for a specific discipline such as CAx, EES (Electrical/Electronic Engineering Solutions), CASE, and PLM [2]. These tools produce data related to the product model and product structure that are incompatible with one another. Diversity of data from different disciplines offers some challenges such as the following:

1) It is difficult to show, understand, and construct the interdisciplinary and functional relationships between the different systems and components.

2) Increasing the efficiency of directing and organizing the design development process can be achieved by making use of the information extracted from product models.

3) The imprecision and incompleteness of the design requirements pose challenges in the analysis and exchange of product data.

A. Early Design Stage in the Development Process

In the early stages of the design process, the data of product models are used to describe the links, connections, and interfaces of the product elements, and functions of the various domains in an abstract way. The necessity of viewing the integrated overall mechatronic system alongside its interfaces and connections between the different domains/disciplines throughout the entire design development process is vital. Also, a common language is valuable in order to enable traceability, and reasoning between the different components and functions.

B. Functional Modeling

Functional modeling provides a high-level system view specifying the functionality of the product from the product description. Functional modeling comprises specification of a model that describes the function and the functional relationships as objects and relations, facilitating the development process. Through functional product modeling, a solution-independent and abstract representation of a task to be created can be represented [3]. For this reason, functional modeling is considered when modeling at a conceptual level, where functions can be drawn from the realization of the different requirements of customers [4]. This abstraction of the basic concepts using the product function is used in many areas and is supported by suitable development tools, especially in electrical, electronic, hydraulic, pneumatic, thermal, and software development. Originally, functional modelling was not established for the support of computer-aided modeling and design, where it is considered as a model-based approach. The development of the functional model is done throughout the design process using documents only [5]. The formulation of a functional basis for the functional models is needed to proceed to model based functional design. Therefore, a contained controlled vocabulary has been developed for functional modeling in the design knowledge repository. It consists of 53 functions (in a verb form), and 45 flows (in a noun from). Each of the functions, and flows is structured in a three-level hierarchical taxonomy [6]. The most abstract forms are at the highest level, which is called the “primary

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class," e.g., branch, channel, or convert for functions, and energy, material, and signal for flows.

C. System Engineering

Model-based Systems Engineering (MBSE) is a multi-disciplinary approach to help understand the context and specification to satisfy the specified customer requirements by developing system solution in response to the different needs of the stakeholders [7]. Aspects of MBSE include behavioral analysis, system architecture, requirement traceability, performance analysis, system simulation, test, and so on [8]. Numerous process models, methods and tools are available for supporting model-based development. The system is usually modeled using UML (Unified Modeling Language) and System Modeling Language (SysML). They are widely used modeling languages that support MBSE, which are provided by the Object Management Group's System Modeling Language [9].

System Modeling Language (SysML) is an extension of MBSE and can be utilized as a computational mechatronic product model. However, there is a lack of acknowledgement and practice of MBSE in industry, which indicates that there is a need for further development of MBSE with respect to usability [10]. Therefore, the following criteria need to be fulfilled:

1) The models must display the abstract mapping of the product functions, activities and components, and their dependencies. They should also provide information about the internal changes between the disciplines to aid in the development process of the product.

2) The models may be able to contain meta-model information as well, in which the traceability, and reasoning between systems, sub-systems, and components are permitted.

3) The data of the product model should participate in the advancement, guidance, and organizing of the process development models.

II. DATA MANAGEMENT IN PRODUCT MODELS

STEP, which stands for STandard for the Exchange of Product model data, is known as the ISO 10303 [11] standard. Application Protocol (AP) is a part of STEP that specifies the scope, context, and information requirements of STEP. Different parts of STEP APs are used for different engineering domains; for example, AP 203, AP 209, and AP 214 are used in mechanical design. AP 233 is used for the exchange of the product data and information in system engineering and it is used in many industries such as aerospace, automotive, and shipbuilding [11].

AP 233 defines the element of a system that interacts with other systems as a connector. The link between two connectors is defined as a connection [12]. However, no further details are given for the description of connections, and connectors. [13] integrates UML with AP 233 in order to provide more detailed information about the interface connections and connector. But this work is limited to software engineering. [1] proposes a multidisciplinary interface model to aid the multidisciplinary integration. His work provides a structural representation of the interface in order to be able to store information about the model data for future reuse of knowledge. Three aspects of the interface are defined: Type (geometry, energy, control, or data), configuration (to describe what elements are linked), and desired/undesired (weather the link creates positive or negative effect).

[5] proposes a data scheme for functional product description, where SysML model capabilities are integrated. This data scheme benefits from the abstraction level of the design and provides the information between the requirement, functional, and logical levels. However, the compatibility rules are not enforced to guarantee a correct integration. [14] develops a consistency check between the object flows of the functional model in SysML. In his work, the ports between the two systems have to match; i.e., energy to energy, material to material, or signal to signal. A detailed port description for the different object flows is not available. The present work will develop data modeling in SysML for the data management in the functional model. It will provide a detailed description of the object flows in SysML and, at the same time, guarantees compatible port matching.

III. DEVELOPMENT OF DATA MANAGEMENT FOR FUNCTIONAL DESCRIPTION OF PRODUCT MODELS

The scope of the present study is the functional product description, which is important since a functional model is the heart of the conceptual design phase of the mechatronic design process. Moreover, as this study focuses on the data exchange of the product model, the aim is to model the object flow, while the object functions are outside the scope of this work.

A. Object Flows

Object flows are defined as the input and the output of a function. They are used for the data and information exchange between different functions. [6] and [15] classified three basic flows in any design problem: Energy, Material, and Signal. These flows are specified more accurately in the form of vocabulary, and each basic flow is categorized into primary, secondary, and tertiary (or class, basic, and sub-basic). The vocabulary is used to describe the flow in a high-level of abstraction, and with of development of the flow categorization, a more accurate description can be achieved.

B. Modeling in SysML

SysML aims to provide a language that enables to capture different aspects of the information about a system in an integrated model. This would increase the communication

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between different aspects of the model, and it decreases the ambiguity between the designers and stockholders. Moreover, SysML has the capability for model system interfaces with different types. Interface model of SysML v1.3 retains all the capabilities from SysML v1.2 and provides additional capabilities.

Object Modeling Group (OMG) works for the development of STEP AP 233 within SysML by performing a mapping of the data construction between them.

Previous work used hierarchical structures to model the data exchange between different levels of the early stage of the development process; namely, between requirements, functional, and logical levels. Even though hierarchical structure provides a good overview of the of the system, and closes the gap and understanding between levels, it does not consider the internal data structures among each system level.

C. Integration of Object Flows in SysML for Functional Model Description

The link between functions in the functional level is performed according to the functional basis mentioned previously. For the modeling of different categories of the class flows in SysML, the development of ports are introduced next. Ports in SysML v1.3 is represented here as the interface of functions with other functions or with the environment. Each port can be specified with a type and, therefore, is called a typed port. Three types of ports are proposed for the representation of the object flows: flow ports, full ports, and proxy ports. Flow ports are typed by flow specifications and they are introduced here for the representation of the Energy flow class. The details of basic and sub-basic descriptions of the flow class can be contained in the flow specifications, which specify the types of flow coming in or out of a function, as shown in Fig III-1.

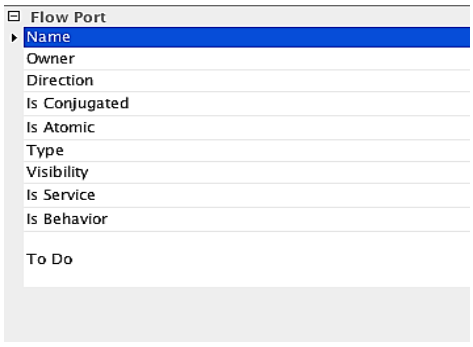

Figure .III 1: Flow specification

Full ports are typed by a block, where it is presented here for the modeling of the Material class. Full ports are used for the representation of a part of a system, in which the information of the Material class is stored inside the block.

Proxy ports are typed by an interface block. It is used for representing the Signal class as it specifies which features are accessible, and it cannot have behavior or internal parts.

D. Port Compatibility

The connection between different types of ports should be done without violating the constraints. The compatibility between ports is based on the port type, name, and direction. Proxy ports do not require a compatibility check as it can provide signal/information to all other port types. For example, Fig III-2 shows a violation of the port name, where two materials with different names are to be transferred from a function to another.

Figure .III 2: An exchange of material with different names

Another example is shown in Fig III-3, where the direction of the energy flow is now consistent.

Figure .III 3: Inconsistence of flow direction

IV. APPLICATION EXAMPLE: CONVEYOR SYSTEM

The goal of this section is to demonstrate the application of the proposed data modeling in SysML according to the defined ports and object flows. The evaluation will be limited only to the data exchange of the functional modeling.

A. Presentation of the Conveyor System

An electro-mechanical conveyor system falls within the category of a mechatronic system. In the present case study, such a system that is used to transport fish from the feeding station to the cutting station in a fish processing machine is considered [16] (Fig. IV-1). Conveyor systems are widely used in fish processing machines in order to provide an intermittent motion for the fish during transportation for cutting. The motion profile is planned in such a way that the cutter has sufficient time to cut the head of each fish with minimal wastage of meat, while the fish is kept stationary. Furthermore, the fish has to be held firmly during the transportation and cutting operations.

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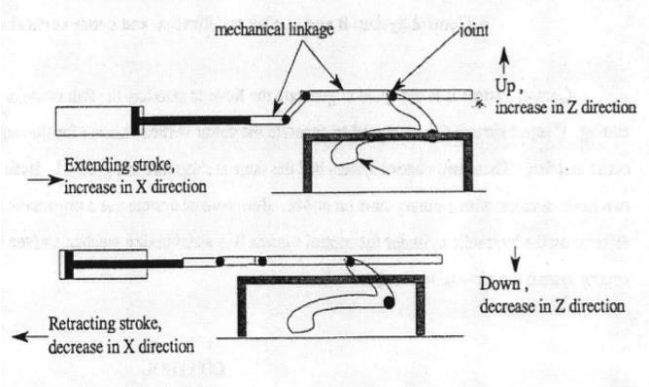

Figure .[IV 1: The conveyor system [17

Many considerations have to be addressed in the design of a conveyor system. In the present example, a main objective of the conveyor system design is to cut the fish head rapidly (e.g., in a cycle time of two seconds) and accurately. Also, the system has to operate under medium to light-duty load, and must have a medium to low cost.

B. Development of the Functional Model

The main functional requirement of the drive system is to "Produce an intermittent motion" of acceptable characteristic. The main function can be modeled as a black box with inputs and outputs. The input flows to the main function are human energy, electrical energy, and solid material. Human energy represents the energy for human interaction to turn the machine on, feed the fish at the inlet of the conveyor, and monitor the machine operation. The electrical energy includes the electrical power supply to the motors, hydraulic system, and other hardware. The solid material is the fish. There is only one output, which is solid and represents the processed fish. Subsequently, the main function of the conveyor system is decomposed into sub-functions arranged in sequential and parallel structures. At the same time, the inputs and the output should be preserved. Fig. IV-2 shows the functional structure of the "Produce intermittent motion." The functional structure offers a discipline- and solution-nature view. Electric energy is used to drive the conveyor because of the advantages of using an AC motor. They can provide low cost, stable speed, high power factor, and high reliability.

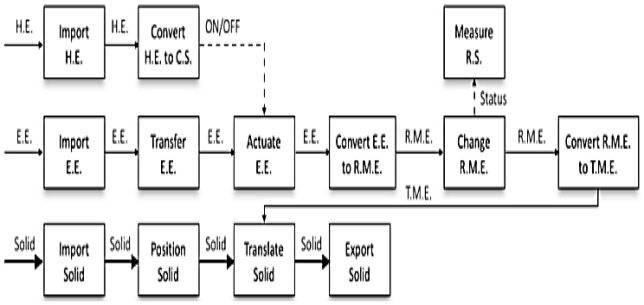

Figure .IV 2: The functional model of the conveyor system

C. Functional Model Development in SysML

In order to computationally model the multidisciplinary interface for the functional description of the product model, MagicDraw [18], which is a computational software that enables the modeling language UML, and SysML that comes with extra extensions for system simulation [19], are used as the platform software for SysML modeling. Fig. IV-3 shows the functional model that was created using the Internal Block Diagram (IBD) with the functions indicated in the boxes. The ports indicate the interfaces of functions with each other and are indicated in small boxes attached to the functions. They provide the incoming and outgoing Material, Energy, and Control signal.

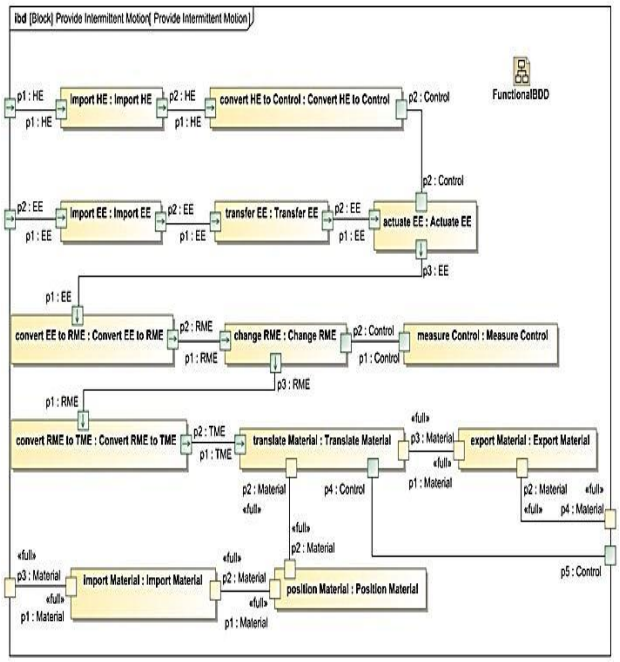

Figure .IV 3:Functional model in SysML

The port type indicates the flow class. For example, the ports with an arrow indicate the Energy class. Moreover, each port is further described by additional information for the basic/secondary level of flow information.

D. Evaluation of the Developed Port Model

The SysML port syntax provides the possibility of allowing only one direction of flow and unspecified flow. Also, static semantics prevent incompatible connections between ports. Correct data exchange can be automatically checked. The current SysML port specification provides generic port modeling that can be used to represent the necessary modeling aspect of this stage, namely functional modeling.

The advantage of port modeling with graph style arrangement is that it gives a structural overview from the usability viewpoint. It is essential that port modeling can be kept free of redundancies and changes can be tracked. In

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addition, SysML offers much convenience since it is able to set links, and store information within the model, where the need for re-use is addressed. It, also, aids in the data management of the design, where it can provide support for paper-based functional modeling to help with the abstract description of the design.

V. CONCLUSION

This paper presented the applicability of SysML for port modeling in the functional description within the conceptual design phase. It presented a potentially formal computational port modeling approach for an integrated product model, where it can be substituted for the formal paper-based modeling approach. It can benefit from the static and dynamic consistency checking of the functional model and provides an important and relevant feedback for the designer. Also, It aids in for the data management and knowledge reuse for the later design phase.

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Development Approach of a Machine Learning Algorithm for Mooring Line Integrity Monitoring

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***Abstract*- The purpose of this study is to propose a development approach for a machine learning algorithm to monitor the integrity of fixed mooring lines supporting a floating structure. The study proposed a plan to utilize simulations for the training data of a machine learning algorithm, analyzed the system, condition, and response parameters of floating structures and mooring lines, and discussed machine learning training with the collected data.**

***Index Terms*—Mooring line, Monitoring, Maintenance, Machine Learning, Algorithm**

I. INTRODUCTION

Floating structures are in increasingly greater use for the development of marine resources. They are supported by fixed mooring lines. Since damage to mooring lines can lead to damage to floating structures, stable mooring is essential to the maintenance of floating structures. [1] In fact, 23 mooring systems have been destroyed and caused human and property damage since 2000[2] with approximately 1500 mooring lines repaired or replaced.[3] Given the expectation that such damage cases will increase according to the rising demand for floating structures, the maintenance of mooring lines will become even more important.

The integrity of mooring lines is, however, not monitored effectively due to limitations with measurement. This study thus set out to propose an approach to the development of a machine learning algorithm to promote the effective monitoring of fixed mooring lines in integrity..

II. CONVENTIONAL MONITORING METHODS FOR MOORING LINES

Various methods have been attempted to monitor the integrity of mooring lines including sound waves, sensors and remotely operated vehicles (ROVs).

A.A Method with a Simple Sonar Probe

A simple sonar probe assesses the integrity of mooring lines by checking their displacement with sound waves. It is simple and wonderful, but it can fail to detect damage to mooring lines in mud due to tension. Another disadvantage of the method is that if it cannot check mooring lines for about two weeks, average period of marine climate changes and in this period, there can be heavy typhoon, the structure can be damaged.

B.A Method with an ROV

ROVs are unmanned undersea vehicles that are operated remotely. They are put in the water to check the clinometer and the integrity of mooring lines. It is, however, available only when the weather is fine and can be difficult to operate due to current disturbance.

C. A Method with an Instrumented Mooring Line

This method attaches sensors to mooring lines to check their integrity. It is a good approach, but it is impossible to figure out whether abnormal signals from mooring lines are due to a problem with the sensors or with the mooring lines.

D. FPS Offset Monitoring and Line Failure Detection

It detects damage to mooring lines with the offset yield strength of floating production systems (FPSs). It, however, depends on the observer's experiences relatively.

Reviewed conventional monitoring methods and found that there were still considerable limitations with measuring mooring lines and examining their integrity. This study thus proposed an approach to the development of a machine learning algorithm to overcome the old problems.

III. CONCEPT OF MACHINE LEARNING APPLICATION TO MONITOR THE INTEGRITY OF MOORING LINES

Fixed mooring lines and floating production systems show different behavioral responses according to system parameters such as the length of mooring lines and the weight of floating production systems and condition parameters such as wave height and current strength.

The major elements affecting the integrity of mooring lines are the section area and weight of mooring lines. Over time, damage to the section of the mooring line

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occurs, and biological pollution materials such as seaweeds are attached to the mooring line. The section area and weight of mooring lines are known as initial values at the time of installation, but

IV. GENERATION OF LEARNING DATA THROUGH SIMULATIONS

Programs to interpret the behavioral responses of mooring lines such as CHARM3D are used to generate learning data for machine learning through simulations. Such interpretation programs require input information including system and condition parameters and use them to compute response parameter values (Fig. 1).

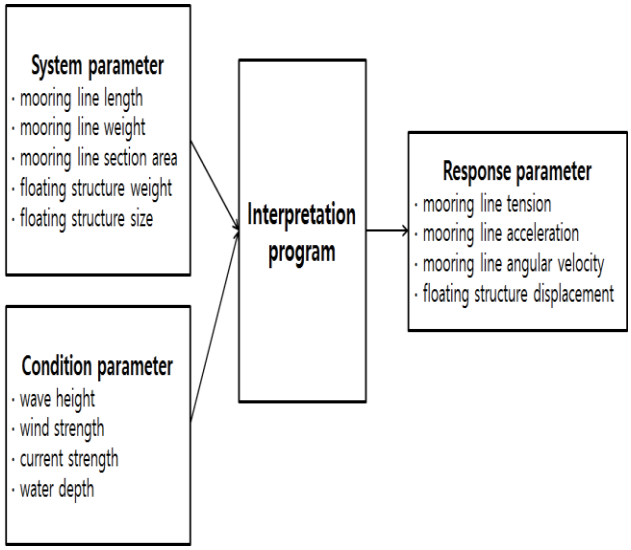

Fig. 1. Data generation through simulations

It is thus necessary to set the type and scope of system and condition parameters to be used in a simulation in advance. And consider whether response parameters can be measured in real system.

The initial values of system parameters are known at the stage of design and making. The concerned parameter values can be adjusted and entered in the program to reflect damage to the section area of mooring lines and changes to their weight. The representative system parameters of floating structures include the weight and size of floating structures and the length, section area and weight of mooring lines. Since the weight and size of structures and the length of

mooring lines remain the same over time, they can be used as fixed values in simulations. The section area and weight of mooring lines, however, change over time as they have been explained above, which raises a need to consider the scope of damage to the section area and changes to the weight and reflect diverse values randomly altered from their initial values in simulations.

The representative condition parameters of floating structures include the wave height, wind strength, current strength, and water depth, of which the wave height, wind strength, and current strength continue to change and can be measured with all kinds of measuring sensors. In simulations, those values should be changed randomly and diversely to reflect the situations that continue to change. The deep sea, where floating structures are commonly installed, undergoes few changes to the water depth and can thus be used as a fixed value in simulations.

It is easy to measure the displacement of floating structures, one of the response parameters, with GPS and a clinometer, but it is very difficult to measure the displacement of mooring lines underwater. There are limited response parameters of mooring lines that can be measured relatively easily, and they include tension, acceleration, and angular velocity. It will be thus realistic to use such response parameters as the displacement of floating structures and the tension, acceleration, and angular velocity of mooring lines in the training of machine learning.

Table 1 presents the parameters that should be used in simulations to generate training data for machine learning.

Table 1 Necessary parameters for simulations

Classification	Variable
System variables	Mooring line length
	Mooring line weight
	Mooring line section area
	Floating structure weight
	Floating structure size
Condition variables	Wave height
	Wind strength
	Current strength
	Water depth
Response Variables	Mooring line tension
	Mooring line acceleration
	Mooring line angular velocity
	Floating structure displacement

V. MACHINE LEARNING TO MONITOR THE INTEGRITY OF MOORING LINES

The section area and weight of mooring lines can be estimated by developing a machine learning algorithm based on abundant pattern information collected in simulations. A

machine learning algorithm uses the condition and response parameter values and the known system parameter values as inputs. And estimates the section area and weight of mooring lines, the unknown system parameter values (Fig. 2).

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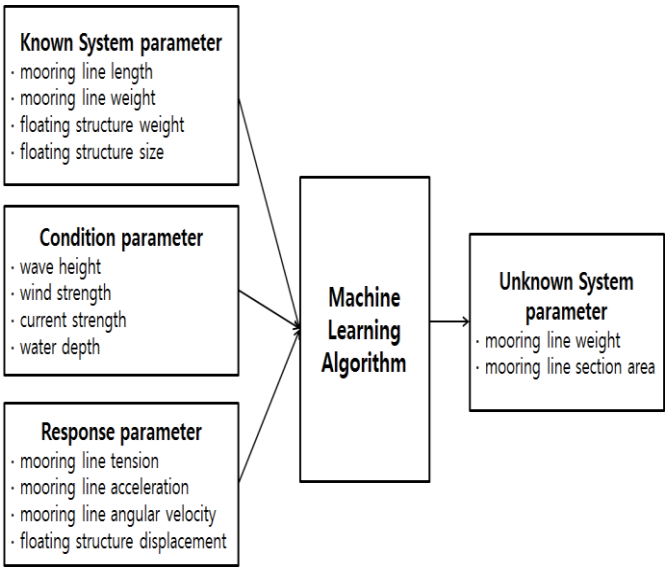
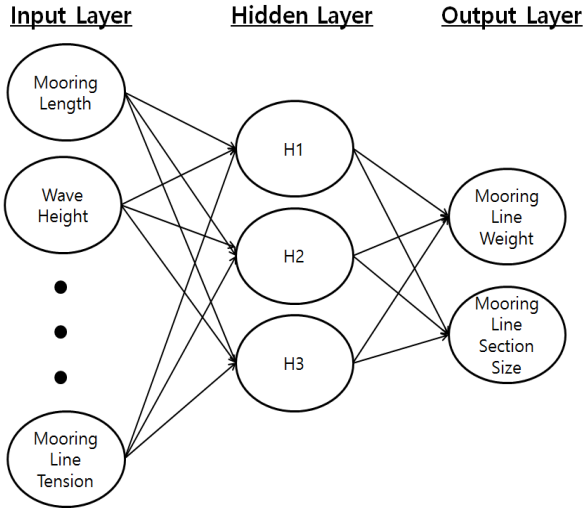


Fig. 2. Estimation of section area and weight of mooring lines through machine learning

There are various types of machine learning, of which deep learning will be proper to fulfill the goal of monitoring the integrity of mooring lines. Based on the artificial neural network theory, deep learning uses input/output layers like human neurons and multiple hidden layers and is effective for solving complex non-linear problems.

It is thus required to designate the input/output and hidden layers of an artificial neural network in order to implement an effective algorithm. Since input values include the condition and response parameter values and the known system parameter values, the input layer will contain the length of mooring lines, the weight of floating structures, wave height, and cable tension. The output layer will contain the weight and section area of mooring lines, the result values sought after by this study (Fig. 3).



nodes. It is thus needed to designate them randomly many times and adjust them according to the data characteristics. In addition, several hyper-parameters should be adjusted including the weights to connect different layers and the learning rate of back-propagation to increase the accuracy of an algorithm.

In an actual measurement of a structure's behavioral responses, measuring noises happen often. Such noises should be reflected in a machine learning algorithm test, in which Gaussian random noises can be used. It will be a useful approach to a test in a situation closer to the reality to insert Gaussian random noises into the data generated in simulations artificially, simulate them like actual measurement data, and test an algorithm with such data.

IV. CONCLUSION

This study proposed a development approach for a machine learning algorithm to monitor the integrity of fixed mooring lines supporting a floating structure. Huge amounts of actual data are needed according to the various situations of fixed mooring lines to develop a machine learning algorithm, but it is practically impossible to obtain them. Thus, in this study, training with data generated in simulations. In addition, the study analyzed the system parameters of floating structures and mooring lines (length, section area, and weight of mooring lines and the weight and size of floating structures), the condition parameters (wave height, wind velocity, current strength and water depth), and response parameters (tension, acceleration, and angular velocity of mooring lines and the displacement of floating structures), as well as proposed parameters that should be used in a simulation.

Deep learning, a type of machine learning, was deemed to be appropriate for the goal of monitoring the integrity of mooring lines. A deep learning-based machine learning algorithm used the condition and response parameter values and the known system parameter values as inputs and estimated the section area and weight of mooring lines, the unknown system parameter values. The use of Gaussian random noises was also proposed to test the machine learning algorithm in a situation close to the reality.

Based on this study, a machine learning algorithm is being developed for the monitoring of mooring line soundness, and it is expected that the maintenance of floating structures will be more effectively performed.

ACKNOWLEDGEMENTS

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MEST) (No. 2017R1A2B4011753) they vary with time. Today there are no methods to measure such changes directly. If there are massive data of response

parameter values according to system and condition parameters, machine learning can be possible with such data. In such a case, machine learning can help to estimate the section area and weight of mooring lines according to the given condition and response parameter values and the known system parameter values including the length of mooring lines. The purpose of this study was to propose a development approach for a machine learning algorithm to estimate the section area and weight of mooring lines, unknown system parameters, with condition and response parameters and known system parameters to monitor the integrity of mooring lines. The problem with the approach was the impossibility of collecting enormous amounts of actual data according to the various situations of fixed mooring lines Thus, in this study, using simulation data performed computer program in various conditions as learning data."

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Krushi Roboter-"Future Farmer's Friend

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Abstract: -- **This robotic vehicle is an agricultural machine of a considerable power and great soil clearing capacity. This multipurpose system gives an advance method to sow, plough, and water and cut the crops with minimum man power and labor making it an efficient vehicle. As jobs in agriculture require intelligence and quick, where robots could be substituted. The mode of operation of the proposed machine is simple even to the lay man. Model is controlled using Android Application through BLUETOOTH. The application is specifically designed for moving the robot in variable directions such as, forward, backward, left and right. Developed agriculture needs to find new ways to improve efficiency. The project gives an integrated application in the field of agriculture, which plays a vital role in the development of nation. The machine will cultivate the farm by considering particular rows and specific column at fixed distance depending on crop. Moreover the vehicle can be controlled through Bluetooth medium using an Android smart phone. The whole process calculation, processing, monitoring are designed with motors & sensor interfaced with microcontroller.**

Keywords: - Bluetooth, microcontroller, motor driver circuit, transmitter and receiver.

I. INTRODUCTION

In the field of agriculture, various operations for handling heavy material are performed. For example, in vegetable cropping, workers should handle heavy vegetables in the harvest season. Additionally, in organic farming, which is fast gaining popularity, workers should handle heavy compost bags in the fertilizing season. These operations are dull, repetitive, or require strength and skill for the workers. In the 1980s, many agricultural robots were started for research and development. Kawamura and co-workers developed the fruit harvesting in orchard. Grand and co-workers developed the apple harvesting robot. They have been followed by many other works. Over history, agriculture has evolved from a manual occupation to a highly industrialized business, utilizing wide variety of tools and machines. Researchers are now looking towards the realization of autonomous agricultural vehicles. The first stage of development, automatic vehicle guidance, has been studied for many years, with a number of innovations explored as early as the 1920s. The concept of fully autonomous agricultural vehicles is far from new examples of early driverless tractor prototypes using leader cable guidance systems date back to the 1950s and 1960s. In the 1980s, the potential for combining computers with image sensors provided opportunities for machine vision based guidance systems. During the mid-1980s, researchers at Michigan State University and Texas A&M University were exploring machine vision guidance. Also during that decade, a program for robotic harvesting of oranges was successfully performed at the University of Florida. In 1997, agricultural automation had become a major issue along with the advocacy of precision agriculture. A robot is a machine that can be programmed and reprogrammed to do certain tasks and usually consists of a manipulator such as a claw, hand, or tool attached to a mobile body or a stationary platform. Autonomous robots work completely under the control of a computer program. They often use sensors to gather data about their surroundings in order to navigate. Tele-controlled robots work under the control of humans and/or computer programs. Remote-controlled robots are controlled by humans with a controller such as a joystick or other hand-held device.

II.RELATED WORKS

Several Projects like User friendly fuzzy logic based farm automation using arduino and Lab view using x bee controller are being undertaken. Also automatic milking systems, irrigation and harvesting systems, Tank farming automation using several meter designs are practiced in most of the western countries.

III.SYSTEM ARCHITECTURE

3.1 Existing System

At present, People use the manual controlled Tractors and other irrigational equipment. The agricultural function is performed by this respective vehicle, to perform different functions. So farmers using one vehicle to perform one task. For example, we are using tractor for only one task such as

cultivating, for smoothening the surface we are using roller, for harvesting and seed flowing we are using labours to cut the crops and flows the seeds on the agricultural land respectively and we are using old method to watering the agricultural land. So farmers need individual vehicles or labours to perform individual tasks of the farming.

3.2 Proposed system Configuration

In this project we will be fabricating a multipurpose irrigation vehicle that will be able to dig the Earth, Sow the seeds and Cultivate the crop after the harvest is ready. We have designed an agricultural robot which will be able to perform five different functions including sowing, ploughing, water pumping, harvesting, rolling. We will be using a android smart phone application to control the vehicle to respond to the control signal this type of vehicle should be useful for the farmers as a low investment option instead of buying 2 or more machines to do this work done by a single machine of ours. We are using solar panel as a power supply to our agricultural robot.

3.3 DC Motor

DC Motors fall into the category of Electrical motors that converts electrical energy into mechanical energy. There are several kinds of DC Motors. They work on the principle that when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move which is known as the motoring action. If the direction of electric current in the wire is reversed then the direction of the rotation is also reversed. When magnetic field and electric field interact they produce a mechanical force which causes the direction of rotation of this motor to change and is given by Fleming's left hand rule which states that if the index finger, middle finger, and thumb of your left hand are stretched mutually perpendicular to each other and if the index finger represent the direction of the magnetic field, middle finger represents the direction of the electric current the then the thumb represents the direction in which the force is experienced by the shaft of the dc motor.

3.4 Bluetooth:

Here Bluetooth is used as a basic universal Remote control for Bluetooth enabled serial devices such as Bluetooth modules connected to the microcontroller. It is a short-range wireless networking technology and is used to link (or pair) two devices, such as smart phones and headsets, cameras and printers, and keyboards and computers, it is sometimes called a cable-replacement technology. Both devices must support Bluetooth in order to be paired, if they do, though paring the paring is designed to happen automatically, with little to no user interaction. The Bluetooth module used here is a HC-05 based on SPP support. HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. In our idea we have made use of blue tooth Control App available on Android as controlling software more like a remote control for the manual operation of the robot.

3.5 Water sprinkler:

The type of water sprinkler used here is E-JET905F. This water sprinkler comes in use when the humidity level goes below the set point.

3.6 Camera:

The cameras used in robots are commonly used as an image sensor. These cameras are sensitive to IR light and have an IR filter placed in front of the lens. Cheap webcams may not have such a filter, which makes them very sensitive to sunlight. Camera calibration has always been an essential component of photogrammetric measurement. Self-calibration has become essential for high-accuracy close range measurement. The sensor that is used in the camera has a highly integrated cmos constructed array with extraction and enhancement facilities built in the space. It also performs extracting any extra edges from the image but the microcontroller has to process it. The two extreme types of calibration approaches are named as the photogrammetric calibration and pure auto calibration techniques. Traditionally the methods of calibration were used to resolve a pack of non-linear equations based on triangle measurement principle. Using servo, we can control the tilt angle of the camera in the device.

IV WORKING PRINCIPLE

In this project we will be fabricating a multipurpose irrigation vehicle that will be able to DIG the Earth, Sow the seeds and Cultivate the crop after the harvest is ready, We will be using a android smart phone application to control the vehicle to respond to the control signal this type of vehicle should be useful for the farmers as a low investment option instead of buying 2 or more machines to do this work done by a single machine of ours. Heart of our robot is intel's most power family of microcontroller 8051,we are using at89c2051 Two microcontrollers ic2 is first microcontroller which acts as master controller ,decodes all the commands received from the transmitter and is responsible for executing all the commands received from the remote and also generating pwm pulses for the speed control . ld293 motor driver ic which drives two motors these two motors are vehicle driver motors and it also runs the motors for all other attachments of agriculture in the vehicle seed sowing, cultivating, harvesting, ploughing and rolling.

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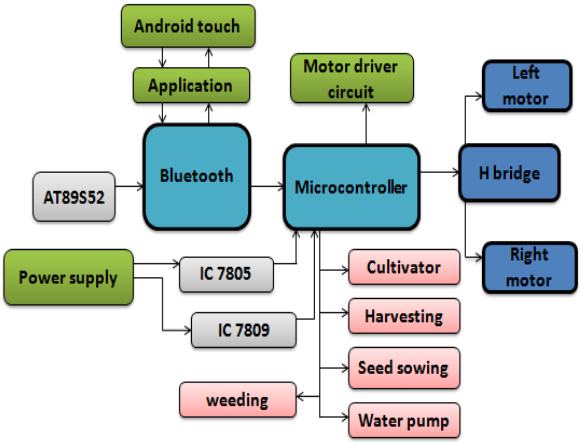


Fig.4.1 represents System Architecture of the

IMAGE PROCESSING USING MATLAB

The programmed location and orientation of the robotic arm is stored with each image. For each sector, all ripe fruits are identified by the image processing software, listed, and picked one by one in a looped task. To improve the therapeutic effect of the image processing in finding and locating the apples on the tree, the platform was designed to control the lighting conditions to the greatest extent possible, using a canopy to cover the entire tree. The MATLAB platform is also used to reduce the effects of changing ambient lighting conditions and provide a uniform background (blue) to ease location.

Fig Processed image under MATLAB

V. MARKET POTENTIAL AND ADVANTAGES

MARKET SIZE

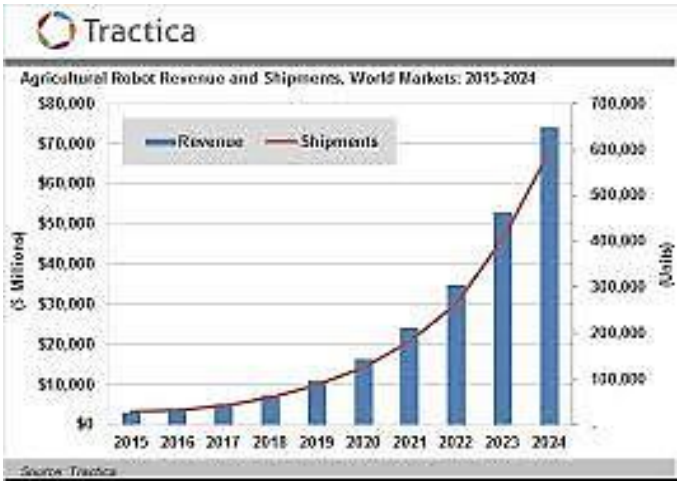
India's gross domestic product(GDP) is expected to grow at 7.1% in FY 2016-17,led by growth in private consumption while agriculture GDP is expected to grow above trend at 4.1% - to Rs 1.11trillion

MARKET GROWTH:

The increasing use of precision agriculture, among farmers, for collecting and processing data helps in making better decisions on fertilizing, planting and harvesting crops .the technique has immense potential to enhance crop yields and profits and to resolve the food and water crises. The increasing need for monitoring crop health for yields and production and the increasing government support for the adoption of modern agriculture techniques are expected to drive the industry demand over the forecast periods.

MARKET PROFITABILITY

- The trend of maximizing agricultural resources, in a sustainable manner, is positively influencing farmers with its growing demand in the world's food supply chain.
- The proliferation of IoT has revolutionized the agriculture industry that primarily depends on technology, engineering and physical and biological sciences.



NOVEL:

- The process of automation in the system totally resolves 90-95% of the problems of the exiosting.
- Here we are using RFID technology for the control of the machine by giving unique RFID tags for vehicle
- This project is the solution for all the manual work.

CUSTOMER TYPE

Farmers having their own farm land.

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VI. FUTURE ENHANCEMENT

It can be concluded that either GPS and machine vision technologies will be fused. Together or one of them will be fused. With another technology (e.g., laser radar) as the trend development for agricultural vehicle guidance systems. The application of new popular robotic technologies for agricultural guidance systems will augment the realization of agricultural vehicle automation in the future.

VII. CONCLUSION

This multipurpose system gives an advance method to sow, plough and cut the crops with minimum man power and labour making it an efficient vehicle. The machine will cultivate the farm by considering particular rows and specific column at fixed distance depending on crop. The obstacle detection problem will also be considered, sensed by infrared sensor. It can be concluded that either GPS and machine vision technologies will be fused. Together or one of them will be fused. With another technology (e.g., laser radar) as the trend development for agricultural vehicle guidance systems. The application of new popular robotic technologies for agricultural guidance systems will augment the realization of agricultural vehicle automation in the future.

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Hand Gesture Based Survivellence Robot

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Abstract: -- **In the past decade, robotic systems have been used with increased popularity for explosive ordnance (EOD) missions. Advances in robotic technology have made it possible for robots to per-form functions, previously only possible by human workers wearing a blast suit. The primary advantage to using robotic systems for explosive ordinance disposal is the reduced risk to humans. Currently, EOD robots are able to traverse a variety of terrain, collect and destroy certain explosives and provide improved reconnaissance capabilities to law enforcement and military agencies. Although far from perfected, these robots are saving lives by finding and disposing of explosives without the need for direct human contact reliable robotic platform. The key features of the robot include an hand gesture interface which provides additional sensor feedback and enhanced visual awareness compared to existing systems, an on board three degree of freedom manipulator arm providing an enlarged workspace, and a dexterous gripper allowing for the removal of detonators. The flexible and modular robot design utilizes commercial off the shelf components for ease of maintenance and repairs. The robot provides a safe distance threat assessment and increased capacity for explosive ordinance disposal, improving the effectiveness of bomb disposal teams. The robots low-cost, hand gesture operation and ease-of-maintenance promote its widespread appeal, thereby saving the lives of both law enforcement personnel and civilians. Robot will detect the position of the bomb by using GPS module. The user just needs to wear a gesture device which includes a sensor. The sensor will record the movement of hand in a specific direction.**

Index Terms: GPS, sensor, wireless communication, GSM, EOD Robots

I. INTRODUCTION

Here we are going to construct a Robot which is used for bomb detecting and disposal purpose. Use wireless camera for video feedback so operator can operate more efficiently. The operation of robot is controlled by using wireless hand gesture module so it can provide more range of operation. Also construct a basic bomb diffusing robot which can handle simple tasks like cutting wires, flip on switches, lift light objects, etc. and a simple autonomous robot to help in the transit of the bomb. Also gives video feedback to us so effective handling of robot can be possible. This paper details the design and implementation of an intelligent explosive ordinance disposal (EOD) robot to provide law enforcement agencies with a cost effective and Due to this more security will provide to bomb disposal squad. Also it is more applicable for police, nuclear radioactive material handling, also for military purpose. We are going to interface the camera so For the future purpose that images capture by camera of bomb will be more useful. Here we use robotic arm which have 180 degree of freedom so operation of robot handling will be more softly. We are going to use stepper and Dc motors as actuator, Robot base will rotate 360 degree, elbow, shoulder and gripper also will move according to their directions the input to the system is from the user. This input is first processed at the control application, serially transmitted over a Radio Link. This input is then received at the robot and processed again. The output of the system is the processed signal to the appropriate module. This module can be a motor of the base of the robot or the robotic arm. The main goal of the project is to provide safety to the bomb disposal squad by providing an extra line of defence. Provide a remote monitoring and controlling application for analysis of a suspicious packet (or bomb).Allow the user to manipulate the packet using the robotic arm. To provide visual feedback from the site of the packet. To provide a very user friendly control application.

II. INTRODUCTION

We are going to interface of camera so for future purpose that images capture by camera of bomb will be more useful. Here we use robotic arm which have 180 degree of freedom so operation of robot handling will be more softly.

2.2 Need of work

To construct a basic bomb diffusing robot which can handle simple tasks like cutting wires, flip on switches ,lift light objects, etc. and a simple autonomous robot to help in the transit of the bomb. Also gives video feedback to us so effective handling of robot can be possible.

2.3 Review of literature survey

"Design and Implementation of a Bomb Diffusing Surveillance Robot using RF Technology" is paper by Reddy Pannnala; DR. R.V. Krishnaiah is an author of this

paper, this paper published in 2013. Advantages of this project are a robot that can be controlled by hand gestures and by a RF remote. This project is much useful for mines detection, surveillance applications. In this project RF module is use so that range is very small. “Bomb Detection and Diffusion in Planes by application of robotics”, Prashant Limje, Shailesh Khekale is a author of this paper, this paper published in 2013. Advantage of his project is, they have idea dynamic3D videogame is realized: the paper provides the reference for the mission to find and retrieve a bomb placed inside an airplane. But it is Difficult to achieve reliability. “Hand Gesture Recognition Bomb Diffusing Surveillance Robot” is paper of Sagar Radive, Neha Lokhande, Apoorva Kamat, Shubhrojit Chakraborty, Vishal Pande National Conference on Emerging Trends in Engineering & Technology 2012the hand gesture recognition makes the robot more user friendly but also there is need of Improvising the range of wireless communication so as to be able to put to a wider use. A Multipurpose Robot for Military Tribute to the Defense Ministry is paper of V. Prasanna Balaji & H. Goutham, International Journal on Theoretical and Applied Research in Mechanical Engineering (IJTARME), 2013 this also helps on remote bomb detonation and automatic bomb detection. Our robot also has terrain climbing facility so that it can be used in hilly regions. Future aim is to reduce the response time to a greater extent.

The outcomes of literature survey are followings
: For more user friendly operation video camera is beneficial.
: Due to wire range may decrease so we are going to use RF module.
: For more soften operation we will use 5-DOF.

III. OUTCOMES OF LITERATURE SURVEY.

For more user friendly operation video camera is beneficial.
Due to wire range may decrease so we are going to use RF module.
For more soften operation we will use 5-DOF

IV. FIGURES

4.1 Block Diagram

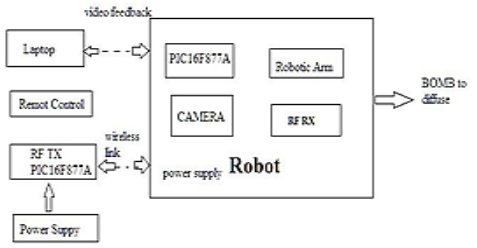

Fig 4.1 Block diagram of project

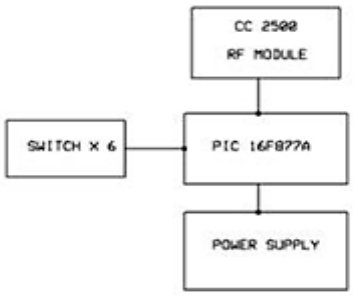

Fig 4.2 Block diagram of Transmitter

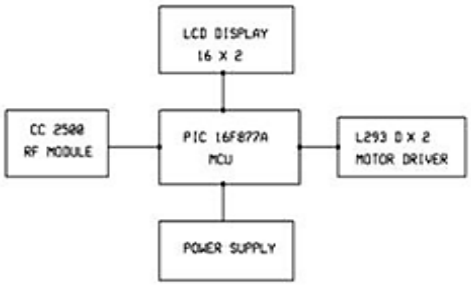

Fig 4.3 Block diagram of Receiver

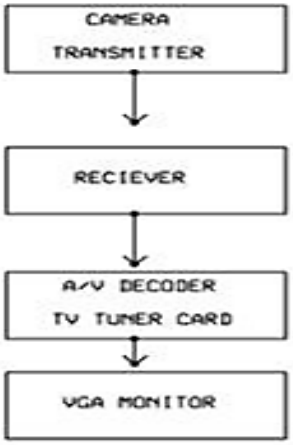

Fig 4.4 Block diagram of camera

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V. CIRCUIT DIAGRAM

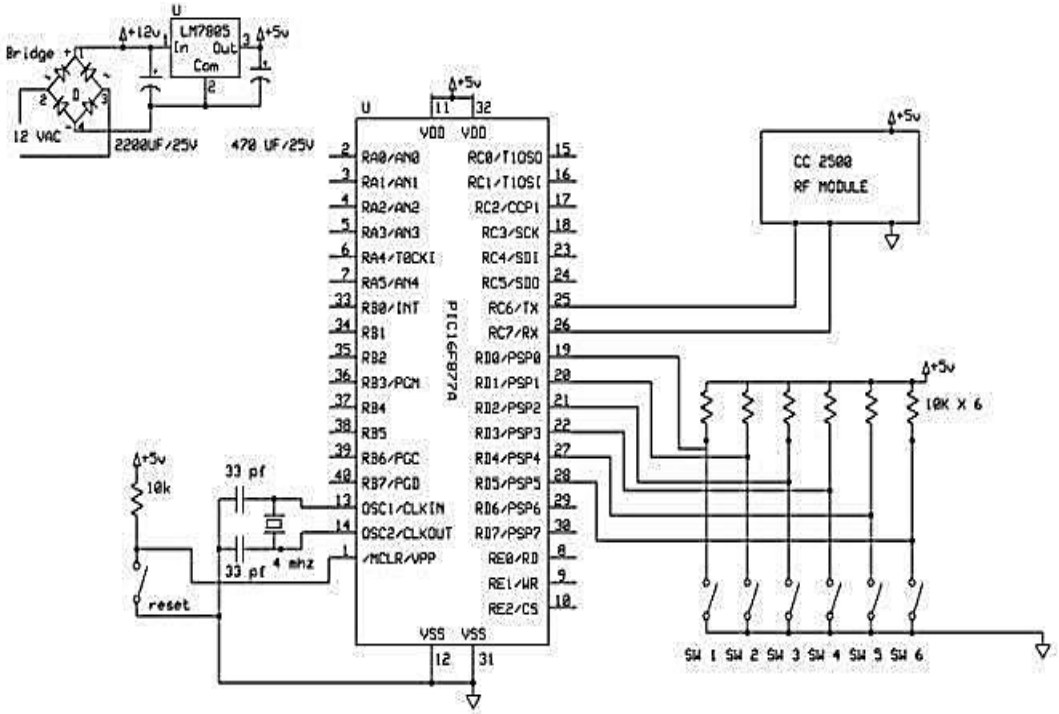

Fig.5.1 Circuit diagram of transmitter section

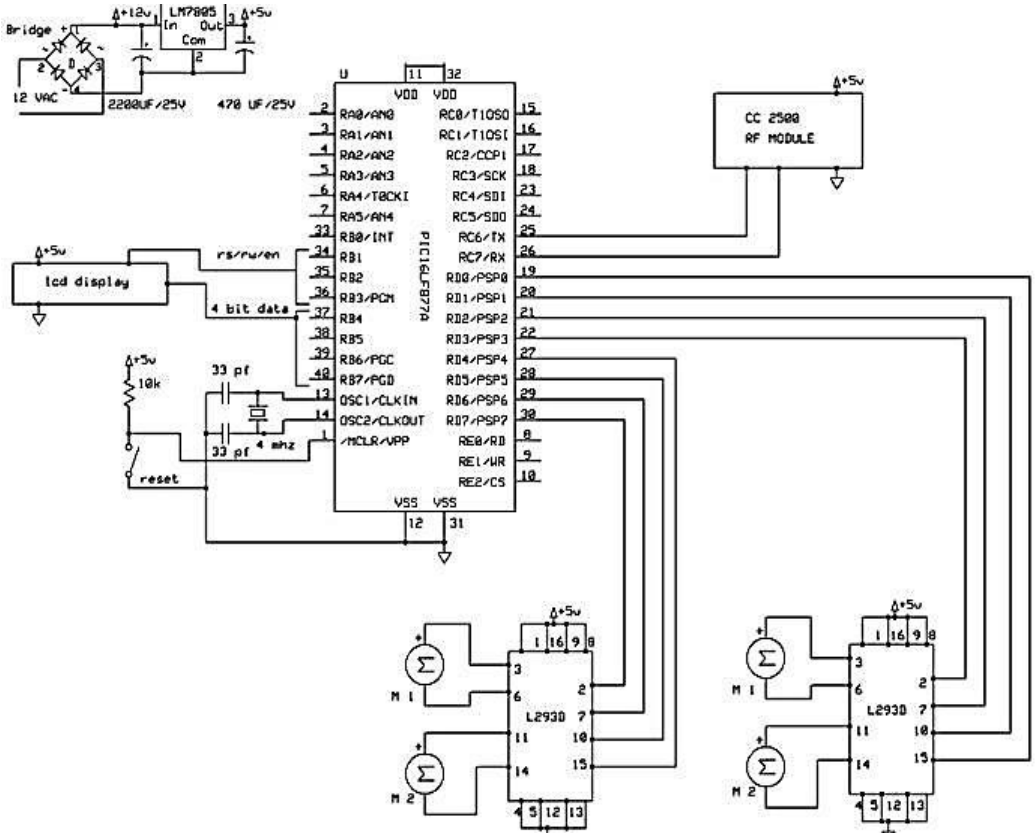

Fig.5.2 Circuit diagram of receiver section

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VI. IMPLICATION (SOCIAL IMPACT)

The main idea of this robot is to provide the bomb disposal squad with safety and security from the risks that they face every day. The bomb disposal squad of has metal detectors and other equipment for bomb detection and disposal, but they have to risk their lives by approaching the bomb or the suspicious packet without any safety and precautions. Our robot provides an extra layer of protection to the bomb disposal squad by allowing them to check and analyze a suspicious packet before actually approaching it for disposal. Wireless robots reduce or eliminate a bomb technician's time-on-target. Provide video feedback to operator so more safety to bomb disposal squad.

VII.HARDWARE USED

7.1 PIC microcontroller
7.2 base of robot
7.3 robotic arm
7.4 Switches
7.5 DC motors
7.6 Battery
7.7 wireless camera
7.8 Wireless Transmission module (Hand gesture module)
7.9 pc/laptop

7. 1 PIC Microcontroller

: Flash Memory: 14.3 Kbytes (8192 words)
: Data SRAM: 368 bytes
: Data EEPROM: 256 bytes
: Self-reprogrammable under software control
: In-Circuit Serial Programming via two pins(5V)
: Watchdog Timer with on-chip RC oscillator
: Programmable code protection
: Power-saving Sleep mode

7.2 RF module

VIII. DESCRIPTION

The CC2500 is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports vari ous modulation formats and has a configurable data rate up to 500k Baud.

8.1 Wireless Camera

Fig 7.2 Wireless Camera

8.2 Key Features:

Image sensor-CMOS
Signal system-PAL/CCIRNTSC/EIA
Horizontal resolution-380 TV line
Scan Freq.-PAL/CCIR:50HZ/NTSC/ELA:60
Antenna-50ohm SMA
Demodulation mode-FM
Transmission power supply-DC 9V
Receiving Freq.-1.2G/2.4G

IX. PROBLEM STATEMENT

To construct a basic bomb diffusing robot which can handle simple tasks like cutting wires, flip on switches, lift light objects, etc. and a simple autonomous robot to help in the transit of the bomb. Also gives video feedback to us so effective handling of robot can be possible.

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The Microstructures of Hydroxyapatite/Collagen Thin Films Coating on Ti6Al4V Titanium Alloy Using Electrodeposit Method

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Department of Industrial Engineering, Faculty of Engineering, Thammasat University,
Klong Nuang, Klong Luang, Pathumtani

***Abstract*:-- Composite coating of hydroxyapatite/collagen (HAP/collagen) was prepared on the Ti6Al4V, titanium alloy platefor implant materials of orthopedic and dental applicationsby using electrodeposit method.The aim of this research was to study the coating process of hydroxyapatite/collagen and investigate the effect of electrical voltage on structure of coating surface. In this research, Ca(NO3)2. 4H2OandNH4H2PO4 were used to prepare HAP, and collagen type I was from SIGMA-ALDRICH. The electrical-voltage coating parameters were usedbetween of 2-10 voltage for 50 minute at room temperature. The result of X-ray diffraction (XRD) test found that at 5 voltageof electrodeposit showed theclearest peaks of hydroxyapatite, which were accordance to thecharacteristic of coating surface and its components which were analyzed by SEM-EDS method, while collagen on coating surface was analyzed by FT-IR method.**

***Index Terms*-surface coating, hydroxyapatite, collagen, electrodeposit method**

I. INTRODUCTION

Hydroxyapatite (HAP) is a bioactive ceramic that is composed mainlyof calcium and phosphorus which are the components of mineral bone [1].It has been coated on metallic implants to promote osseointegration [1]. Most techniques to coat HAP on an implant material, such as plasma spray, electrophoretic deposition and hot isostatic pressing, require high sintering temperature which leads to crack formation due to mismatch of thermal expansion [2]. Furthermore, these techniques are expensive and consume high energy power to operate the instruments [4].

The biomimetic technique is one of the methods to coat HAP on a metallic implant [5]. It does not require high energy power and high processing temperature, preventing the formation of crack and coating instability [3]. Recently, a polydopamine film was utilized to form the biomimetic HAP on medical grade stainless steel (SS316L) through a functionalization process [6]. The application of polydopamine as an intermediate layer to functionalize biomolecules is adopted from the work of Lee et al. [7]. The functionalization mechanism is based on the existence of amine and thiol/catechol functional groups which will participate in the binding process [8]. This mechanism produces strong and stable anchorage properties [9]. Besides, the biomimetic HAP grafted on the polydopamine film mimics the natural properties of bone. Those properties cause the polydopamine film to become a favorable way to optimize the surface of metallic implants [10].

Collagen fibers are another type of component, existing as the main organic composition of bone extracellular matrix [11]. It is commonly used to improve the biocompatibility of implant surfaces [12,13]. These fibers act as a building template for bone formation and provide mechanical strength to bone [14]. The immobilization of collagen on material surfaces through a physical absorption technique shows simplicity and flexibility, but generally this method produces instability of the coating film [15]. Meanwhile, a covalent immobilization technique compromises better control of coating parameters such as coating thickness, ligand density and molecular orientation [16]. There are various strategies to covalently immobilize the collagen onto metallic surfaces that usually involve complex chemistry and regularly induce additional toxic factors [17,18]. Therefore, the exploration of a simple and versatile covalent immobilization technique is crucial to immobilize the collagen fibers to promote osseointegration without producing toxic residues. The aim of this study was to coat collagen type I and HAP on a Ti6Al4V, titanium alloy plate using electrodeposit method.The crystal structure of HAP was investigated by X-ray diffractometer. The morphology of HAP was characterized using scanning electron microscope, and the chemical composition was analyzed by energy dispersive X-ray spectroscopy (EDX).Finally, Fouriertransform infrared spectroscopy (FT-IR) was used to analyze the molecular structures of HAP and collagen.

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II.EXPERIMENT PROCEDURE

A.Material Preparation

Material for electrolytic coating in this study, the Ti6Al4Vtitanium alloy plate with the size of 10 x 20 mm2 and 1.5 mm of thickness was grinded with 600 and 1000 of grid number of abrasive papers and polished with 0.3 micron of alumina powder

B.Solution Preparation

Hydroxyapatite(HPA) solution was prepared with Ca/P ratio at 1.67 by using NH4H2PO4 0.143 mg and Ca(NO3)2.4H2O 0.248 mg dissolved in deionized water 50 ml and stirred by magnetic stirrer at 240 rpm for 30 minus. The concentrations of NH4H2PO4 andCa(NO3)2.4H2O were 0.025 and 0.042 molar, respectively.

HAP/collagen compound solution was prepared by using HAP solution mixed with Collagen Type I at the concentration of 0.1% and was stirred by magnetic stirrer at 240 rpmfor 30 minus.

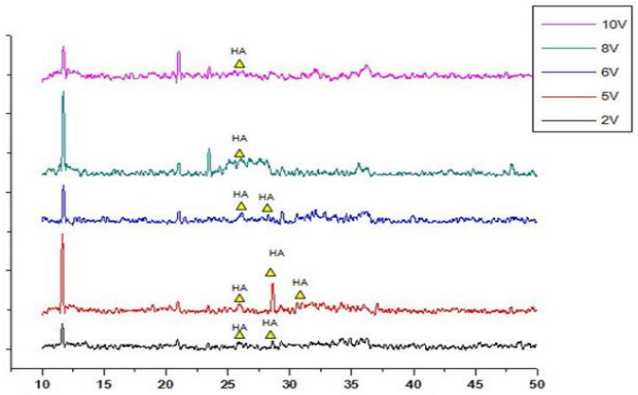
B.Experimental method

The first step of this study, hydroxyapatite electrolytic coating was carried out at 2, 5 and 10 voltage for 50 minus by usingthe TI6Al4Vtitanium alloy plate as cathode and the stainless steel plate as an anode in HAP solution. Then, the specimen was rinsed by deionized water and dried at room temperature. The HAP coated specimens were analyzed by X-ray diffraction, scanning electron microscope and FT-IR spectrometer. The best condition of HAP coating was selected and coated in the second step of HAP/collagen electrolytic coating. The specimen was analyzed by Fourier Transform Infrared (FT-IR) spectrometer

III. RESULTS AND DISCUSSION

A.XRD Analysis

The standard peaks of the hydroxyapatite crystal structure analyzed by using XRD spectrometer were found at the 2θ angles of 25.89, 28.68, 32.05 and 39.66 [19]. Fig. 1 shows the analysis peaks of the hydroxyapatite crystal structure of the specimens which were coated at 2, 5, 6, 8 and 10 voltage.It was found that the clearest peaks are at 5 voltage coating. The specimens of 5, 6, 8 and 10 voltage were analyzed by scanning electron microscope (SEM) and energy dispersive x-ray spectroscopy (EDX).



B.SEM/EDXAnalysis

The results of the surface structures of coated hydroxyapatite at 5, 6, 8 and 10 voltage analyzed by SEM were shown in Fig. 2.The plate structure of hydroxyapatite was found. From EDX analysis, the CA/P ratio of 5 voltage coated specimen is at 1.44 which is the nearest ratio of 1.67 in the human bone [20]. The specimen coated at 5 voltage was selected to coat collagen and analyze by Fourier Transform Infrared (FT-IR) spectrometer.

C. FT-IR Spectrometer Analysis

The result of HAP/collagen surface structure of 5 voltage coated specimen analysis by using FT-IR spectrometer shows the relationship between wave range of infrared between 650-4000 cm-1 and transmittance in Fig. 3. The wave numbers of collagen and HAP were found at 1646.31 and 3257.41 cm-1, respectively. The HAP/collagen surface was analyzed by SEM and shown in Fig. 4.

IV. CONCLUSION

The result of HAP coating on the TI6Al4V titanium alloy plate by using electrodeposit method was found that the coating at 5 voltage can be obtained Ca/P ratio of 1.44 which is nearest number of human bone ratio of 1.67. The crystal plate of HAP was found. The coating of HAP/collagen was analyzed by FT-IR spectrometer and found that collagen and HAP were at the wave numbers of 1646.31 cm-1 and 3257.41 cm-1, respectively.

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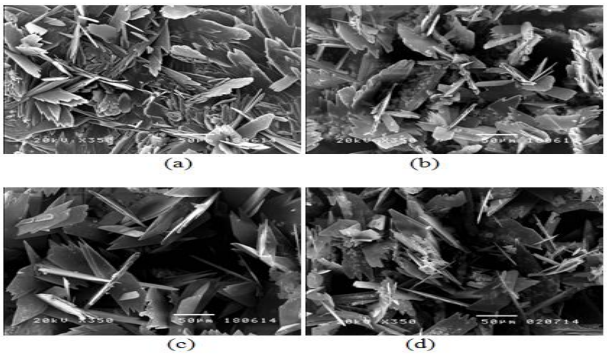

Fig. 2 SEM photographs of hydroxyapatite surfaces coated at (a) 5V, (b) 6V, (c) 8V and (d) 10V

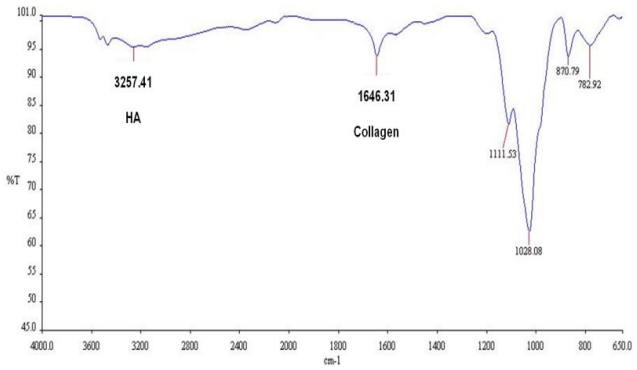

Fig.3 FT-IR spectrum HAP/collagen

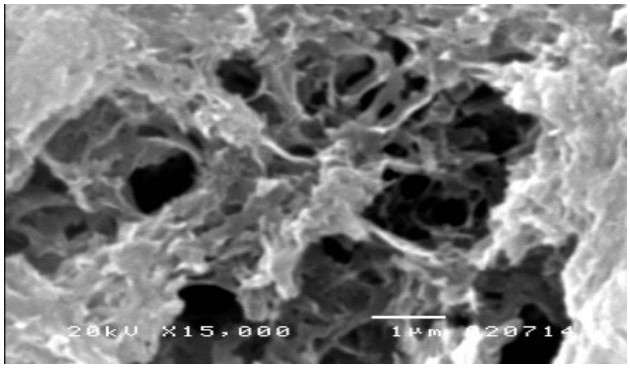

Fig. 4SEM photograph ofHAP/collagen

V. ACKNOWLEDGEMENT

This research was financial supported by Faculty of Engineering, and X-ray diffraction and SEM/EDX analyses were investigated at Department of Physics, Faculty of Science and Technology, Thammasat University, Thailand. The investigation of FT-IR spectrometer was performed at The Science and Technology Research Tool Center, Rungsit University, Thailand.

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Artificial Intelligence

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Abstract: **- This paper reviews the meaning of artificial intelligence and its various advantages and disadvantages including its applications. It also considers the current progress of this technology in the real world and discusses the applications of AI in the fields of heavy industries, gaming, aviation, weather forecasting, expert systems with the focus being on expert systems. The paper concludes by analysing the future potential of Artificial Intelligence.**

***Keywords*---** **Turing Test, Gaming Industry, Weather Predictions, Expert System**

I. INTRODUCTION

Artificial Intelligence (AI) is defined as intelligence exhibited by an artificial entity to solve complex problems and such a system is generally assumed to be a computer or machine. Artificial Intelligence is an integration of computer science and physiology Intelligence in simple language is the computational part of the ability to achieve goals in the world. Intelligence is the ability to think to imagine creating memorizing and understanding, recognizing patterns, making choices adapting to change and learn from experience. Artificial intelligence concerned with making computers behave like humans more human like fashion and in much less time than a human takes. Hence it is called as Artificial Intelligence. Artificial intelligence can be divided into parts according to philosophy of AI.

The different levels of artificial intelligence

Within the realm of artificial intelligence, there are different classifications. They include:

Strong Vs Weak

Strong artificial intelligence refers to the work that looks to genuinely imitate a human – and that could potentially even explain the way humans think. Few examples of this exist, currently. Then there is weak artificial intelligence, which simply aims to build systems that are able to behave in the same manner as humans but do not have the aim of thinking as humans think.

Narrow Vs General

Another classification of artificial intelligence are those that are meant to meet certain tasks, known as narrow artificial intelligence; and those designed to reason, known as general artificial intelligence.

So what are the pros and cons of artificial intelligence?

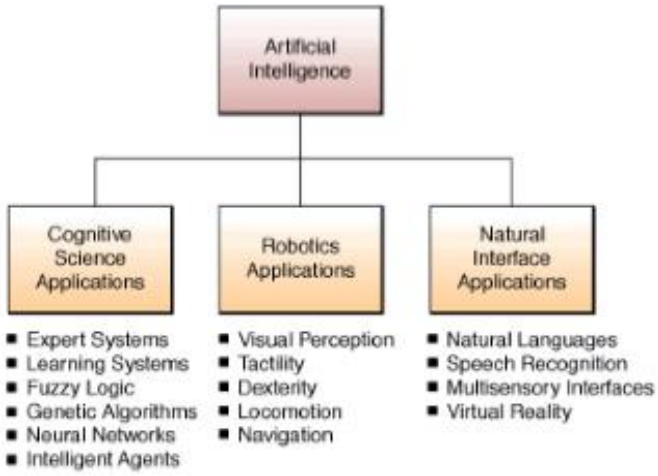


Fig 1. Overview of Artificial Intelligence

AI and a lively debate is on-going as to whether this is even possible.

Intelligence = perceive + Analyse + React

Also, there is a huge different between short term memory and RAM. Short-term memory holds pointers to the long-term memory where all the information is actually stored while RAM stores data that is isomorphic to data being held on a hard disk. Also, RAM has a memory limit while there seems to be no capacity limit when it comes to short-term memory.

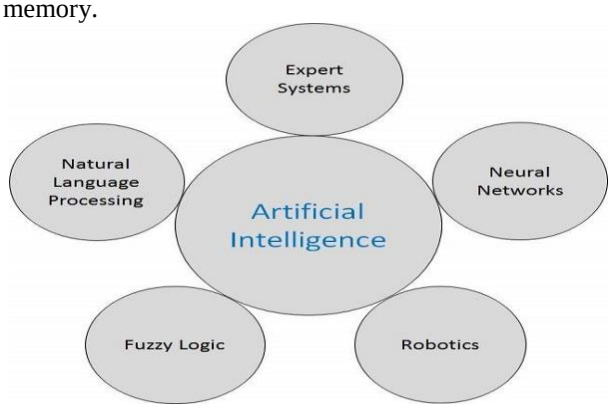


Fig 2. Areas of Artificial Intelligence locations.

If the judge cannot reliably tell the machine from the human, the machine is said to have passed the test. In order to test the machine's intelligence rather than its ability to render words into audio, the conversation is limited to a text-only channel such as a computer keyboard and screen." Sufficiently many interrogators are unable to distinguish the computer from the human being then it is to be concluded that the computer thinks.

Neural Networks:

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurones) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurones. This is true of ANNs as well.

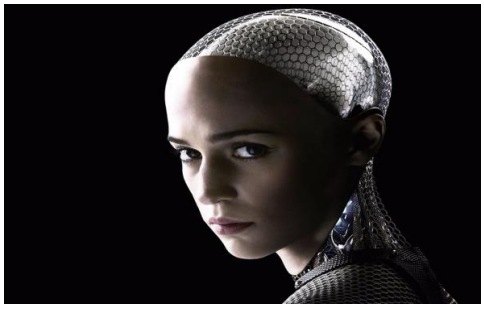
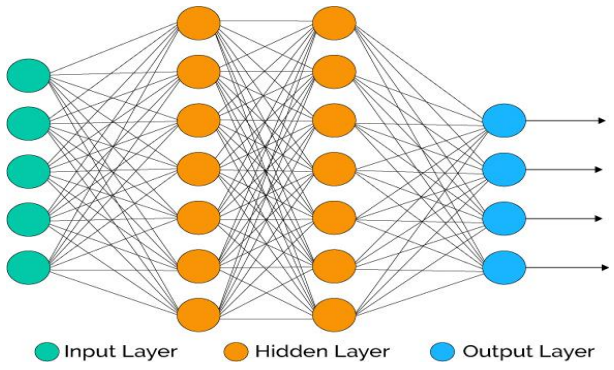


Fig 3. Neural Network

Why we use neural network?

Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyse.



This expert can then be used to provide projections given new situations of interest and answer "what if"questions.

Other advantages include:

1. Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.
2. Self-Organisation: An ANN can create its own organisation or representation of the information it receives during learning time.
3. Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are beingdesigned and manufactured which take advantage of this capability.
4. Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance.

AI EXPERIMENTS

1. SEEING AI BY MICROSOFT
2. THING TRANSLATOR
3. NSYNTH SOUND MAKER
4. GIORGIO CAM

Roots of AI:-

Artificial Intelligence has identifiable roots in a number of older disciplines, particularly

- Philosophy
- Logic/Mathematics
- Computation
- Psychology/Cognitive Science
- Biology/Neuroscience

There is inevitably much overlap Example, between philosophy and logic, or between mathematics and computation. By looking at each of these in turn, we can gain a better understanding of their role in AI, and how these underlying disciplines have developed to play that role.

II. ADVANTAGES AND DISADVANTAGES

One massive advantage of artificial intelligence is its potential to complete mundane tasks through intricate automation that will increase productivity. Theoretically this can even remove "boring" tasks from humans and free them up to be increasingly creative.

Faster decisions

Using artificial intelligence alongside cognitive technologies can help make faster decisions and carry out actions quicker.

Avoiding errors

The phrase "human error" was born because humans, naturally, make mistakes from time to time. Computers however, do not make these mistakes – that is, of course, assuming they are programmedproperly. With artificial intelligence, data could be processed error-free, no matter how big the dataset might be.

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Taking risks on behalf of humans
With artificial intelligence, you can arguably lessen the risks you expose humans to in the name of research. Take, for example, space exploration and the Mars rover, known as Curiosity. It can travel across the landscape of Mars, exploring it and determining the best paths to take, while learning to think for itself. Using artificial intelligence in this manner could potentially lead to massive benefits in areas such as demand forecasting, medical diagnosis and oil exploration.

The disadvantages
Job losses
Take, for example, the concept of driverless cars, which 0could displace the need to have millions of human drivers, from taxi drivers to chauffeurs, very quickly. Of course some would argue that artificial intelligence will create more wealth than it destroys – but there is genuine risk that this will not be distributed evenly, particularly during its early expansion.

Distribution of power
Artificial intelligence carries the risk, in the minds of some, of taking control away from humans – de-humanising actions in many ways. Nations that are in possession of artificial intelligence could theoretically kill humans without needing to pull a trigger.

Lack of judgement calls
Humans can take unique circumstances and judgement calls into account when they make their decisions, something that artificial intelligence may never be able to do. One example occurred in Sydney, Australia, in 2014 when a shooting drama in the downtown area prompted people to make numerous calls to Uber in an effort to escape the area. The result was that Uber's ride rates surged based on its supply and demand algorithm – there was no consideration involved for the circumstances in which the riders found themselves.

So is artificial intelligence really a threat?
If you think that artificial intelligence is just a futuristic, Jet sons-style image that is unlikely to ever affect humans on a mass scale then look no further than the employees of Fukoko Mutual Life Insurance in Japan. In January 2017, 34 of its employees were dismissed from their jobs because the insurer had installed a new artificial intelligence system that could read medical certificates, gather data on hospital stays and surgeries, and, in the process, save the company an estimated 140 million Yen per year in salary costs.
Clearly, artificial intelligence has massive potential advantages. The key for humans, however, will be to use their own judgement to apply it productively and ensure the "rise of the robots" doesn't get out of hand.

III. CURRENT PROGRESS

Artificial intelligence is the ability of a computer to understand what you're asking and then infer the best possible answer from all the available evidence. You may think of AI as Seri or Google Now on your iPhone, Jarvis from Iron Man or IBM's Watson.Progress of late is furious — an AI R&D arms race is underway among the world's top technology giants. Soon AI will become the most important human collaboration tool ever created, amplifying our abilities and providing a simple user interface to all exponential technologies. Ultimately, it's helping us speed toward a world of abundance. The implications of true AI are staggering, and I asked Stephen to share his top five breakthroughs from recent years to illustrate some of them.
Recent Top 5 Breakthroughs in AI: 2011 – 2015
"It's amazing," said Gold. "For 50 years, we've ideated about this idea of artificial intelligence. But it's only been in the last few years that we've seen a fundamentaltransformation in this technology."

Here are the breakthroughs Stephen identified in artificial intelligence research from 2011-2015:

1. IBM Watson wins Jeopardy demo's integration of natural language Processing, machine learning (ML), and big data.
In 2011, IBM's AI system, dubbed "Watson," won a game of Jeopardy against the top two all-time champions. This was a historic moment, the "Kitty Hawk moment" for artificial intelligence. "It was really the first substantial, commercial demonstration of the power of this technology," explained Gold. "We wanted to prove a point that you could bring together some very unique technologies: natural language technologies, artificial intelligence, the context, the machine learning and deep learning, analytics and data and do something purposeful that ideally could be commercialized."

2. Seri/Google Now redefines human-data interaction.
In the past few years, systems like Siri and Google Now opened our minds to the idea that we don't have to be tethered to a laptop to haveseamless interaction with information. In this model, AIs will move from speech recognition to natural language interaction, to natural language generation, and eventually to an ability to write as well as receive information.

3. Deep learning demonstrates how machines learn on their own, advance and adapt.
"Machine learning is about man assisting computers. Deep learning is about systems beginning to progress and learn on their own," says Gold. "Historically, systems have always been trained. They've been programmed. And, over time,

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the programming languages changed. We certainly moved beyond FORTRAN and BASIC, but we've always been limited to this idea of conventional rules and logic and structured data. "As we move into the area of AI and cognitive computing, we're exploring the ability of computers to do more unaided/unassisted learning.

4. Image recognition and interpretation now rivals what humans can do — allowing for imagine interpretation and anomaly detection.

Image recognition has exploded over the last few years. Facebook and Google Photos, for example, each have tens of billions of images on their platform. With this dataset, they (and many others) aredeveloping technologies thatgo beyond facial recognition providing algorithms that can tell you what is in the image: a boat, plane, car, cat, dog, and so on.

5. AI Apps proliferate: universities scramble to adopt AI curriculum

As AI begins to impact every industry and every profession, there is a response where schools and universities are ramping up their AI and machine learning curriculum. IBM, for example, is working with over 150 partners to present both business and technology-oriented students with cognitive computing curricula.

So what's in store for the near future?

Anticipated Top AI Breakthroughs: 2016 – 2018

Here are Gold's predictions for the most exciting, disruptive developments coming in AI in the next three years. As entrepreneurs and investors, these are the areas you should be focusing on, as the business opportunities are tremendous.

1. Next-gen A.I. systems will beat the Turing Test

Alan Turing created the Turing Test over half a century ago as a way to determine a machine's ability to exhibit intelligent behaviour indistinguishable from that of a human. Loosely, if an artificial system passed the Turing Test, it could be considered "AI."Gold believes, "that for all practical purposes, these systems will pass the Turing Test" in the next three-year period. Perhaps more importantly, if it does, this event will accelerate the conversation about the proper use of these technologies and their applications.

2. All five human senses (yes, including taste, smell and touch) will become part of the normal computing experience.

AIs will begin to sense and use all five senses. "The sense of touch, smell, and hearing will become prominent in the use of AI," explained Gold. "It will begin to process all that additional incremental information. "When applied to our computing experience, we will engage in a much more intuitive and natural ecosystem that appeals to all of our senses.

3. Solving big problems: detect and deter terrorism, manage global climate change.

AI will help solve some of society's most daunting challenges.Gold continues, "We've discussed AI's impact on healthcare. We're already seeing this technology being deployed in governments to assist in the understanding and pre-emptive discovery of terrorist activity."We'll see revolutions in how we manage climate change, redesign and democratize education, make scientific discoveries, leverage energy resources, and develop solutions to difficult problems.

4. Leverage ALL health data (genomic, phenotypic, and social) to redefine the practice of medicine.

"I think AI's effect on healthcare will be far more pervasive and far quicker than anyone anticipates," says Gold. "Even today, AI/machine learning is being used in oncology to identify optimal treatment patterns. But it goes far beyond this. AI is being used to match clinical trials with patients, drive robotic surgeons, read radiological findings and analyse genomic sequences.

5. AI will be woven into the very fabric of our lives — physically and virtually.

Ultimately, during the AI revolution taking place in the next three years, AIs will be integrated into everything around us, combining sensors and networks and making all systems "smart."AIs will push forward the ideas of transparency, of seamless interaction with devices and information, making everything personalized and easy to use. We'll be able to harness that sensor data and put it into an actionable form, at the moment when we need to make a decision.

IV. APPLICATIONS

Artificial Intelligence in the form of neural networks and expert systems has applications in almost all human activities. The combination of high precision and low computation time makes AI a cutting edge technology. Robot ES‟ s are already taking over workshop level jobs in large industries, thus side lining humans into a more supervisory role. Stock brokerage firms are now using Artificial Intelligence to analyse data, make analysis and buy or sell stocks without the interference of any human beings. Some of the applications of Artificial Intelligence are as follows-

A. Gaming Industry-

One of the most commonly known applications of AI in the gaming industry is its use in chess. Even though these machines are not as intelligent as humans, they use brute force algorithms and scan 100‟ s of positions every second so as to determine the next move. As stated earlier, AI is

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also being used in Microsoft Xbox 360‟ s Kinect for body motion detection. But it is still in its infancy and requires a lot more advancement for it to be used in day-to-day applications.

B. Heavy industries-

Artificial Intelligence robots have become very common in heavy industries and are employed in jobs that are otherwise considered dangerous for humans. These robots also increase the efficiency, as they do not need any break while working thus overcoming the inherent disadvantage of tiredness in humans.

Fig 4. AI Applications

C. Weather Forecasting-

Neural networks are nowadays being used for predicting weather conditions. Past data is provided to the neural network, which then analyses the data for patterns and predicts the future weather conditions.

D. Expert Systems-

• Expert Systems are machines that are trained to have total expertise in specific areas of interest. They are developed to solve the problems in niche areas. These systems use statistical analysis and data mining to solve these problems by deducing the solutions through a logical flow of yes-no questions.

• **Inference engine-**

It seeks information from the knowledge base on being presented with a query, analyses it and responds with a solution or recommendation in the way a human expert would

• **Rule-**

It is a conditional statement that links the given conditions to the final solution.

F. Knowledge representation:

Data mining seeks to discover interesting patterns from large volumes of Data. These patterns can take various forms, such as association rules, classification rules, and decision trees, and therefore, knowledge representation becomes an issue of interest in data mining.

V. FUTURE ASPECTS

The use of artificial intelligence will lead to production of machines and computers, which are much more advanced than what we have today. Speech recognition systems will reach much higher levels of performance and will be able to communicate with humans, using both text and voice, in unstructured English. There will be a great future some day for expert system applications in all aspects of health care, in both clinical and administrative areas, in improving patient care and in allocation offinancial, social, and other resources.

VI. CONCLUSION

The computing world has a lot to gain or benefits from various AI approaches. Their ability to learn by example makes them very flexible and powerful. Furthermore there is no need to devise an algorithm in order to perform a specific task i.e. there is no need to understand the internal mechanisms of that task. They are also very well suited for real time systems because of their fast response and computational times which are due to their parallel architecture. The goal of artificial intelligence is to create computers whose intelligence equals or surpasses humans. Achieving this goal is the famous “AI problem from last decade researchers are trying to close the gap between human intelligence and artificial intelligence.

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Computer Network Routing using Swarm Intelligence

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Abstract: **- With the revolution in computing, particularly in telecommunication there has been a considerable amount of research how to include phenomenon in nature for network routing particularly Swarm Intelligence in telecommunication routing. Various algorithms have been proposed time to time by various researchers for performing efficient routing in wired and wireless adhoc networks. This paper provides overview of novel routing algorithms inspired by communicative and evaluative methods and procedures of Social Insects like Ants and Bees.**

Keywords**: - Stigmergy, Antnet. Ant Colony Based Routing Algorithm. Termite, Foragers, Bee Hive, Pheromone**

I. INTRODUCTION

The Swarm Intelligence can be defined as a framework for designing and analyzing the large system consisting of numerous smaller and simpler units, interacting locally [1]. The behavior of the total system is defined by the result of interaction between the individuals, thus defining the property of a system as a whole. The methodology of swarm intelligence is devised from the behavior of swarms or social insects like ants, honeybees and termites [2]. Swarm insects have intellectual ability, restrained capability and react naturally in a probabilistic manner based on the environment. For example, initially ant wanders randomly around its nest. Once the food is found, the ant finds the shortest path between the nest and sources of food by leaving trails of pheromones with different density depending upon the quality and quantity of food. The Swarm intelligence exhibit the characteristics like; self-organized, homogenous nature, local interaction based on simple rules, scalability and robustness [3] [4].

II. PRINCIPLES OF SWARM INTELLIGENCE

The design framework of Swarm Intelligence is based on four main principles which are:

A. Positive feedback

The positive feedback is used to encourage the good solutions over rest of the solutions.

B. Negative feedback

The negative feedback is used to weed out the poor or old solutions.

C. Randomness

The randomness principle allows the Swarm Intelligence to find the solutions at random, thus exploring different and new solutions. This principle is usually used when solutions to the problem are very large and it's unpredictable coming out with a good solution.

D. Multiple Interactions

The individuals also known as agents communicate using multiple interactions. The information collected locally needs to be interacted from one portion of the system to another. This multiple interaction allows proper coordination of events at local level. For example, in adhoc network, there is the need to coordinate local routing information between the nodes during the communication process.

III. ROUTING USING SWARM INTELLIGENCE

The routing can be defined as the process of transferring information between the different networking using a device called as a router. The effective routing process in conjunction with congestion control and flow control determines the performance of the network. The routing algorithms can be mainly categorized into two groups; Adaptive and Non- Adaptive. The Non-Adaptive routing does not take into consideration the current status and topological information of network., while Adaptive routing do. In MANETS the routing algorithms can be classified as proactive, reactive and geographical based. In proactive, the routing information is maintained all the time for each and every node [5][6][7], while in reactive a route information is maintained only on demand basis [8][9][10].In geographical based routing, location information is used for routing[11][12].

The decentralized and adaptive nature of swarm motivates it to be used in routing algorithms. There are different types of Swarm Intelligence based routing algorithms which are as:

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A. Antnet Algorithm

Antnet is the adaptive routing algorithm that was versed in for performing routing in the packet switching network [13] [14]. The Antnet is based on a framework of Ant Colony Optimization with the aim of exploring the behavior of an ant colony for finding the shortest path. Antnet model works in two phases; forward and backward, so it is often known by the name of Forward-Backward model. Initially at regular intervals, the source node generates forward ants towards the destination with the aim of exploring the path in a controlled fashion. The forward ants and the packets share the same queues, so forward ants can determine the status of the network effectively as both packets and forward ants will experience same network conditions. The forward ant generation process is followed by initialization of the routing table. For initialization of routing table with lower convergence time Antnet makes use of broadcasting with time out mechanism. Initially router sends the Hello packet to all of its connected nodes, which in term floods to all of its neighboring nodes other than the node where the Hello packet originated from. At the end of time out, the routing table can be extracted from the topology table contained in each and every router. After the initialization is over, the source node generates an ant also known as agent toward destination for establishing reliable and efficient path using hop count as a metric by referring to initialized routing table. This forward movement of an ant, from source towards the destination is known as Forward ant from Source to Destination. The ant moves from one node to another adjacent node based on the routing table and stores the information of all the visited nodes in a data structure called a Stack.

This is followed by retrace using backward ant. The forward ant upon arrival at the destination stops updating the stack and copies the contents of stack onto the agent called as backward ant, finally destroying itself. Now Backward ant from Destination to source goes from destination to source following the same path of that of a Forward ant from Source to Destination. The Backward ant upon reaching the source indicates the existence of a reliable path from source to destination. Finally, the data packets are transmitted from source to destination through a reliable set up path using forward and backward ant.

B. Ant Based Control Algorithm

Ant Based Control algorithm is a circuit switching routing protocol [15]. This routing protocol uses ants known as agents for generating a route between two nodes. When the ants move, depositing artificial pheromone that is the function of path from source to current node and congestion till encountered. The selection of the next hop is based on pheromone value. Each and every node maintains the pheromone table. The entries in the table are the probabilities influencing the selection of the next node on the way to the destination. The Ant Based Control Algorithm uses only forward ant (agent). At regular intervals the ants are forwarded from source to destination and are finally destroyed upon reaching destination. Routing Table at each node is updated based on the life of an ant. As the ant arrives at a node, the probability entry in the pheromone table is increased based on the formula:

$$Pnew = (Pold + \Delta P) / (1 + \Delta P) \quad (1)$$

Where is new probability, is old probability and is change in probability. The probability for rest of the entries in the pheromone according to formula:

$$Pnew = Pold(1 + \Delta P) / \Delta P \quad (2)$$

The final goal of the algorithm is to find the shortest path while avoiding the congested path, with call routing via the path with highest probability.

C. Ant Colony Based Routing Algorithm

This type of routing algorithm is used for MANET [15]. The Adhoc network possesses some characteristics like decentralized control, mobility, deployable and expandable. The disadvantages of MANET Includes limited range, security, speed and reliability. Since the topology MANET keeps on changing with respect to time, therefore requiring a special type of routing algorithm that not only performs route maintenance, but also detects the path failure between the pair of nodes. The working of Ant Colony Based Routing Algorithm is divided into two stages:

1) Maintenance of Route: This phase helps in maintaining and strengthening the route that has already been created during route discovery phase. Since the nodes are mobile in nature, so there is constant requirement of refreshing or maintaining the route between the nodes. Once the route between source and destination is determined, its then it relies on data packets to maintain the route. Suppose node Ni forward the packet via node Nj to destination node Nk,this phase will strengthen the path by increasing the value of pheromone along the path Nj and Nk by some value
[16].

2) Handling of Route Failure: This phase deal with failure of links that may be caused due to mobility or due to crash of nodes. Since each and every packet is coupled with acknowledgement, indicating link failure. Once the link failure is detected, the route error message is passed to preceding node and path is deactivated by setting value of pheromone to zero. The preceding node then tries to find the alternate path. If path is found, then packet is forward via that particular path. If no path is found, then the node tries to broadcast message to its neighbors until source node is found. The source node on receiving the route error message reinitializes the route discovery phase. This algorithm is able maintain multiple paths, if the optimal path breaks, then it

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chooses next leading path, thus providing multiple paths in case failure of optimal path.

D. Mobile Ant Based Routing

The Mobile Ant Based Routing is the extension of AntNet Algorithm for large scale adhoc networks. This particular algorithm divides the large scale network into rectangular zones and corresponding geographical areas [4]. It is actually a combination of three routing protocols; Topology Abstracting Protocol, Straight Packet Forwarding and Mobile Ant Based Routing [17]. The Topology Abstracting Protocol uses logical links and logical routers to generate simplified network. The logical router is the collection of all the nodes with the zone. Mobile Ant Based Routing is used for routing within the simplified topology generated by the Topology Abstracting Protocol. Ants are used at this level to periodically update routing table. The forward ants are transmitted towards the zones containing the destination, the path information collected by the forward ants during their traversal are sent back to their sources with the help of backward ants. Followed by updating logical link probabilities. The Straight Packet Forwarding is used for the movement of data within the simplified topology and for transferring packets between the logical routers.

E. Termite

The Termite is the extension of Ant Based Control Algorithm. It is similar to Ant Colony Based Routing Algorithm with the difference in route discovery and failure handling mechanism [18]. The Termite is Hill Climbing Technique with principle based on Swarm Intelligence. Each termite collects a pebble and moves towards the path with high pheromone deposit. Initially, if no pebble is present, the agent moves in a random path to find the pebble while depositing pheromone on its path. When the agent finds the pebble, it picks the pebble and moves toward the path with high concentration of pheromone. If the agent finds another pebble on its way, the agent puts the original pebble down and infuses it with pheromone which evaporates, thus creating a gradient for others to follow. With this rule, a group of termites can collect a number of pebbles in one place. This Termite policy can be utilized for routing the packets from source to destination by using artificial pheromone to produce next hop probabilities for random routing. The control traffic is reduced using Stigmergy. Let S be the source node, C be the current node where packet has arrived and K be previous hop node. The current node updates the pheromone table as:

$$P_{P,K} = P_{K,S} + \gamma \quad (3)$$

And decay the pheromone value periodically with rate τ as:

$$P_{C,d} = P_{C,d} . e^{-t} \quad \forall C \in N, \forall d \in D \quad (4)$$

1) Termite Route Discovery using PREQ and RREP: Initially, if the node fails to find a destination in pheromone table, a route request is initiated with the help of PREQ packet following a random walk until it finds the node containing destination pheromone. Then a route reply is sent using RREQ packet following the same pheromone trail to the source.

2) Handling route failure: If the node is unable to transfer to its neighbor, the neighbor is removed from the pheromone table and next hop for the packet is calculated and sent via new calculated path. If there is no possibility of alternate route, then the packet is simply discarded.

F. BeeHive

BeeHive [19] [20] [21] is the routing algorithm inspired from honey bee, where paths are constantly tried out to learn new routes and get used to varying network environment, and data are spread over multiple paths to enhance network performance and resources utilization. Since the majority of foragers explore the food within the vicinity of hive while only minority of foragers explore the source of food to distant locations. Therefore, this approach of forager bees can be transformed into a model with two agents; short distance agent and long distance agent. The short distance agent collects and dissimilate the routing information within the neighborhood while as a long distance agent collects and dissimilates the routing information to all the nodes in the network. The network is divided into forage zones and forage regions. A forage can be defined as collectively set of nodes forming around a node from which short distance bee can reach. The same node can participate in multiple forage zones, further the network can be viewed as non-overlapping set of clusters called as forage regions. For each forage region, there is the represented node, which is the node with smallest IP address and is used for long distance communication. Each node maintains route information of all the nodes within the forage zone and representative node maintains information for forage regions. The entire process can be summarized as:

1. Initially forage regions are formed and the first generation of short distance bee agent communication is launched to communicate their identifiers in neigh hood.
2. If a node receives a short distance bee, whose IP address is less than representative node address then it is discontinued as representative node and new representative node is chosen the smallest IP address of the two.
3. If a node learns that its representative node has joined another foraging region, then it repeats the step 1.
4. Step 1-3 is continued until network is divided into overlapping zones and disjoint regions.
5. The algorithm enters into normal phase. The non-Representative nodes periodically send its short distance bee agents by broadcasting to each of its neighbors.

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6. If the node has received a replica of bee agent, then it updates its local table and updates its local table, broadcasting the information to its neighbors except for the one it received from. This process continues until agent expires or replica of the same message is received.
7. Representative nodes launch long distance communication with the same procedure as for short distance communication with exception of longer expiry timer.
8. Finally each node maintains routing information for reaching node within the zone and to reach the representative node. If the Communication is beyond the zone, then it is forwarded to representative node of foraging region containing the destination node.

IV. CONCLUSION

Swarm Intelligence has emerged as a novel field for reconstructing old-fashioned algorithm design paradigm of developers by enabling them to aim for working principle found in nature and using them for design and development of new algorithms. Inherent properties of swarm intelligence as observed in nature include: massive system scalability, emergent behavior and intelligence from low complexity local interactions, autonomy, and Stigmergy. Communication network management is becoming gradually more challenging due to the increasing size, rapidly changing topology, and complexity of communication networks. Therefore, Swarm Intelligence based approach offers to be a powerful means to solve routing problems.

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Gradual Structural ZnO/TiO_2/Cdse Quantum Dot Sensitized Solar Cell Design

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***Abstract*— In this study, ZnO/TiO_2 graded surface, which is offered as an alternative to ZnO and TiO_2 photo-anode surfaces, which are generally used in CdSe QDSSCs, has been studied. In the study, while the ZnO layer was coated on the FTO surface with spin coating method, TiO_2 surfaces were coated with the doctor blade method. CdSe QDs were coated on the by using the chemical bath deposition (CBD) method of pre-synthesized QDs. The power conversation efficiency (PCE) value for TiO_2/CdSe QDSSCs 2.115±0.124, while PCE was up to 2.507±0.117 with ZnO/TiO_2/CdSe QDSSC.**

***Index Terms*— CdSe; QDSSC; ZnO; TiO_2**

I. INTRODUCTION

In recent years, studies on quantum dot sensitized solar cells (QDSSC) have been increasing. The main reason for this is the unique optical and electrical properties of the QDs [1], as well as the potential for the efficiency of the solar cell, well above the efficiency value of the conventional solar panels [2]. However, power conversion efficiencies (PCE) of QDSSC obtained by experimental studies have been far from this theoretical value. The main reasons for this are the charge losses due to the lack of proper material combinations in the QDSSC structure [3]. The charge recombination that occur in QDSSC usually occur at electron transitions between QD and redox pairs with wide band-band TiO_2 or ZnO [4].

In QDSSC designs, light absorption rate is low, whereas semiconductors such as TiO_2 and ZnO, which have a wide energy band gap, are used as an effective interface in the transfer of electrons absorbed by light by QDSSC [5], [6]. In the literature, especially in dye sensitized solar cell studies, ZnO semiconductor material has been used as photoanode for the first time [7]. However, TiO_2 metal oxide material of QDSSC applications has become more preferred material than ZnOs with its highly porous structure. The highly porous nature of TiO_2 allows the QDs to accumulate more in these pores, the more light to be absorbed by the QDs [8]. On the other hand, ZnO provides high electron mobility and offers wide band gap [9].

In the light of these reasons, instead of using one of the ZnO and TiO_2 metal oxides, ZnO/TiO_2 photoanode surface was designed in this study. CdSe QDs were used to harvest light in the study. CdSe QDs were coated on $FTO/ZnO/TiO_2$ and FTO/TiO_2 photoanode surface CBD methods and QDSSCs performances were compared.

II. MATERIALS AND METHODS

A. Preparation of Photoanode Electrode

Fluorine doped tin oxide (FTO) was used to coat the photoanode surface in the study. Before coating the photoanode surfaces, FTO was washed with detergent, HCI and etnanol, respectively, in an ultrasonic bath for 15 minutes and surface contamination was removed. The surface was then dried with N_2 and made ready for coating.

In order to prepare the photoanode surface, ZnO metal oxide surface was first coated to FTO. For this purpose, ZnO metal oxide was prepared by modifying the method proposed by Singh et al [10]. So that 0.1 M zinc acetate dihydrate was dissolved in methanol and it became clear in ultrasonic bath. Then, the pH value of the solution was adjusted to 7 and the solution was kept in the ultrasonic bath a little more. Then the pH value was adjusted again in order to increase the OH ions and crystallize the solution and the crystals were solved. The solution, which was then washed with methanol, was dried and annealed and made ready for use.

Paste ZnO was coated onto the FTO surface at 2500 rpm by spin coating method. then the surface was annealed at 450 ℃.

After the preparation of the FTO/ZnO surface, the TiO_2 layer was coated on the surface. TiO_2 is coated on the surface in 3 different layers. First, the transparent TiO2 surface was coated on FTO/ZnO surface by spray coation method and sintered. After the surface has dried, a second layer of TiO_2 as an active layer is coated on the surface, this time with doctor blade method, and the surface is sintered at 450 ℃ for the second time. Finally, the reflective TiO_2 surface was coated on the surface with doctor blade method and the surface was sintered for the last time and the $FTO/ZnO/TiO_2$ photoanode was made ready. The schematic representation of this surface is shown in Fig. 1.

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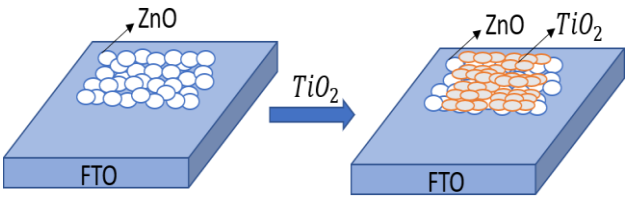

Figure 1. Schematic representation of FTO/ZnO/TiO_2 photoanode.

B. Coating CdSe QD on Photoanode

Freshly synthesized CdSe QDs were coated on photoanode surface by CBD method [11]. For this, CdSe has synthesized QDs first [12]. In the synthesis of CdSe QDs, firstly, 0.2 mmol Se and 0.5 mmol $NaHB_4$ were dissolved in 5 ml of ultrapure water and mixed in an inert environment at 80 ℃ for 30 min. At the end of 30 minutes, the NaHSe premise was ready. The premise was put on standby at the temperature. Meanwhile, 0.4 mmol of $CdCl_2$, 0.38 mmol of MPA were dissolved in 40 ml of ultrapure water simultaneously and the pH of the solution was adjusted to 12. Then, NaHSe precursor was added into Cd precursor and the mixture was mixed at 100 ℃ for 30 min and CdSe QDs were obtained. The obtained CdSe QDs were centrifuged with methanol and re-dissolved in ultrapure water and the pH was adjusted to 10a.

For the CdSe QDs to be coated on the photoanode surface, the photoanode surface was immersed in 5 ml of CdSe QD solution and kept for 24 hours. After the surface was removed from the solution, it was dried with N_2 and made ready for use.

C. Assessment FTO/ZnO/TiO2/CdSe QDSSC

For preparing the QDSSC, platinum counter electrode was used in this study. For this Pt was coated on FTO the surface [13]. And also for electrolyte iodine / iodide was used.

After photoanode and counter electrode were ready, the surface assessment as active layer became face to face and electrolyte was injected between surface. Schematic representation of ZnO/TiO_2/CdSe QDSSC is shown at Fig. 2.

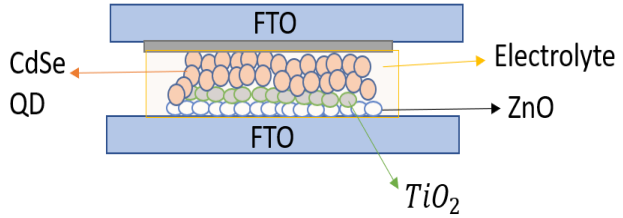

Figure 2. Schematic representation of CdSe QDSSC

D. Characterization

As a characterization study, the absorbance and emission characteristic curves of the synthesized CdSe QDs were extracted. In addition, absorbance analysis was performed in CdSe QDs coated on the photoanode surface. The designed QDSSCs were studied in 5 repetitions and a J-V characterization study was performed for each QDSSC.

III. RESULTS AND DISCUSSION

Characterization studies were started with the absorbance and emission study of CdSe QDs synthesized on water basis. Absorbance measurements of CdSe QDs were made with UV-1800 Shimadzu UV-vis Spectrometer, scanning process was carried out in the wavelength range of 400-700 nm. Emission characterization processes were carried out with Model TM-2/2005 Lifetime Spectrofluorometer device and the exciting wavelength was chosen as 380 nm. Emission characterization studies for CdSe QDs were performed in the range of 400-700 nm. The absorbance and emission characteristic curves obtained as a result of the study are shown in Fig. 3.

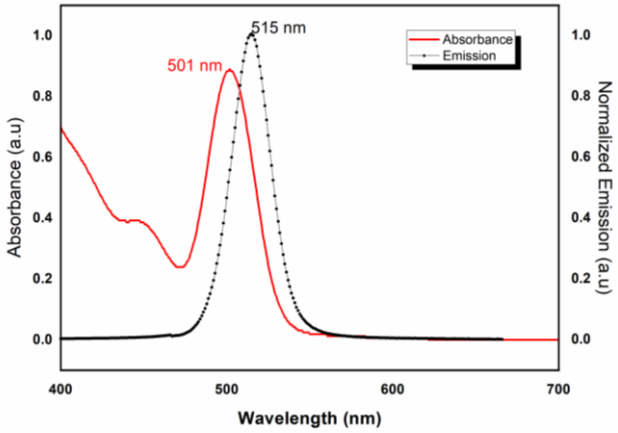

Figure 3. Absorbance and emission characterization results of CdSe QDs.

The absorbance wavelength peak for water-based, MPA-coated CdSe QDs was found to be 501 nm, and the characterization of the absorbance is consistent with the literature [14]. The diameters of synthesized CdSe QDs were calculated to be 2.38 nm. The emission peak for CdSe QDs was observed around 515 nm, with a stock shift of 14 nm relative to the absorbance peak. In addition, the photoluminescence quantum efficiency (PL QY) of CdSe QDs was calculated by the comparative PL QY method and was found to be 56.21%.

In the analysis performed over the photoluminescence peaks of the CdSe QDs with the origin pro 8 program, the FWHM value of the PL peak was calculated to be 34.2 nm. FWHM is an important parameter to determine the size distribution in the QD solution [15]. The small size distribution is an important criterion for obtaining light in a narrow range at the desired wavelength, especially in LED studies. The FWHM value of CdSe QDs synthesized in this study has an average value in the literature.

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After the absorbance and emission characterizations of CdSe QD solutions were extracted, absorbance measurements of photoanode electrodes obtained by coating CdSe QDs on FTO/TiO_2 and FTO/ZnO/TiO_2 surfaces with CBD method for 24 hours were made. The extraction of absorbance properties for photoanode consisting of QD and metal oxide surfaces is an important parameter for the harvest of incoming light. The absorbance measurements of the photoanode were also carried out with the UV-1800 Shimadzu UV-vis Spectrometer device, and the remaining parts of the photoanode surfaces in the active areas were covered with tape, allowing the light to come only to the photoanode coated surface. The absorbance results of photoanode surfaces are shown in Fig. 4.

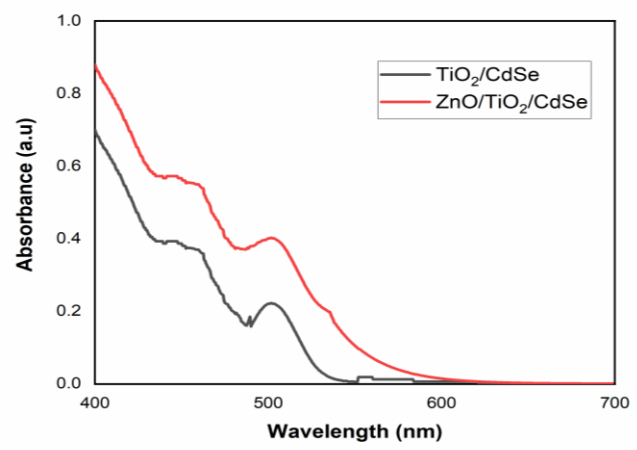

Figure 4. Absorbance of TiO_2/CdSe QD and ZnO/TiO_2/CdSe QD photoanode surfaces.

When Figure 4 is examined in detail, it is seen that the light absorption capacity of the ZnO/TiO_2/CdSe photoanode surface is higher. This is an important factor for QDSSC to achieve an increase in efficiency [16]. On the other hand, the absorbance peak of CdSe QDs coated on the surface of the ZnO/TiO_2/CdSe photoanode was observed around 508 nm, shifting towards 7 nm red compared to the CdSe QD solution. This shift is thought to be due to the small increase in size of CdSe QDs deposited on the surface with the addition of ZnO [17]. The absorbance peak for the TiO_2/CdSe photoanode surface is more consistent with the absorbance peak obtained in the CdSe solution, and an absorbance peak at 503 nm was observed with a right shift of 2 nm. On the other hand, the absorbance peak of the photoanode was obtained approximately 24% less when compared with the ZnO/TiO_2/CdSe surface. This shows that the combination of porous TiO_2 and high mobility ZnO metal oxides increases the photoanode absorbance.

In the study, in order to determine the effects of TiO_2 and gradual ZnO/TiO_2 metal oxide surfaces on QDSSC performances, QDSSCs were designed using both metal oxide structures. In order to minimize the margin of error in the study, 5-repeat designs and measurements were made. In this context, 5 CdSe QDSSCs were designed in two different surfaces, using TiO_2 and ZnO/TiO_2 thicknesses, CBD coating times, added electrolyte amounts and identical counter electrodes.

J-V analyzes for the designed QDSSCs were made under 1000 W/m^2 irradiance, and the J-V characteristic curves obtained for TiO_2/CdSe and ZnO/TiO_2/CdSe QDSSCs are shown in Fig. 5.

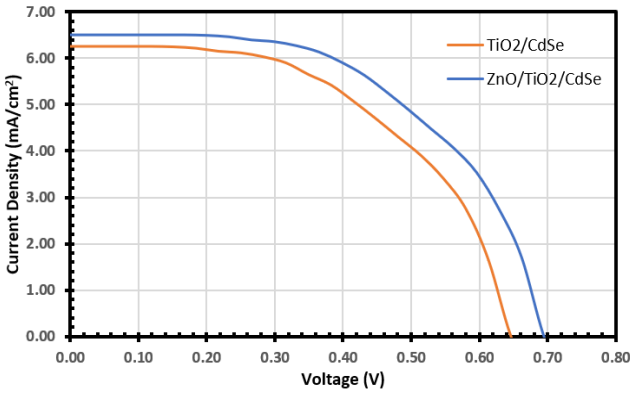

Figure 5. J-V characteristic curves of CdSe QDSSCs.

The result obtained in the J-V characteristic curves is consistent with the result obtained in the photoanode absorbance curves and it is seen that adding ZnO metal oxide causes an increase in QDSSC current and voltage values. This situation can be interpreted as increasing the radiation absorption of the ZnO layer, thus increasing the amount of photons harvested from the QD clearance and contributing to more electron production. In addition, the ZnO layer may have caused a partial decrease in charge recombination such that the narrower band gap compared to TiO_2 may have played an active role in the transmission of the electron to the outer circuit without recombination. The parameter values obtained with the J-V characteristic curves of the designed QDSSCs are shown in Table 1.

Table 1. J-V characteristic parameters of CdSe QDSSCs.

	J_{sc} (mA/cm^2)	V_{oc} (V)	J_{max} (mA/cm^2)	V_{max} (V)	FF (%)	PCE (%)
TiO_2/CdSe	6.261	0.661	4.700	0.450	51.105	2.115
ZnO/TiO_2/CdSe	6.512	0.694	5.278	0.475	55.480	2.507

As can be seen in Table 1, the J_{sc} of TiO_2/CdSe QDSSCs was measured as 6.261 mA/cm^2. On the other hand, the J_{sc} of ZnO/TiO_2/CdSe QDSSCs increased up to 6.512 mA/cm^2 with the addition of the ZnO metal oxide layer. This situation indicates that the ZnO layer causes an increase in the current value that can be generated by the QDSSC. So

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much so that ZnO has facilitated electron transfer with TiO_2 with its high electron mobility feature and is thought to cause an increase in current value. Similar to the J_{sc} value, the V_{oc} value increased with the addition of the ZnO layer and increased from 0.661 V to 0.694 V. These increases in J_{sc} and V_{oc} naturally increased power conversation efficiency (PCE). PCE was 2.115 ±0.124% for TiO_2/CdSe QDSSCs, while PCE increased to 2.507±0.117% for ZnO/TiO_2/CdSe QDSSCs. So much so that adding the ZnO layer to the photoanode surface increased the PCE of QDSSC by 1.185 times.

This clearly shows that the use of the ZnO/TiO_2 hybrid photoanode arrangement directly affects the performance of the CdSe QDSSC. Although ZnO metal oxide has a slightly lower energy band gap than TiO_2, it has a wider bandwidth than CdSe QDs. This situation provides a more suitable energy band level to suppress charge recombination occurring between TiO_2 and CdSe QDs and increase the electron transfer rate and causes an increase in the performance of QDSSC.

IV. CONCLUSION

A In this study, ZnO/TiO_2 photoanode electrode presented as an alternative to TiO_2, which has wide energy band structure, which is very advantageous with its wide porous structure, which is frequently used in QDSSC designs, was tested in CdSe QDSSCs. In the study, it was determined that the ZnO layer increases the light absorption and causes an increase in the voltage and current values obtained from the QDSSC. The efficiency of CdSe QDSSCs designed using ZnO has been measured 1,185 times higher than QDSSCs without ZnO. Such that the PCE of ZnO/TiO_2/CdSe QDSSCs was found to be 2.507±0.117.

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