AGE ESTIMATION USING WRINKLE FEATURES AND FACE TRIANGLE

A thesis submitted

By

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CERTIFICATE

This is to certify that the thesis entitled "**AGE ESTIMATION USING WRINKLE FEATURES AND FACE TRIANGLE"** which is submitted by **Pinki Jewaria (2017PEC5506**) in partial fulfillment of the requirement for the degree of **Master of Technology in Electronics and Communication Engineering** submitted to **Malaviya National Institute of Technology Jaipur** is a record of student's own work carried out under my supervision. The matter in this report has not been submitted to any other university or institution for the award of any degree.

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DECLARATION

I, **Pinki Jewaria**, do hereby declare that this thesis titled as "**Age Estimation Using Wrinkle Features And Face Triangle"**,being submitted by me in partial fulfillment of **M. Tech (Electronics and Communication Engineering)** is my own work under the supervision of **Dr. K.K. Sharma** and the contents of this thesis work have not been submitted to any other Institute or University for the award of any other degree. It neither contains material already published written by another person nor contains any material copied from other sources. However, some references have been taken just to correlate and compare the results and those instances have been clearly mentioned and credit has been given to the original authors.

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Pinki Jewaria

ABSTRACT

Human faces are interestingly very informative and can be studied for many aspects like gender, age, race, emotions, identity, expression, the origin of a human .Nowadays, age estimation has developed many applications like underage prevention of alcohol, underage driving practices ,underage internet access and many more where age is to be detected. Age estimation can be done on the basis of facial features. Age progression is general y indicated by skin texture, face structure, skin color. Here in this study basically three types of classification have been done on which basis study has been performed to estimate the age of human Firstly, ratios of distances between left eye and right eye to right eye and mouth, eye to eye distance, eye to nose tip distance have been analyzed. Secondly, the face angle has been realized to estimate the age of human. The proposed method is based on the face triangle which has three coordinate points between left eyeball, right eyeball and mouth point. The face angle between left eyeball, mouth point, and right eyeball estimates the age of a human. This study concerns with providing a methodology to estimate age groups using face features. This study has proved that face angle can estimate and classify human age according to face features extracted from human facial images. The third one is to use wrinkle analysis on face images. The proposed method is focusing on the cheek area and wrinkles analysis using discrete cosine transform (DCT). With the increasing age, wrinkles on human face increases, so this has been used for age estimation. DCT is applied on facial images to estimate higher energy ceofficients, higher the coefficients more will be the age. In other words, wrinkle energy increases with increasing age.

Keywords: Age estimation, Viola Jones algorithm, Edge detection, DCT, SVM.

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LIST OF ABBREVIATIONS

DCT…….Discrete cosine transform
SVM……..Support Vector Machine
KNN……..K-nearest neighbor
ROC……..Receiver operating characteristics
CS……Cumulative Score
CNN……..……Convolutional Neural Networks
FGNET……Face and Gesture Recognition Research Network Dataset
LBP……... Local Binary Patterns
MAE……...Mean Absolute Error
MORPH……... Craniofacial Longitudinal Morphological Face Dataset
PCA…….Principal Component Analysis
ROC……..Region of Interest
STD……Standard Deviation
SVR…….Support Vector Regression

Chapter 1
INTRODUCTION

1.1BACKGROUND

There are many applications where age estimation can play a vital role like age estimation of immigrants, law enforcement to track suspects, prevention of minors not to purchase alcohol, cigarette, voting, user authentication and security purposes at various venues like airports and banks and also for investigation purpose in different areas . This could have happened anywhere like for admission in a school or college, at hospitals, at the passport office, job interview. These are a few applications where age estimation can be used. [1] Human beings possess an ability not only to recognize faces but also to distinguish one face from another, whereas machines have only recently started displaying these skills. Age estimation is an interesting and very useful activity which can determine the age of a human by reading facial features. .However, the facial appearance may vary accordingly as it can be affected by many factors, genetic effects, bony structure, facial poses ,hairstyle, etc. However, age estimation provides an idea of age but not with accuracy. The commonly used measure for age estimation is mean an absolute error which is (MAE), Eigenface or principal component analysis that is (PCA) [5] and linear discriminate analysis that is (LDA) [6,7].But this thesis focuses mainly on face features such as distance between various facial features such as eye to eye distance, eye to nose tip distance, eye to mouth distance, eye to chin distance, their ratios and angle between various features like angle subtended by both eyes to mouth, angle subtended by nose to both eyes, area of face have been taken into consideration and thereby simulated using MATLAB and wrinkle analysis of various facial areas like cheek area under eyes, forehead, chin area etc which are most affected by growing age.

1.2 AUTOMATIC AGE ESTIMATION

It would be very useful to have an automated Age Estimation System that takes a human facial image as its input and assigns an output label to the image. Below is the block diagram.

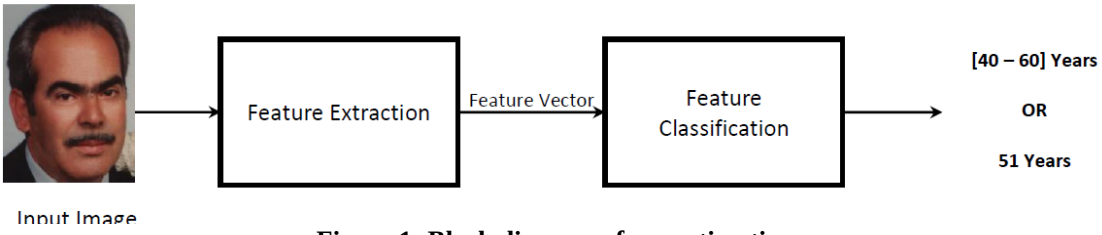

Figure 1 :Block diagram of age estimation

1.3MOTIVATION

There are a lot of desired real-world applications associated with facial aging. Age estimation by machine learning is useful in many days to day life applications. There is a lot of scope in the age estimation process. As this area can be explored in much depth.Age estimation method seems to be an interesting area. Aging population index from the customer's point of view of service would be very useful information that can be applied in the Electronic Customer Relationship Management (ECRM) [19].

Though there is potential demand in applications which require age restrictions like vending machines,in cinemas,liquor consumption due to some exception cases depending upon genetic effects, lifestyle, the health of people ,it becomes a bit difficult in age estimation[2]. So, there is a huge scope in doing research in this field.

Looking at the current aging research work, FG-NET [4] and MORPH [5] datasets have been used.

1.4 OBJECTIVES

For humans age, it would be interesting to characterize the progressive [2] but subtle variations in facial representation because it has many useful implications some are the following:

1 Age estimation is a form of soft biometrics which provides ancillary data about the user's identity information [18].It can be used in addition to the biometric system [12].

2 Age estimation finds scope in developing many applications like underage prevention of alcohol, underage driving practices,underage internet access and many more where age is to be detected. Age estimation can be done on the basis of facial features.
The automatic age estimation method is so critical in developing such applications [5].

3 In marketing,to know the age of customer classes has been the challenging part,which is essentially required by companies to retain their customer base and sustain a high amount of cost input [1].

1.5 PRESENT WORK

Here,in this work, Viola-Jones Algorithm with Cascade Object Detector has been widely used to extract the results.Using the algorithm,the facial parts like eyes, mouth, the nose has been detected which then used to estimate age using face triangle,face angle and feature distance ratios.Also used edge detection with Canny Operator and DCT for wrinkle detection and analysis.Then made a feature vector using all features and then classification using SVM which ultimately yielded accuracy and estimated age belonging to different classes.

1.6 THESIS ORGANIZATION

The outline of the thesis is like this:

In chapter 1,the requirement of age estimation and its applications are discussed and emphasized.Motivation to perform this work is also discussed.this chapter presents a brief introduction of the existing work associated with age estimation.

In chapter 2, provided an extensive review of related work of the literature that is related to this thesis,mentioned about different age estimation methods and also about edge detection Viola-Jones algorithm and SVM.

In chapter 3, the proposed method which includes age estimation based wrinkle analysis and feature extraction using SVM is discussed.

In Chapter 4, Simulation and results showing various graphs and plots and comparing the accuracy of the work.

In Chapter 5, the overall conclusion of the thesis is presented. It also contains some future research topics which need attention and further investigation, which includes DWT and meager energy analysis.

Chapter 2
LITERATURE REVIEW

2.1INTRODUCTION

Age progression is a spontaneous process which cannot be controlled, changes are specific for everyone. So it becomes a little bit difficult to capture accurately the age of a person due to diversified information by the human faces.

However, the pattern of changes in a human face has been observed and some common type of changes observed [17].Basically, two stages of changes observed in human life [18]. During the aging of young people, the most common change is craniofacial growth, geometrical (shape, facial feature distance) change of head. On the other hand,in adult aging, craniofacial growth goes negligible but some changes like wrinkles become noticeable.

2.2 PREVIOUS WORK ON AGE ESTIMATION

The Principal component analysis (PCA) and linear discriminate analysis (LDA) are the methods which were used for face recognition previously.

The first real human age estimation theory was given by using the aging function by Vanities [1, 17].

2.2.1 Age Estimation Using Facial Features

To analyze age eyes, nose and mouth were also used before. Frontal configuration of the face makes an isosceles triangle with both eyes and mouth [20].

Facial age classification method uses a model using test data and training data.This model detects the age for any image and the research was carried out by Kwon and Lobo [10]. .

2.3 PREVIOUS WORK ON FACE ANGLE

Age estimation [11] using face triangle gave useful and effective age estimation for the human face.Face area,then the eye area detected by using the algorithm.After that nose area and then mouth area has been detected. Then a triangle called a face triangle with all three coordinate points which are left eyeball point, mouth point, and right eyeball points are

detected. With the age progression of a person, the face angle also changes. So, by detecting the face angle age can be estimated.

2.3.1 **Previous Work On Wrinkle Analysis**

In the previous work [13],wrinkle features were considered for different age groups for the different facial parts.In this,Facial parts were classified and divided into six regions forehead,left the eye,right eye, right cheek,left cheek and chin to extract wrinkles of the face. By calculating the value of shown edges or wrinkles in those six different parts, six wrinkle features were calculated.Feature no. 1 to Feature no. 6, denote the number of the wrinkles in the forehead area, area under the left eye, area under the right eye, right cheek area, left cheek area, and chin area accordingly.

Figure 2 gives information about the number of wrinkles in the respective class.For a child there is no wrinkle, for an adult, there are some wrinkles but in case of the old person, there is a number of wrinkles that can be 10 or above 10.

In this Sobel operator is used for edge detection which gives very sharp edges to count as a wrinkle.

The RGB image is converted to binary then Sobel detector is applied.The binary 1 shows wrinkle and binary 0 as an area without wrinkle is considered.

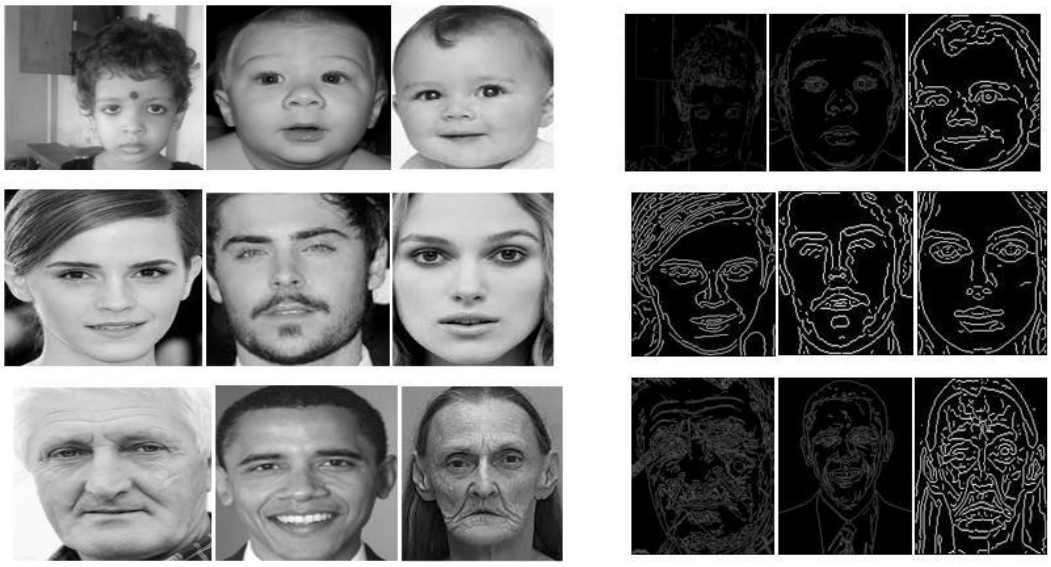

Figure 2:Wrinkle based age estimation

2.4 REVIEW OF VIOLA-JONES ALGORITHM

2.4.1 Viola Jones Algorithm

This algorithm was given by Paul Viola and Michael Jones in 2001 [15] [16] [17]. This was the first algorithm which was used for object detection.This algorithm can be used in facial parts detection so in the proposed method we are extracting it to detect all facial parts which are used in making of the feature vector.Image segmentation is used to integrate the faces detected in different backgrounds and highlights face features such as eyes, nose, mouth, lips as shown in Figure 6.

In Viola-Jones algorithm face detector uses features instead of pixels as features contain much information and much faster than the pixel form system.Some of the features are also called Haar features. This algorithm uses three types of features :

(1) two-rectangle feature

(2)three-rectangle feature and

(3) four-rectangle feature.

Figure 3 shows these features.[15]

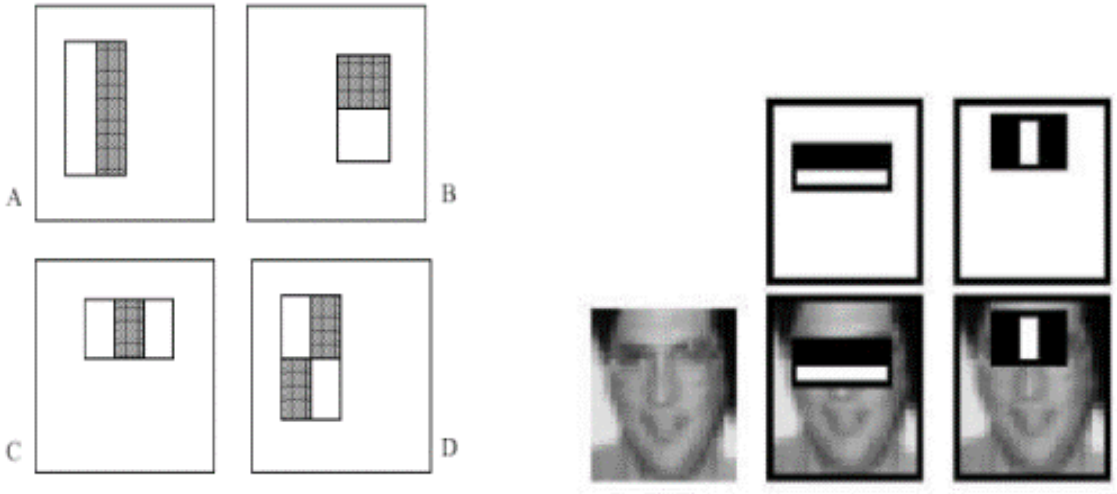

Figure 3:showing basic features (A and B)two rectangle,(C)three rectange feature,(D) shows four rectangle feature

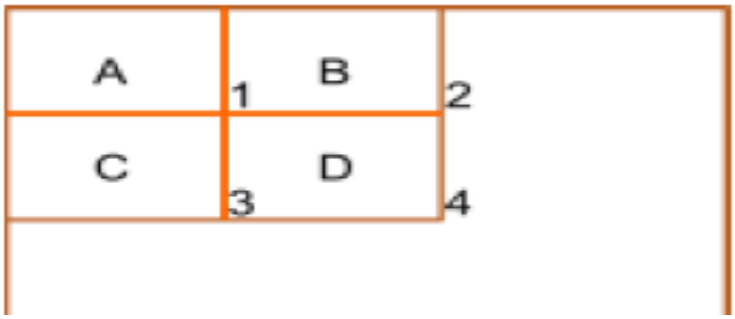

Figure 4:Calculation of pixel sum within a rectangle

2.4.2 CASCADE CLASSIFIER

This classifier contains a cascade of a various classifier to process an image or object in a systematic way for the presence of image parts of the target object.Every stage uses more complex binary classifiers which rejects the undesired parts of the images resulting in more accurate results.fig.5 [14] shows the cascade classifier.

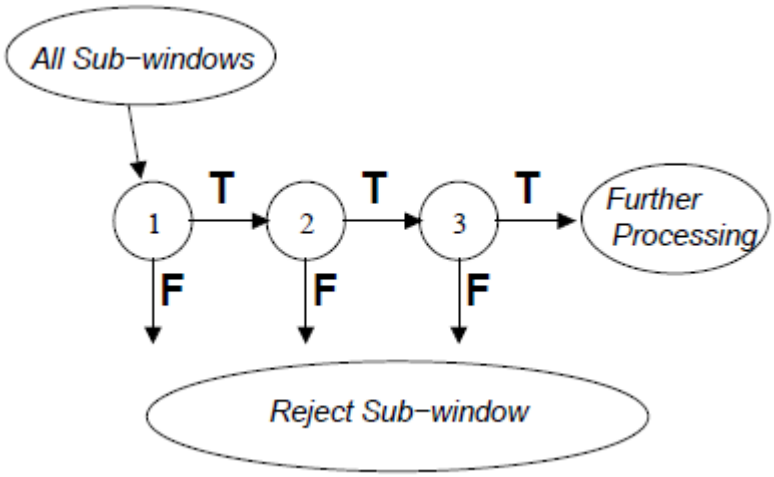

Figure 5:Cascade Classifier

The output is shown in fig. 6 from viola jones object detector:

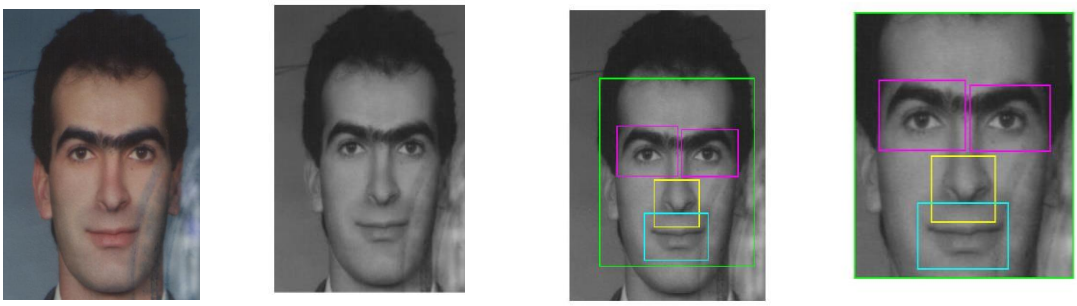

Figure 6:Features extraction using Viola Jones Algorithm

2.5 EDGE DETECTION

Edge detection is done by using a canny operator which represents the wrinkle as binary 1 and without wrinkle area as binary 0.The first image is converted from RGB to gray and then apply a canny operator on the images and then a number of wrinkles fetch the output.

2.6 DCT ENERGY CALCULATION

Here after normalization DCT is applied on wrinkle image and wrinkle energy is determined which plays a very important role in age estimation.Higher the value of coefficients of DCT higher will be the wrinkle energy.With the increasing age wrinkle increases on the faces of human beings,specifically, the cheek area gets much affected facial part.So,to find out wrinkle energy we use DCT on images of different age groups and see the variations in wrinkle energy by considering higher DCT coefficients.

The cheek area is detected by MATLAB inbuilt command and get a spate image then normalize the output image.

2.7 SUPPORT VECTOR MACHINE (SVM)

SVM is a statistical classification process given by Cortes and Vapnik [1] in 1995.SVM is based on the principle of Structural Risk Minimization (SRM) , SVM gives a threshold that separates a positive and negative sample(support vectors) from the training datasets with a

maximum difference which clearly defines the accuracy of this tool. here SVM is used for classification and comparision.

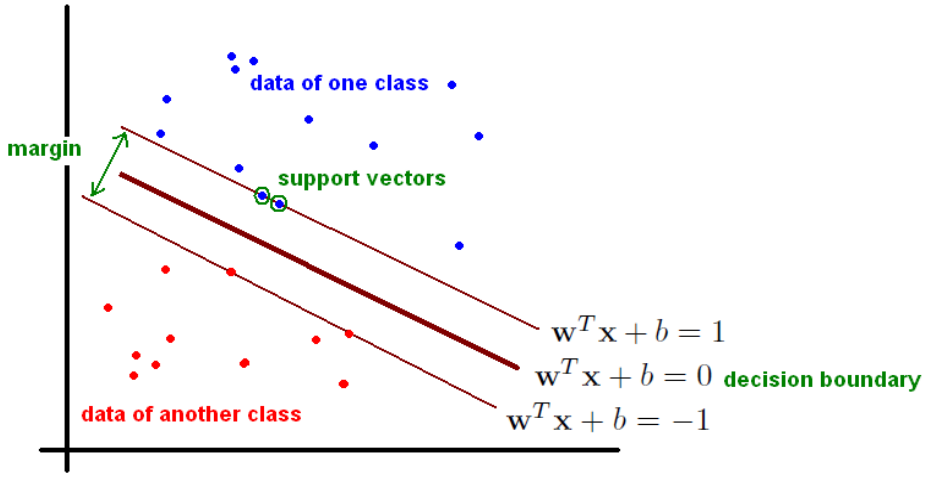

Figure 7 Results using SVM

Chapter 3
MODIFIED METHOD FOR AGE ESTIMATION

3.1 INTRODUCTION

The process presented here is based on facial parts. In the modified method, we use different facial parts like eyes, nose, mouth, and wrinkles. We detect all the parts by using Viola-Jones Cascade Object Detector and then calculated the distances (eye to eye, eye to nose and eye to mouth) and hence formed an isosceles triangle. Lastly, wrinkle detection and calculating DCT energy of wrinkle resulting in a feature vector which includes nine features and then calculated the accuracy with the help of SVM classifier.

The block diagram for the proposed method is given below:

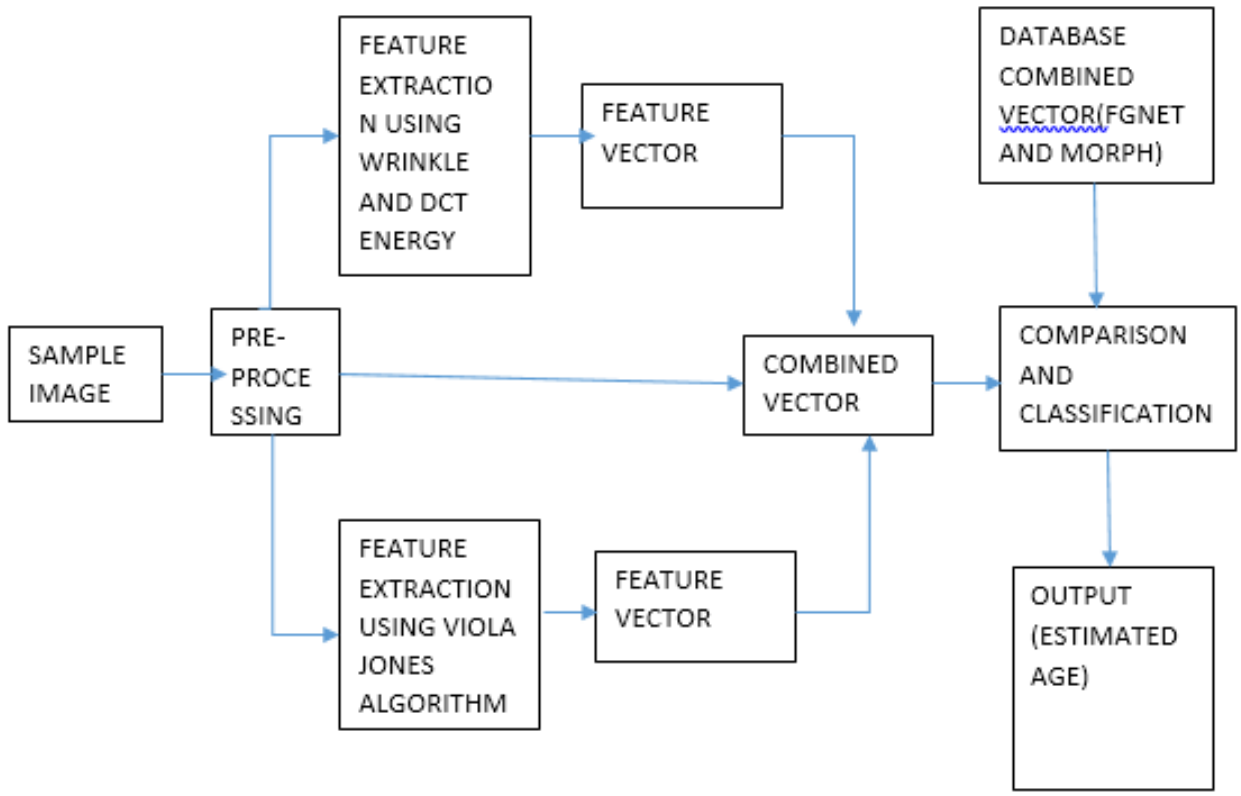

Figure 8 Block Diagram for proposed method

The following steps explain the modified method :

3.1.1 Pre-processing & formation of feature vector (F1)

The first group from age 0 to 15 years as a child group, second group from age 16 to 40 years as an adult and third group from age 41 and above years which is an elderly group.Used FGNET[14] dataset for making the age groups.

Following steps used the Viola-Jones algorithm with a cascade classifier, here simulating tool used is **Matlab 2015a** software.

Step 1: Read the image and change the image into a gray image,if it is an RGB image.

Step 2: Detected the rectangular face area from the input face image using Cascade Face Detector.

.**Step 3**: After detecting face area, detected eye pair areas.

Step 4: After that, the detected nose area.

Step 5: Then detected mouth area.

Step 6:After determining all these facial parts we identified the center area of all the parts,resulting in iris detection, nose tip and mouth center point.

Step 7: Thereafter, by using Matlab inbuilt "imtool",calculated the coordinates of central parts of each facial part like left eye(a1,b1), right eye(a2,b2), nose(a4,b4) and mouth(a3,b3),refer Figure 14.

Step8: Then with the help of coordinates,the distance between both the eyes,eye to nose and eye to mouth calculated.

$$E\_E = \sqrt{[(a2 - a1)^2 + (b2 - b1)^2]} \text{……..(1)}$$

where E_E is the distance between two eyes.

Step 9: Then calculated the midpoint of two eye ball i.e. E_E/2

(X coordinate of the point of the mouth).

Step 10: Likewise calculate eye to mouth and eye to nose distances which are E_M and E_N respectively.

Step 10: Afterwards, calculated ratios:

$$\text{Eye to mouth ratio} = E\_M\_R = \frac{E\_E}{E\_M} \text{……(2)}$$

$$\text{Eye to nose ratio} = E\_N\_R = \frac{E\_E}{E\_N} \text{…….(3)}$$

Step 11: Draw a triangle by using three coordinate points left eyeball (a1, b1), right eyeball (a2,b2) & mouth point (a3, b3) and also calculated the slope m1 and m2.

Step 12: Calculated face angle(THETA_M) and area of face triangle(AREA_M).

$$\text{THETA\_M} = \tan^{-1}\left[\frac{\text{m1}-\text{m2}}{1+\text{m1}\times\text{m2}}\right] \text{……(4)}$$

$$\text{AREA\_M} = \sqrt[2]{(S \times (S - A) \times (S - B) \times (S - C))} \quad \ldots\ldots\ldots\ldots(5)$$

where ,

m1 and m2 are the slopes wrt left eye to mouth and right eye to mouth respectively

S=perimeter of triangle = (A+B+C)/2

A = E_E

B=LE_M

C=RE_M

Step 13: Again draw a triangle by using three coordinate points left eyeball (a1, b1), right eyeball (a2,b2) & nose point (a4, b4).also calculated the slope n1 and n2.

Step 14: calculate the mouth angle (THETA_N) and triangle area(AREA_N).

$$THETA\_N = \tan^{-1}\left[\frac{n1-n2}{1+n1\times n2}\right]\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

$$\text{AREA\_N} = \sqrt[2]{(S \times (S - P) \times (S - Q) \times (S - R))} \ldots\ldots\ldots(7)$$

where ,

n1 and n2 are the slopes wrt left eye to nose tip and right eye to nose tip respectively

S = perimeter of triangle=(P+Q+R)/2

P = E_E

Q=LE_N

R=RE_N

With the help of all these steps, ultimately we got a feature vector(F1) for all the age classes.

3.1.2 Feature Vector [F2]

For making feature vector F2, wrinkles are detected using edge detection, used the Canny Operator for detecting the wrinkles. Thereafter, wrinkles and DCT energy is calculated from the cropped cheek area and got two more features which makes feature vector F2.

3.1.3 Combined Feature Vector

Now made a combined feature vector which includes all the eight features. Then all the features are classified by using linear SVM classifier into three groups of images.All these features have been detected from these classes by previously explained processes using Viola-Jones Algorithm,Edge Detection, and DCT energy calculation.

3.2 INPUT DATASET

Here FGNET [14] and MORPH [17] dataset have been considered So,

3.2.1 Fg-Net Dataset

Nevertheless, in spite of the advances in image estimation, it is still a challenging issue. This is due to the fact that face aging process is not only set by distinct elements, such as genetic factors, but also by extrinsic factors, such as life style, expressions, and the environment as well.machine learning technique to intelligent age estimation from facial images using SVM classifier on FG_NET dataset. The proposed work consists of three phases; the first phase is image preprocessing which include five stages: gray scale image, noise removable, face detection, image size normalization, and clipping process. The second phase is a data mining process which includes three stages: feature extraction, feature selection, and classification using the SVM classifier. The third phase includes two stages, estimation, and evaluation.

In a given method FG-NET dataset is used which is categorized into three classes; first class child (0-7), (26-30) ages and this class represents the ages from 3 to 7 years and from 26 to 30 years because this class have four attributes from anyone of this images, second class represents (8-25) ages and this class represents the ages from 8 to 25 years because this class have five attributes from any one of these images, last class represents (31-50) ages and have nine attributes from any one of this images. The Experimental results illustrate that the proposed system can give results with high precision and low time complexity. The practical evaluation of the proposed system gives accuracy up to89.13% with the time taken of 0.023.

FGNET dataset comprises 1002 images with 82 subjects (about 6-18 images per subject). The age

The range is from 0 to 69 years (FGNET aging dataset, given in September 2012). This dataset can also give 68 features which were manually identified for every face images.

Since the images were recovered from the real-life collection of peoples of different subjects, the face images elaborate on all possible features like beards, mustaches, spectacles, etc. Figure 9,illustrates some sample images of the types of variation that have been seen in FGNET. Based on human inspection, the first row and second row are very clear images but the last line is seen as blurred images that do not have enough information related to wrinkle.

Figure 9:Sample images for FGNET dataset

3.2.2 Morph Dataset

MORPH dataset was collected from the given reference .MORPH dataset includes metadata such as height,weight,gender,age,etc that are categorized into two groups. In the latest version of 2015, it contains 55,000 isolated images of more than 13,000 persons, spanning from 2003 to 2007. Age range from 16 to 77 with a median age that is 33. There are four images of every individual aged from 16 to 77 years with a median age of 33 years ranging from one day to 1681 days duration with a standard deviation of 180 days.Figure 10 shows the samples from MORPH dataset.

Fig. 10 sample images for MORPH dataset

Table 1 Table showing datasets

Database	No.of subjects	Database size	Age range(years)
FG-NET	82	1002	0-69
MORPH	13618	55134	27-68

3.3 SUMMARY

This method detects and classifies facial age and age group based on the facial triangle and also based on wrinkles. First, each face image is divided into several convex regions where wrinkles are distributed. Second, these regions are analyzed using a Canny filter and then concatenated into a feature vector. Finally, the face is classified into an age group using a supervised learning algorithm, SVM. Results showed that the proposed method has a classification accuracy of 71.1% on FGNET dataset. This investigation showed that the wrinkle patterns have great potential for age estimation.

Chapter 4
SIMULATION AND RESULTS

4.1 SIMULATION

4.2 FACE ANGLE AND FACIAL DISTANCE METHOD

Figure 11 shown below are the sample images belonging to different classes which were checked for age estimation.

Figure 11:Sample Images(RGB)

Figure 12:Sample Images (Gray)

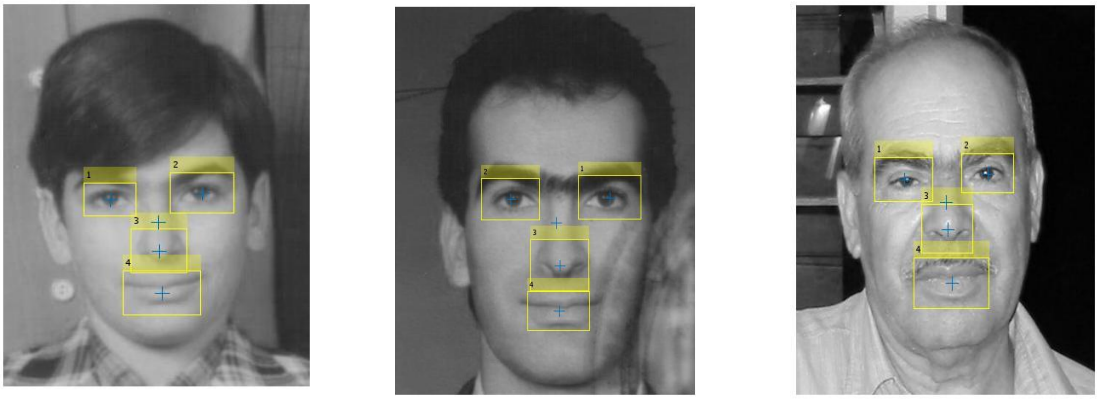

Figure 13:Images highlighting facial features (left eye,right eye,nose,mouth) using Viola Jones Cascade Object Detector

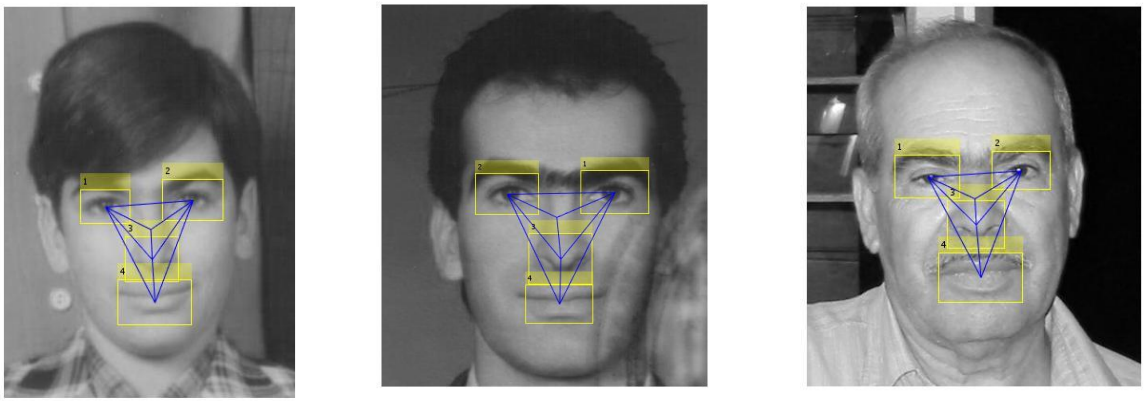

Figure 14:Images showing feature detection using Viola Jones Cascade Object Detector showing face triangle

Table 2 Table showing parameters for Face Angle,distance &ratios method

Parameters for classes				
S.No.	Parameters	Parameters for class(0-20 yrs)	Parameters for class(21-40 yrs)	Parameters for class(41 and above)
1	E_E	86-146	97-152	95-150
2	LE_M	49-200	52-187	54-156
3	LE_N	80-128	90-144	87-149
4	RE_M	50-200	60-180	55-157
5	RE_N	81-130	85-145	82-139
6	E_M_R	0.7-0.8	0.6-0.9	0.6-0.9
7	E_N_R	1.1-1.3	1.2-1.5	1.2-1.6
8	E_NC_R	1.6-1.7	1.7-1.8	1.7-1.8
9	THETA	44-48	45-54	>60
10	THETA1	37-42	40-45	>55
11	AREA M	7130	6629	11403
12	AREA N	3743	2689	6605

4.2.1 Wrinkle Energy Calculation

Images selected for the different age group to analyze age estimation using wrinkle energy method.

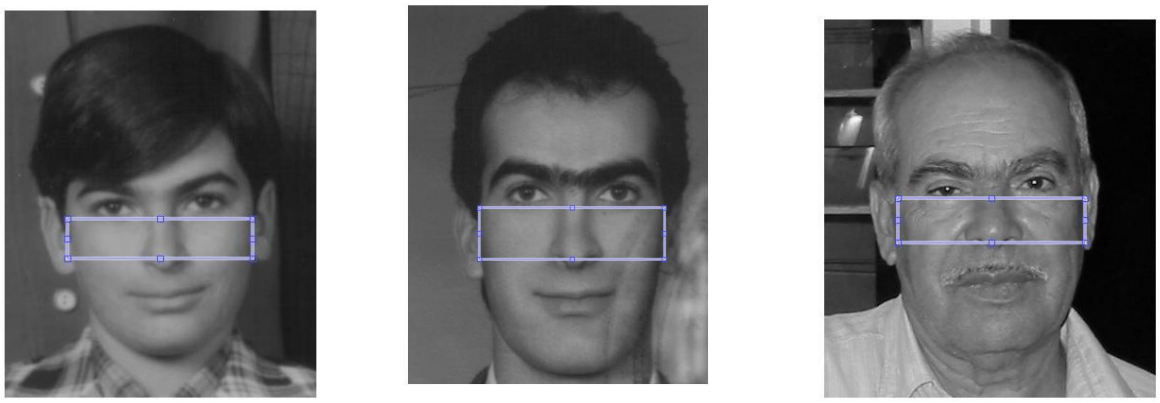

Figure 15:Images showing cheek area for wrinkle detection

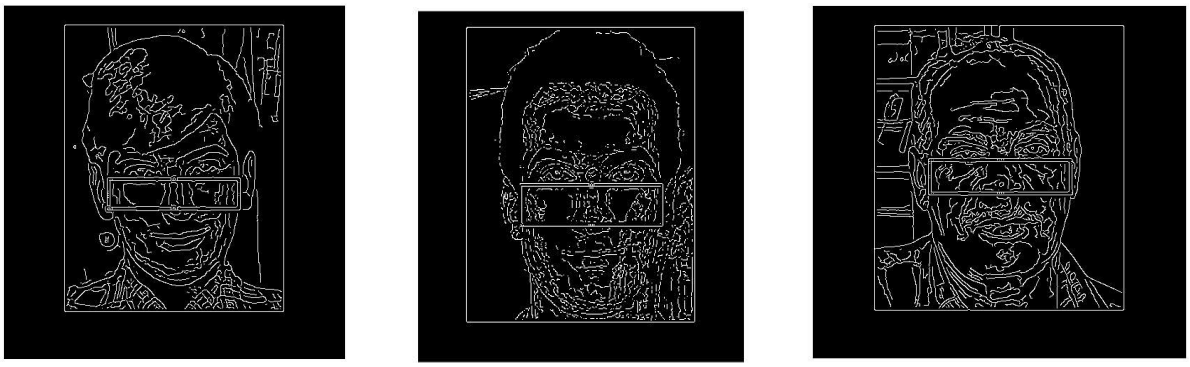

Figure 16:Images showing energy analysis using DCT algorithm

Table 3Table showing parameters for Wrinkle and Energy (DCT) method

S.No.	Parameter	For class(1)	For class(2)	For class(3)
1	Wrinkle	0	0-3	>3
2	Energy	<54	54-59	>59

4.3 RESULTS

The simulation of the proposed scheme is done using MATLAB and the output of images are compared and analyzed with the given methods in the literature. Three of the input images taken as sample and the results obtained by each step of simulation of the proposed method.

4.3.1 Accuracy

To evaluate the performance of age class classification, measurements like precision, recall and F1-measure [17] are explained as,

$$\text{PRECISION} = \frac{\text{TP}}{\text{TP+FP}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

$$RECALL = \frac{TP}{TP+FN} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

$$\text{F1} = \frac{2\times PRECISION\times RECALL}{RECALL+PRECISION} = \frac{2\times TP}{2\times TP+FP+FN} \ldots\ldots\ldots\ldots\ldots\ldots(10)$$

$$CA = \left[\frac{TN+TP}{TN+TP+FN+FP}\right] \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

where TP= True Positive,

FP=False Positive

FN =False Negative.

CA=Classification Accuracy [22]

If both ground truth and predicted answer are yes, then it is a (TP). If the ground truth is yes and predicted answer is no, then it is an (FP). If the ground truth is no and predicted as yes, then it is an (FN). Otherwise, it is a true negative (TN).

The recall is the probability of an object being classified correctly.Precision is the probability that randomly selected object is relevant to the desired group,F1 is the average of precision and recall which is used in characterizing the performance.

4.3.2 ROC Curve

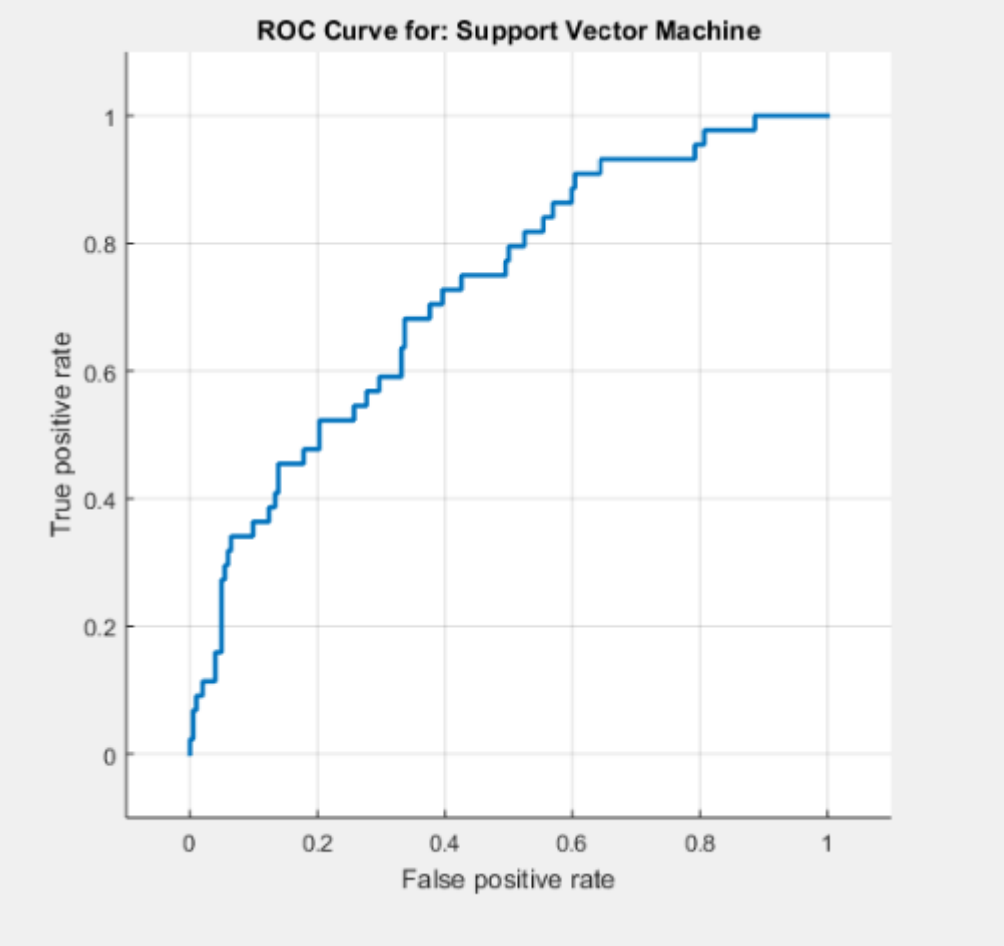

Figure 17:ROC Curve for Support Vector Machine

Table 4Table showing accuracy of results compared from previous work

S.No.	Accuracy of previous work	Accuracy of current work
1.	68%	71.1%

Chapter 5
CONCLUSION AND FUTURE WORK

This part summarises the original effort made by the thesis to the research area of face age estimation. It also highlights possible future improvements and directions of research related to the work presented. The contributions of this thesis are described, their relative merits are discussed and future work is proposed.

5.1 CONCLUSION

In this work, a technique for age estimation has been explained. Whenever the number of features increased the efficiency also increased. In this work, we have used nine features which helped in increased efficiency or in other words, a number of feature vectors gave us better results. As with the increasing age, face changes which result in the complexity of parameters to find out age using datasets. It is also evaluated that in the age group 0 to 20 years. For eye and eyeball detection, face in the taken image must be without spectacle. The image shall be of a frontal face image and it holds a single human face only. This process works with 71.1% accuracy and some time generate mistaken outputs. In this we can add more feature to increase the accuracy So, there seems to be a definite possibility for further extension of the work.

5.2 SCOPE FOR FUTURE WORK

This process can also be used by adding some more features like face angles from more of the features which comprise selecting more feature points like the face angle,face triangle. By improving the method the implementation, the age range can be minimized and more classes can be added.Wrinkle energy also calculated by using **Teagre Keiser** energy and **DWT**,so by adding these, we can get a more efficient result.

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