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Classification of Facial Images into Adult or Minor Categories using Facial Features

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Abstract: ***Facial images have always been used for various analytical and research purposes as they contain abundant information about personal characteristics, including identity, emotional expression, gender, age, etc. A human image is often defined as a complex signal composed of many facial attributes such as skin colour and geometric facial features. Nowadays the real-world applications of facial images have brought in a new dawn in the field of biometrics, security and surveillance, and these attributes play a crucial role in the same. Unrestricted and unintended access to certain resources and information to the minors has a history of physical and psychological implications, which makes age, in particular, more significant among these attributes. Consider a scenario where users may require an age-specific human computer interaction system that can estimate age for secure system access control or intelligence gathering. Automatic human age estimation using facial image analysis will come as a rescue with its potential applications in the field of Age Specific Human Computer Interactions and numerous real-world applications which include human computer interaction and multimedia communication. Here, we aim to identify and classify images provided as input into two main categories, adults and minors. This classification would act as an access controller to the desired resources or information. MATLAB was used to identify the younger and older images. Initially we got the databases of features extracted from the input images using different feature extraction methods. Later we compared the several trained databases to get a specific range for younger and older images. This range then became the basis for identifying the young and the old.***

Index Terms: ***Classification, Feature analysis, Human-Computer Interaction, Security, Surveillance***

I. INTRODUCTION

Unrestricted and unintended access to certain resources and information to the minors has a history of physical and psychological implications. Human age classification via face images will come as a rescue with its potential applications in the field of Age Specific Human Computer Interaction, biometrics, security and surveillance. Here, we are aiming to develop a software that can be integrated into various applications to classify humans into two major age groups; Minors and Adults. This will be done using facial image recognition and analysis through image processing.

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II. METHODOLOGY

The client login initiates the system start-up which captures the image of the client in real time who is intending to log in and access the age restricted resources. The captured image is then sent through a series of pre-processing algorithms which enhance and normalise every image thus making it a suitable input for further processes. Following up is the process of feature extraction which essentially scans the image and looks for certain areas of interest required by our classification model for successful prediction. The features that are extracted are represented as various ratios and numeric values that are then fed to the classification model to categorise the subject image as an "adult" or a "minor". The classifications pertaining to "adults" directly triggers the resource access by the system whereas the "minor" classified subject images require another layer of security in the form of a password on successful submission of which the resources are made accessible the client else the resources are locked by the system and access is denied to the present client The following diagram explains how the system will work for the facial analysis and classification -

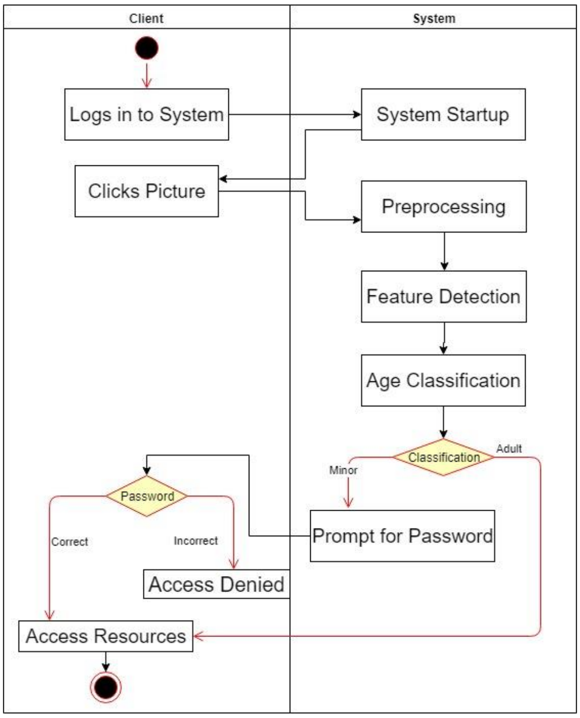

Fig 1: Working Of The Classifier

A. Pre-processing

Pre-processing is the first step in the proposed age

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classification system. Pre-processing of the input image ensures that the image is free from any noise. This also helps in enhancing the features which are important for further processing. Pre-processing consists of colour conversion of input images into grey scale, reduction of salt and pepper and various other types of noises.

1. Conversion of image into Grayscale –
Grayscale images are much less complex as compared to RGB image. Hence indexed or RGB image to grey scale image conversion is done.

```
y=ind2gray(x, map); OR
y=rgb2gray(x);
```

2. Contrast Correction
Contrast correction involves contrast stretching i.e. spreading out the grey level distribution and histogram equalization i.e. general method of modifying intensity distribution

3. Noise Removal
Noise like salt and pepper noise in the image can removed by using a median filter.

```
I = imread ('image.tif');
K = medfilt2 (I);
```

4. Resizing (if required)
Resizing the image may be required in some cases to ensure correct results and normalization.

B. Aging features extraction

Aging features extraction is the second step after pre-processing in the proposed age classification system. Different desired portions of an image can be extracted using different algorithms available in digital processing. Feature extraction plays an important role in minimizing the number of resources that are required to give a description of a large set of data**.** In general, feature extraction deals with constructing variables which help in explaining the data available with sufficient accuracy. Proposed Technique – Facial Ratios The Eye ball centres, nose centre, mouth centre and the face centres were extracted according to which region of interest was determined for analysis. The ratios of eye to nose centre distance, eye to mouth centre distance and mouth centre to nose centre distance have been found to have a considerable difference between adults and minors. Hence these were used as the metric for analysis and classification.

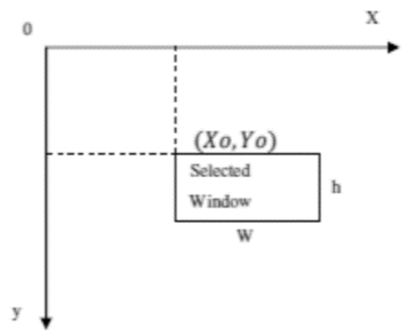

Fig 2: The Window Selection For Eyeball

To find the feature centre, the vision. Cascade Object Dectector function was first used to find the feature region. Once feature region was found, feature centre was achieved by finding the centre of the feature region achieved in previous step. Any threshold required were calculated using the formula:

T = g(x, y) (0.15 * N)

$$f(x) = \{0,\ x < T$$

$$255,\ x > T\}$$

$$P(y) = \sum_{x=1}^{N} I(x,y)$$

$$P(x) = \sum_{y=1}^{N} I(x,y)$$

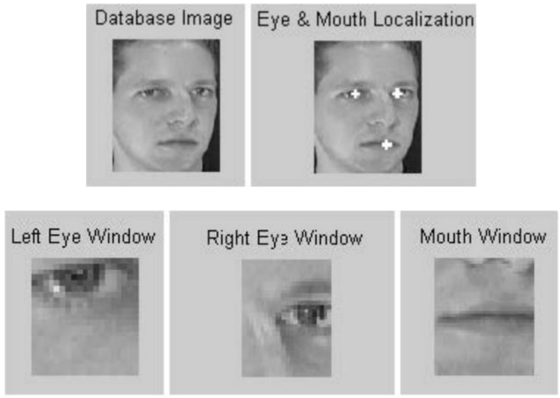

Fig 3: Feature Extraction

C. Feature normalization and feature fusion

The next step after aging feature extraction is feature normalization. Resizing the image according to the need of the software and also rotating is accordingly, equalizing contrast and brightness.

D. Age classifier

The normalized aging features are applied to an age classifier, which is the last step of the proposed age classification system. The ratios were fed to SVM (Support Vector Machine) for the binary classification. The ratios were the ratio of the distance between the eyes and the distance between the eye and the nose. The age classifier assigns one of the two age groups (Adult or Minor) to the input face image.

```
SVMModel=
fitcsvm(X,Y,'KernelFunction','rbf','Standardize',true,'ClassNames',{'negClass','posClass'});
```

The inputs are:
X — Matrix of data points of different images taken for learning in which each data point represents different image used for learning, where each row is one observation, and each column represents an attribute of that particular data point. Y — Array of class labels with every row indicating the value (label) of the corresponding row in X KernelFunction — A mathematical function responsible for defining the hyperplane curve (Taken as linear by default). The resulting, trained model (SVMModel) contains the optimized parameters from the SVM algorithm, enabling you to classify new data. Classify new data using predict. The syntax for classifying new data using a trained SVM classifier (SVMModel) is:

```
[label, score] = predict (SVMModel, newX);
```

The predicted label or the vector of labels returned by the predict function, represents the classification of each data point in newX. Score is n-by-2 matrix of soft scores. Scores are assigned to every observation in X. The first column contains the scores for the observations being classified in the negative class, and the second column contains the scores observations being classified in the positive class.

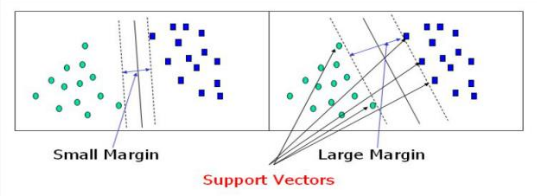

Fig 4: Support Vector Classification Example

III. DATASET

PAL Dataset was used for training**.** The dataset used for training purposes was the PAL Dataset. he dataset used for training purposes was the PAL Dataset. This dataset contains frontal images of 580 individuals from five different ethnicities with the age of subjects varying from 18 years to 93 years. In order to maintain a balance between the number of male and female images in the dataset and reduce the complexity of the dataset, 155 images of each gender were selected.

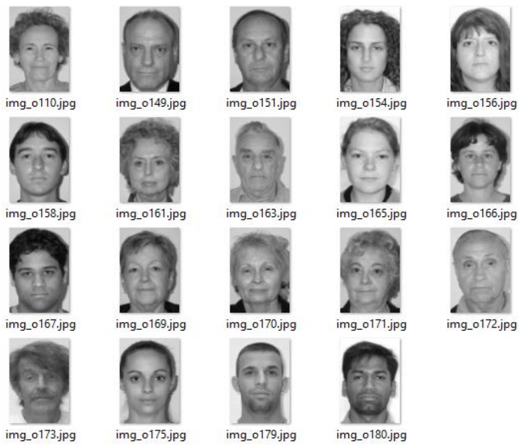

Fig 5: PAL Dataset

For the images of kids below the age of 18, the dataset for training, was made of images downloaded from google. 100 different images of minors were downloaded of different age groups and genders. Testing was performed on images taken live of people around along with a few images from the PAL Dataset that weren't used for training.

IV. WORKING OF CLASSIFIER

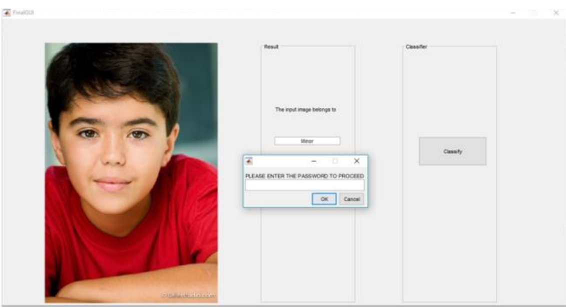

Fig 6: Input Image Classified As Minor. User Prompted To Enter Password To Gain Access

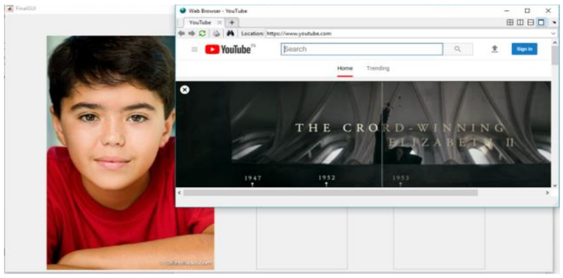

Fig 7: Correct password entered. Access provided

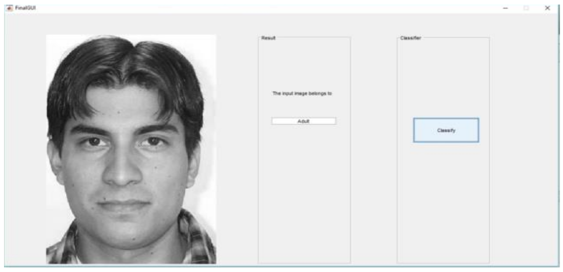

Fig 8: Input image classified as Adult. User not prompted for a password

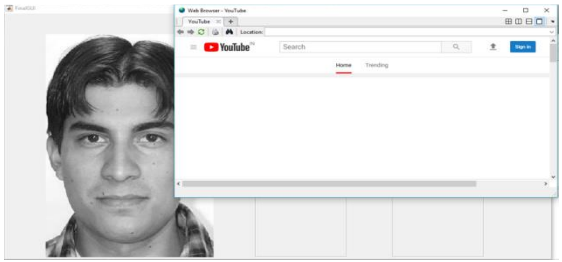

Fig 9: Direct Access Provided

V. CONCLUSION

Here, we aimed to develop a software that can be integrated into various applications like biometrics, security, surveillance etc., to classify humans into two major age groups; Minors and Adults. The concepts of Digital Image processing and Machine learning in the computing environment provided by MATLAB were used to achieve this goal. Our age Classification system works through four major phases namely Pre-processing, Aging Feature extraction, Feature Normalization and the Age classifier. The input image undergoes color conversion and noise reduction before the discussed ageing features and area of interest for are extracted. The extracted features are then normalized before being applied to the age classifier that consists of a support vector machine which uses the previously fed ratios to classify the image. At the end we were able to categorize the facial images into the two intended categories and were able to provide access to the browser accordingly, i.e. minors needed permission to access while the adults were provided direct access.

Table 1: Confusion Matrix

N = 80	Predicted : Minor	Predicted : Adult	
Actual : Minor	TN = 30	FP = 5	35
Actual : Adult	FN = 11	TP = 34	45
	41	39	

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TN = True Negative

FN = False Negative

FP = False Positive

FN = False Negative

N = Total number of images tested

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Professor Sweta Jain received the Masters in Technology in Computer Science and Engineering from Nagpur University in 2009 as a first merit holder. She is currently Assistant professor in computer science and engineering department at Shri Ramdeobaba College of Engineering and Management Nagpur. She has a total teaching experience of around 15 Years. Her research interests include Pattern Recognition, Digital Image Processing and Machine Learning.

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