A Project report on

Age & Gender Classification Using CNN Algorithm

A Dissertation submitted to JNTU Hyderabad in partial fulfillment of the demic requirements for the award of the degree.

Bachelor of Technology

in

Computer Science and Engineering

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CERTIFICATE

This is to certify that the Major Project Phase I report entitled **"Age & Gender Classification Using CNN Algorithm "** being submitted by B. Aravind(21H55A0501), G. Prasanna Kumari(21H55A0505), K. Manoj(21H55A0510) in partial fulfillment for the award of **Bachelor of Technology in Computer Science and Engineering** is a record of bonafide work carried out his/her under my guidance and supervision.

The results embodies in this project report have not been submitted to any other University or Institute for the award of any Degree.

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ABSTRACT

Age and gender, two of the key facial attributes, play a very foundational role in social interactions, making age and gender estimation from a single face image an important task in intelligent applications, such as access control, human-computer interaction, law enforcement, marketing intelligence and visual surveillance, etc. Automatic age and gender classification has become relevant to an increasing amount of applications, particularly since the rise of social platforms and social media. Nevertheless, performance of existing methods on real-world images is still significantly lacking, especially when compared to the tremendous leaps in performance recently reported for the related task of face recognition. Age and Gender Classification using Convolutional Neural Networks gives more accuracy compared to the previous one.

CHAPTER 1
INTRODUCTION

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Introduction

Face detection is a method of recognizing if there is a face in an image or not which is also called as object detection. OpenCV is widely used for object detection. The goal of face emotion analysis is to detect and identify the different types of emotions of a person such as happy, sad, anger, confused, surprise, etc. A gender categorizing model uses face from a given image to predict the gender (male or female) based on their appearance like baldness, long hair, beard and mustache. In age classification, we classify based on wrinkles, hair color and also size of face etc. Deep learning which is a subset of machine learning that uses several layers neural network to repeatedly gain higher level of features from the given input images. The concept of deep learning was inspired by how neurons function in our brain hence it's also called deep neural network. A neural network is a sequence of process that is capable to identify hidden relationships in a set of data and the process is similar to the operation of human brain. We use a deep learning model called convolutional neural network which takes input images and allocate importance (learnable weights and biases) to different aspects/objects in an image and also capable of differentiating one from the other. When compared to other classification algorithms, the pre-processing required in a ConvNet is comparatively lesser.

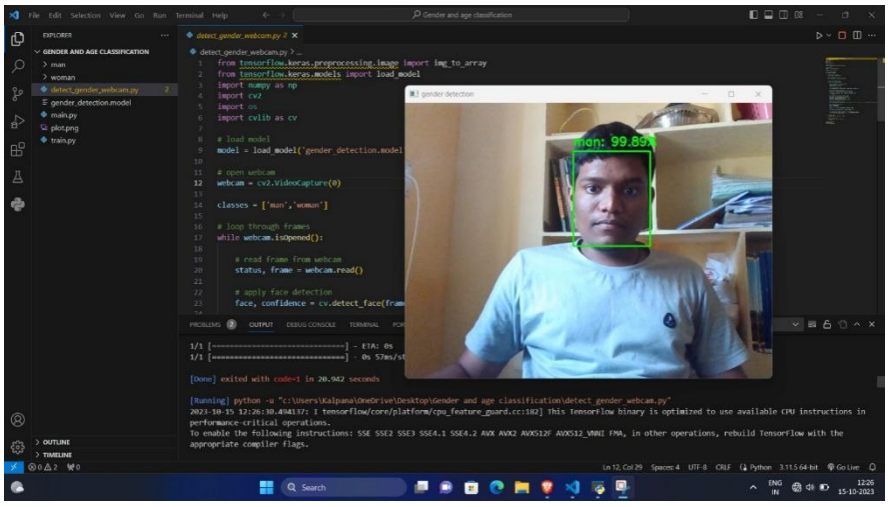

Fig 1: Gender classification

1.1 Problem Statement

With the expansion of real-world applications has expanded day-to-day living, researchers have shown more interest in the soft biometrics sector to close the communication gaps between humans and machines. Age, gender, ethnicity, height, face dimensions, and other soft biometrics are included. Machines cannot classify patterns as effectively and powerfully as the human brain can. Therefore, our goal is to use technology to imitate the ability of the human brain to determine a person's age and gender. This problem can be solved by developing an application for age and gender detection that can accurately determine a person's age and gender. The age and gender of the person are determined by using their human face as the input. The person's age and gender are the output.

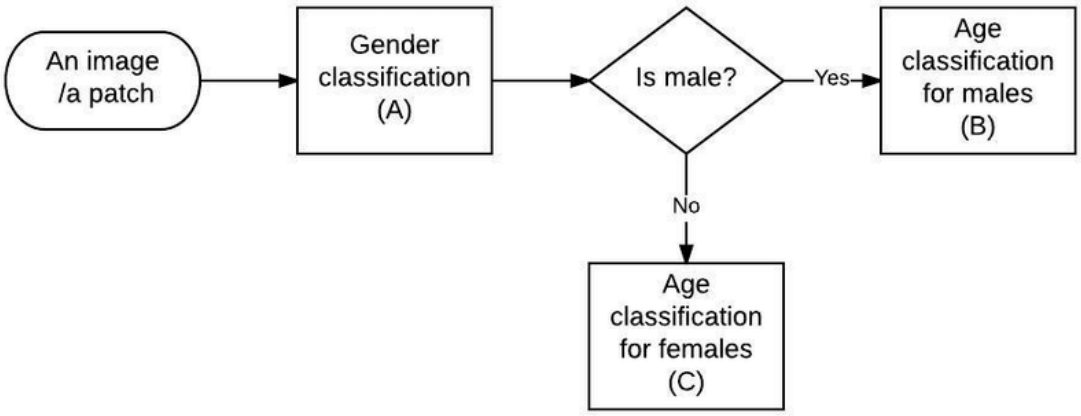

Fig 2: Flow chart

1.2 Research Objective

Convolutional neural networks are the state of the art method used to classify features from an image. A variety of multi-layer CNNs have been created in previous research to accurately classify the age and gender of subjects from images. Previous research has shown a high degree of success when classifying the gender of the subject in an image. Unfortunately it is not so simple for classifying age. One of the key problems faced by researchers with this topic is the idea of the one-off problem. The one-off problem is specific to the classification of age. As previous research has identified that classifying a person's exact age is extremely difficult and often leads to undesirable results, many researchers have resorted to binning ages in groups in order to achieve a more accurate level of classification.

1.3 Scope and Limitations

Targeted Marketing: Age and gender detection can be used in targeted marketing campaigns, helping advertisers tailor their content to specific demographics.

User Personalization: Online platforms can customize user experiences based on detected age and gender, providing personalized recommendations and content.

Healthcare Applications: In healthcare, age and gender detection can assist in patient profiling and the customization of health-related services and advice.

Security Systems: Age and gender detection may enhance security systems, providing an additional layer of verification in applications like facial recognition.

Retail and E-Commerce: Retailers can use age and gender information for targeted product recommendations and to improve the overall shopping experience.

Content Filtering: Age and gender detection can be used in content filtering, ensuring that age-appropriate or gender-specific content is delivered

CHAPTER 2
BACKGROUND WORK

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BACKGROUND WORK

2.1. Age estimation algorithm of facial images based on multi-label sorting

2.1.1 Introduction

In recent years, multi-label sorting learning technology has been widely used in the research fields of document classification, image recognition, gene function prediction, and so on. However, the technology is relatively less applied in the field of age estimation of facial images. In the age estimation dataset, the annotation method is usually a facial image corresponding to an accurate age value, but there are many problems with such a simple annotation method. The most important of these problems is that using an accurate age value to represent the true age of a facial image is unreliable and unstable, due to the slow changes in the face's appearance and the slight differences in facial images between similar ages as the age increases; it is easy to be confused with age classification. In addition, how to use the limited facial dataset to establish a good age estimation model has always been a problem followed with interest in the technical research process of facial age estimation, and the reason why this problem has not been resolved is due to the very small number of samples in the age dataset of facial images.

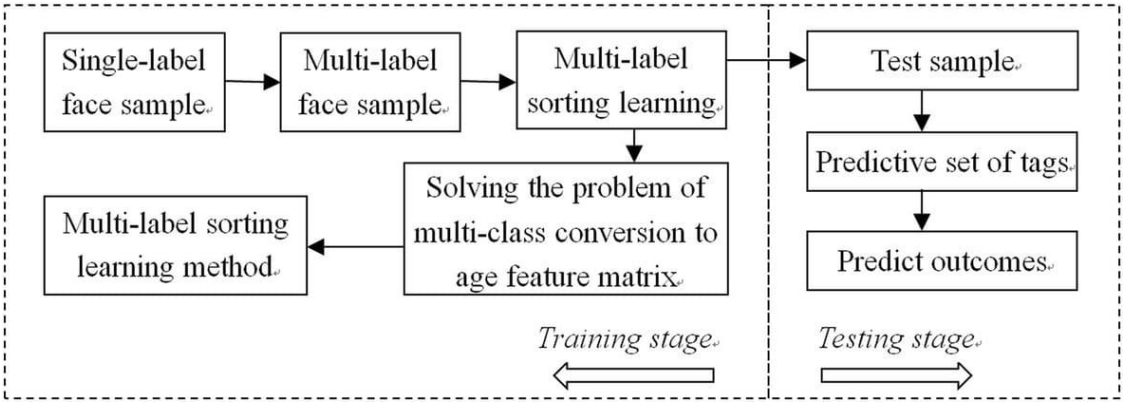

Fig 3: Structure of age estimation

2.1.2 Merits and Demerits

Some of the Benefits are:

- **Creating 360 user profiles**

This can be a starting point for a spectrum of activities connected with marketing or sales and other. Example of such application is creating a profile of a customer which is both Apple user and a sport fan.

- **Building a recommendation system**

A previously created user profile can be a base to making recommendation system, i.e., in loyalty programs or e-commerce stores.

- **Social media targeting**

Such profiles also have another application which is using them to target the specific audience in social media. This can include promotion, content marketing activities or social selling.

- **Automatically detecting adverse drug reaction from text**

Multi-label classification is also very useful in the pharmaceutical industry. Data gathered from sources like Twitter, describing reactions to medicines says a lot about the side effects. Processing this information through the specific algorithms can provide surprising results.

- **Recognizing opinions and sentiments automatically**

The described method appears to be very useful in creating a sophisticated sentiment analysis. Companies use it to perform detailed research about customer feedback on their products.

Some of the Drawbacks are:

- Highly imbalanced dataset each label may occur with a different number, each document (text, photo, sound sample, video) has a different number of labels.

- Different length of a document for text classification problem most of the ML algorithms require documents to have equal length.

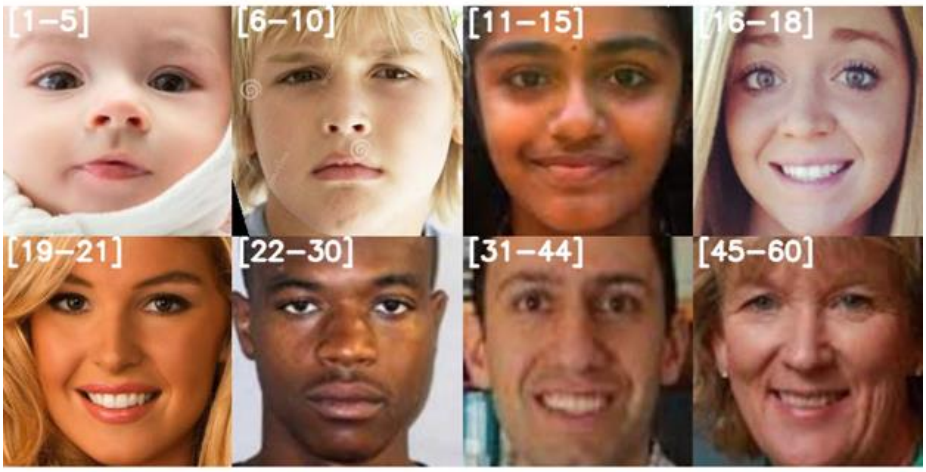

Fig.4: Age Prediction

2.1.3 Implementation

Facial age recognition algorithm based on multi-label sorting makes full use of the ordered information between age labels in training samples. Through the multi-label sorting function established in the previous section and the optimization solution, the age characteristic matrix is finally obtained. Assuming that the obtained age characteristic matrix is a, the prediction function of age estimation for this algorithm constructed thereby is as shown in below equation.

Equation: $y_{t=W^T * x_t}$

Among them, x_t is the facial feature vector of the test face sample and y_t is the age label relevance vector calculated from the prediction Equation. The size of each element represents the correlation degree between the tested face sample and the corresponding age label in this vector. So all elements are sorted in a descending order according to the correlation degree in the vector, which gives the result that it is most likely to approach the real age when the correlation between the top-ranked age value and the tested face sample is maximized.

Therefore, the age of facial image can be estimated, thereby completing the design and implementation of the entire face age estimation algorithm based on multi-tag sorting.

- **Estimation model evaluation criteria**

The face age estimation algorithm mainly uses mean absolute error (MAE) and cumulative score (CS) as the standard to measure the accuracy of age estimation.

- **Mean absolute error (MAE)**

The mean absolute error is the average value of the absolute error between the predicted age and the true age through the age estimation of all tested face images. The specific formula is shown in below equation

$$\text{MAE} = \frac{1}{\hat{N}} \sum_{i=1}^{\hat{N}} |a_i - \hat{a}_i|$$

Table 1 Multi-label sorting calculation algorithm

Algorithm: Multi-label sorting calculation algorithm

Enter: Training sample set $X = \{x_i \in R^d\}_{i=1}^{n}$, corresponding to the age label set $Y = \{y_i \in \{0, 1\}^m\}_{i=1}^{n}$, and parameter λ initialized: $\eta_0 = 1$, $\gamma = 2$, $a_1 = 1$, $W_0 = Z_0 = Z_1 = R^{d \times n}$.

Cycling when conditions do not converge:

1. Set up $\overline{\eta} = \eta_{k-1}$
2. When $F(P_{\overline{\eta}}(Z_{k-1})) > Q_{\overline{\eta}}(P_{\overline{\eta}}(Z_{k-1}), Z_{k-1}))$, so that $\overline{\eta} := \frac{\overline{\eta}}{\gamma}$
3. Set $\eta_k = \overline{\eta}$, and update $\eta_k = \overline{\eta}$:

$$W_k = P_{\eta k}(Z_k)$$

$$a_{k+1} = \frac{1 + \sqrt{1 + 4a_k^2}}{2}$$

$$Z_{k+1} = W_k + \left(\frac{a_k - 1}{a_{k+1}}\right)(W_k - W_{k-1})$$

End Cycle

Fig 5: Multi-label sorting Algorithm

2.2 Gender Identification from Facial Features

2.1.4 Introduction

Gender detection is a non-trivial computer vision problem for identifying the gender of the faces in images. The most fundamental application that is used in face recognition technology is gender detection. Many companies like Facebook, Amazon, Google and other technical companies have their respective different implementations of this gender detection. The software must be able to detect it first, before they can recognize. Gender of a person in each cluster is estimated using aggregation of predictions for individual photos. This consists of two steps, first one is to identify the faces in the image/video. After that the features will be extracted. Second is to classify the type of gender. Detection of faces from the images can be done by using the MTCNN whereas the Haar cascade is used for the face detection in videos. This Face detection is a computer vision problem that involves finding faces in photos. After the detection, the features will be extracted from the detected faces. Based on the extracted features, by using the smaller VGG algorithm the gender will be classified. For the classification of gender in videos and images we used database like the wiki_crop, imdb.

Fig 6: Gender Prediction

2.2.2 Merits and Demerits

Some of the benefits are include:

- Easy to understand conceptually – standard architecture for CNNs
- Well researched and widely used. Great for understanding CNN concepts.
- Available in most popular machine learning libraries
- Good performance at image classification and generalizes well to related tasks
- Trained for weeks on millions of images

Some of the drawbacks are include:

- Research has continued since 2014 and there are often better-performing CNN architectures available
- With over 100 million trained weights, the model size is large. ~500MB on disk.
- Training for a different task (transfer learning) can be difficult due to the deep network and vanishing gradient problem

2.2.3 Implementation

The Haar Cascade is a classifier which is used for the detection of the object for which it is Trained from the sources. By this, better results will be obtained by using high quality images and thereby increasing the number of stages for which the classifier has been trained. HaarCascade classifier is based on the Haar Wavelet technique which is used to analyse the pixels that are present in the images into squares by the function. This technique uses a concept "internal image" to compute the "features" that are detected. Ada boost learning algorithm is used in the Haar Cascade which is used to select a small number of important features from a large set in order to obtain an efficient result of classifiers and then use the cascade techniques for the detection of face in the images.

Haarcascade will be trained by giving some input faces and non faces. In order to detect/recognize the objects with cascade. Haar Cascade classifier is used for the detection of faces in the video.

The dataset which is having names of different nationalities for public use was not found, the images in different regions were collected from various online sources such as Wikipedia. We collected different images of celebrities from IMDb and Wikipedia which can be handily available for public use. This is the largest public dataset readily available for gender classification to date. In total we obtained 460,723 face images from 20,284 celebrities from IMDb and 62,328 from Wikipedia, thus 523,051 in total. While some of the images (from IMDb) contain more than one person in which the photos with the value of strongest face detection below the threshold are used in order to extract the face with a margin. For the pretrained model, 40% margin of the width and height on all four sides have been used.

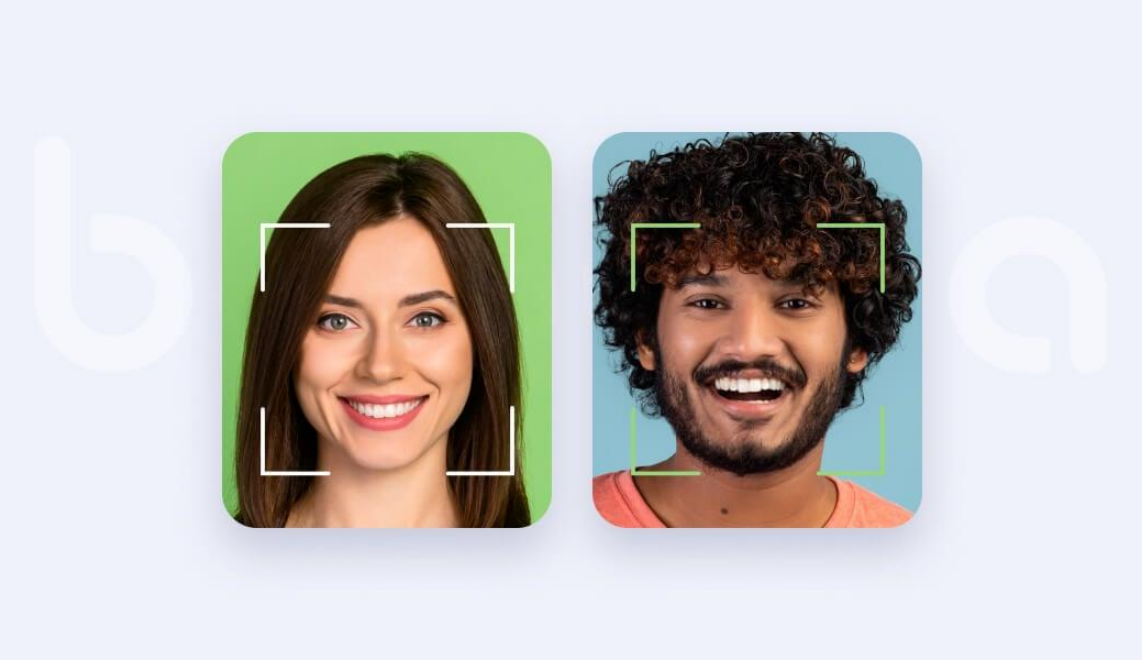

Fig 7: Haar Cascade Face detection

CHAPTER 3
RESULT AND DISCUSSION

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RESULTS AND DISCUSSION

3.1 Result

By evaluating the performance of the proposed algorithm, it is being observed that the quality of image is varied because of the changes made in the illuminating conditions that are dependent on the region or surrounding from where the image has been taken. By the hitting ratios of the gender classification, the output has achieved an accuracy of 93%. From the considered data set, algorithms have shown good robustness and reasonable accuracy for the images taken. The proposed system provides a low complexity and is suitable for real time implementations, such as real time facial recognition. The algorithms have reduced the processing time and their implementation optimization, which has to be performed and detected yet. From plot of accuracy we can see that the model could be trained a little more as the accuracy for both datasets is rising in last epochs. We can see the training of datasets on model is not yet overloaded as both the datasets showing equal skill. From the loss, we see that the model is showing equal performance on both train and validation datasets. If the Original image is not matched with predicted image, then the change will be shown in the graph.

- We Present the outcomes of our Deep Learning model.
- We are trying to evaluate its accuracy and efficiency.
- We Compare its performance with traditional methods and existing methods, showcasing how it outperforms them

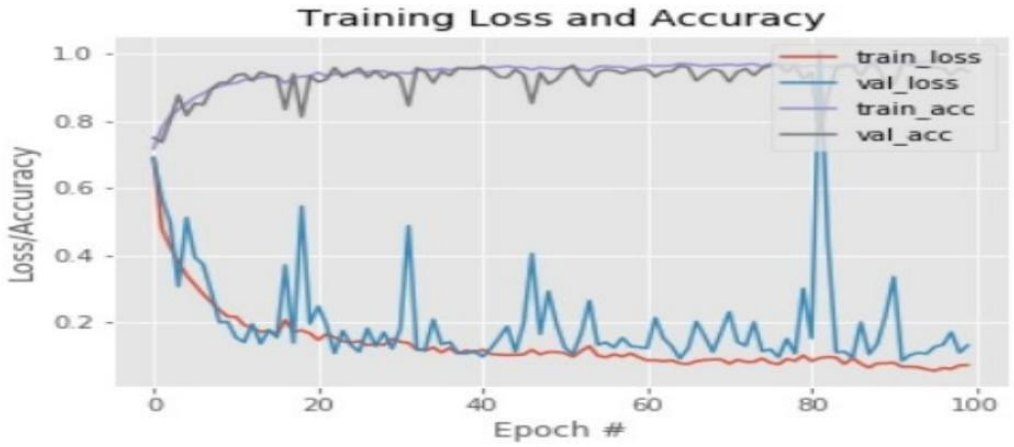

Fig 8: Plot of Loss and Accuracy

CHAPTER 4
CONCLUSION

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A thorough literature review of various Machine Learning and Deep Learning techniques is used to discuss all of the techniques and methods that have already been implemented in this field. Facial images have become increasingly important in recent decades, owing primarily to their promising real-world applications in a variety of emerging fields. The proposed system is capable of classifying gender as either male or female and predicting age from 0 to 80.

The model's accuracy is calculated separately to provide a more accurate comparison and interpretation of the study. The proposed architecture was built methodically to improve accuracy and reduce the number of parameters. Gender classification and age prediction have been manually tested, and the results have been astounding. Because gender classification is considered a binary problem in this study, it has proven to be very efficient with the use of Keras and achieves an overall accuracy of about 90%. Age prediction is affected by a variety of external factors, including lighting effects, facial expressions, and skin tones, but it also produces impressive results.

REFERENCES

REFERENCES

[1] Molokken, K. and Jorgensen, M. (2003) A Review of Software Surveys on Software Effort Estimation. 2003 International Symposium on Empirical Software Engineering, 30 September-1 October 2003, 223-230.

[2] Song, Q. and Shepperd, M. (2011) Predicting Software Project Effort: A Grey Relational Analysis Based Method. Expert Systems with Applications, 38, 7302-7316. http://dx.doi.org/10.1016/j.eswa.2010.12.005

[3] Khatibi, V. and Jawawi, D.N. (2011) Software Cost Estimation Methods: A Review. Journal of Emerging Trends in Modeling: A Systematic Review. Expert Systems with Applications, 38, 11984-11997.http://dx.doi.org/10.1016/j.eswa.2011.03.041

[4]J. W. Bailey and V. R. Basili, "A meta-model for software development resource expenditures," in Proceedings of the 5th International Conference on Software Engineering, ICSE '81, (Piscataway, NJ, USA), pp. 107–116, IEEE Press, 1981.

[5] A. J. Ruchika Malhotra, "Software Effort Prediction using Statistical and Machine Learning Methods," International Journal of Advanced Computer Science and Applications(IJACSA), vol. 2, no. 1, 2011.

[6] C. S. Yadav and R. Singh, "Tuning of cocomo ii model parameters for estimating software development effort using ga for promise project data set," International Journal of Computer Applications, vol. 90, pp. 37–43, March 2014.

[7] F.-S. Wang and L.-H. Chen, "Heuristic optimization," in Encyclopedia of Systems Biology (W. Dubitzky, O. Wolkenhauer, K.-H. Cho, and H. Yokota, eds.), pp. 885–885, Springer New York, 2013. [8] M. Uysal, Estimation of the effort component of the software projects using heuristic algorithms. INTECH Open Access Publisher, 2010