Mini Project Report
On

FACE RECOGNITION USING MATLAB

Submitted in partial fulfillment of the requirements of

Subject **Image Processing and Machine Vision**

Third Year of Engineering

In

Electronics and Telecommunication Engineering

BY

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CERTIFICATE

This is to certify that the project entitled **" FACE RECOGNITION USING MATLAB "**is a bonafide work of 1) **Mr. ABHISHEK SONPAL 2) Mr. SHANTANU SURVE 3) Mrs. GAYATRI VALVI 4)Mrs. VANI VORA** under the supervision of **Prof. A.R Sangale** submitted to the University of Mumbai in partial fulfillment of the requirement for the subject of **"Image Processing and Machine Vision"** of Engineering in Electronics and Telecommunication Engineering.

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ABSTRACT :-

Human face detection by computer systems has become a major field of interest. Face detection algorithms are used in a wide range of applications, such as security control, video retrieving, biometric signal processing, human computer interface, face recognitions and image database management. However, it is difficult to develop a complete robust face detector due to various light conditions, face sizes, face orientations, background and skin colors. In this report, we propose a face detection method for color images. Our method detects skin regions over the entire image, and then generates face candidates based on a connected component analysis. Finally, the face candidates are divided into human face and non-face images by an enhanced version of the template-matching method.Experimental results demonstrate successful face detection over the EE368 training images. These techniques works well under robust conditions like complex background, different face positions. These algorithms give different rates of accuracy under different conditions as experimentally observed. In face detection, we have developed an algorithm that can detect human faces from an image. We have taken skin colour as a tool for detection. The face is our primary focus of attention in social life playing an important role in conveying identity and emotions. We can recognize a number of faces learned throughout our lifespan and identify faces at a glance even after years of separation. This skill is quite robust despite of large variations in visual stimulus due to changing condition, aging and distractions such as beard, glasses or changes in hairstyle. Our aim, which we believe we have reached, was to develop a method of face recognition that is fast, robust, reasonably simple and accurate with a relatively simple and easy to understand algorithms and techniques. The examples provided in this thesis are real-time and taken from our own surroundings.

INTRODUCTION:

There have been many attempts to solve human face detection problem. The early approaches are aimed for gray level images only, and image pyramid schemes are necessary to scale with unknown face sizes. View-based detectors are popular in this category, including Rowley's neural networks classifier [1], Sung and Poggio's correlation templates matching scheme based on image invariants [2] and Eigen-face decomposition [3]. Model based detection is another category of face detectors [4].For color images, various literatures have shown that is possible to separate human skin regions from complex background based on either YCbCr or HSV color space [5, 6, 7, 8].

The face candidates can be generated from the identified skin regions. Numerous approaches can be applied to classify face and non-face from the face candidates, such as wavelet packet analysis [6], template matching for faces, eyes and mouths [8, 9, 10], feature extraction using watersheds and projections [5].In this project, a new face detector for color images is developed. The objective of this project is to develop a very efficient algorithm, in terms of low computational complexity,with the maximum number of face detections and the minimum number of false alarms. To achieve these objectives first, the image is transformed to HSV color space, where the skin pixels are determined. The skin regions in HSV space are described by crossing regions of several 3D linear equations, which are found using training data. Also, the median luminance condition Y value of the image is determined. For high luminance images, the chances that more non-skin pixels are set to skin regions are high, thus an additional but simple classification on YCbCr space is performed to remove hair pixels.

Hence, a binary mask of the original image can be obtained. This binary mask is then filtered with some image morphology processing to break connections between faces and remove scattered noise. A connected component analysis is followed to determine the face candidates. The final step is to determine real faces from the face candidates using a multi-layer classification scheme. The application of this project justifies an assumption that the faces will have approximately the same size. So, we use a correlation template matching for the face candidates that are close to the median size. For large boxes, convolution template matching is used instead because it is more likely that only part of the face candidate box contains the face. Another finer level of template matching is applied to remove hand-like non-faces and five more face templates are tested again to avoid missing a human face.

Moreover, the standard deviation of the pixel gray levels for the face candidates is also used to remove non-faces caused by uniform skin-color like region, such as floors, buildings and clothes.In the following sections, we will present the detailed algorithm of our face detector. We will show that our detector gives 100% accuracy. Face detection is used in many places now a days especially the websites hosting images like picassa, photobucket and facebook. The automatically tagging feature adds a new dimension to sharing pictures among the people who are in the picture and also gives the idea to other people about who the person is in the image. In our project, we have studied and implemented a pretty simple but very effective face detection algorithm which takes human skin colour into account. Computational models of face recognition are interesting because they can contribute not only to theoretical knowledge but also to practical applications. Computers that detect and recognize faces could be applied to a wide variety of tasks including criminal identification, security system, image and film processing, identity verification, tagging purposes and human-computer interaction.

EXPLANATION :-

A)FACE RECOGNITION:

Computational models of face recognition are interesting because they can contribute not only to theoretical knowledge but also to practical applications. Computers that detect and recognize faces could be applied to a wide variety of tasks including criminal identification, security system, image and film processing, identity verification, tagging purposes and human-computer interaction. Unfortunately, developing a computational model of face detection and recognition is quite difficult because faces are complex, multidimensional and meaningful visual stimuli. The face recognition algorithms used here are Principal Component Analysis(PCA), Multilinear Principal Component Analysis (MPCA) and Linear Discriminant Analysis(LDA).Every algorithm has its own advantage. While PCA is the most simple and fast algorithm, MPCA and LDA which have been applied together as a single algorithm named MPCALDA provide better results under complex circumstances like face position, luminance variation etc.

B)FACE DETECTION:

Face detection is the first step of face recognition as it automatically detects a face from a complex background to which the face recognition algorithm can be applied. But detection itself involves many complexities such as background, poses, illumination etc. There are many approaches for face detection such as, colour based, feature based (mouth, eyes, nose), neural network. The approach studied and applied in this thesis is the skin colour based approach. The algorithm is pretty robust as the faces of many people can be detected at once from an image consisting of a group of people. The model to detect skin colour used here is the YCbCr model.

C) COLOUR SEGMENTATION:

The first step is color segmentation of the image. Several color spaces are available but Hue-Saturation-Value (HSV) color map is the most adequate for differentiating the skin regions from the rest of the photo contents. A set of equations that maximize the amount of skin pixels while minimizing the number of background pixels can be found using the plot of skin regions vs. non-skin regions in H vs. S, S vs. V and H vs. V. These bounding equations are used to generate the first binary image. However, some face candidate boxes contained two people because their black hairs were connected and included as skin region. In order to balance taking out the hair vs. loosing some of the face skin pixels, the luminance and chrominance (YCbCr) color space is also used to differentiate the black hair pixels from the skin pixels in case of high luminance images.The following Figure 2-1 ÷ Figure 2-3 show the skin vs. non-skin regions in HSV, YCbCr and RGB color spaces for the training image no. 1.

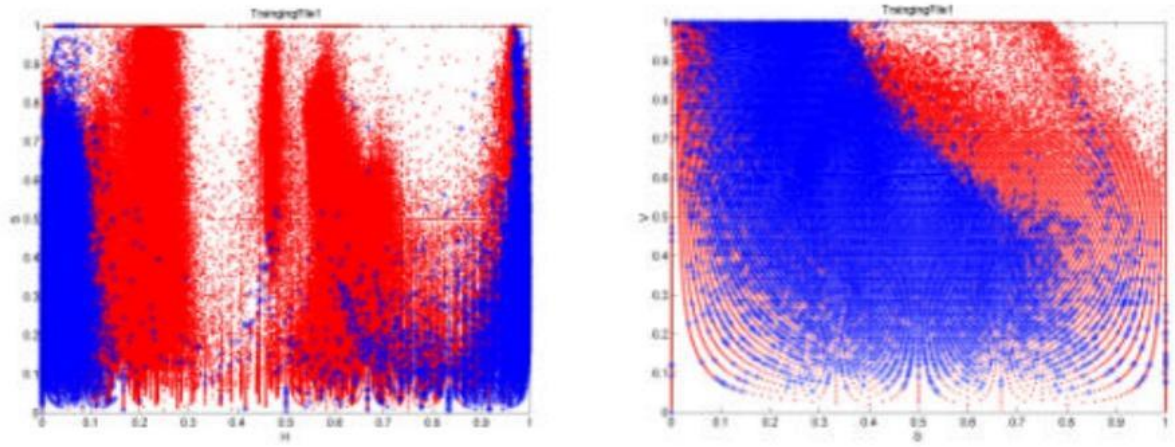

Figure 2-1: Skin data (blue) vs. background data (red) in HSV color space

D) PRINCIPLE COMPONENT ANALYSIS (PCA):

Principal component analysis (PCA) was invented in 1901 by Karl Pearson.PCA involves a mathematical procedure that transforms a number of possibly correlated variables into a number of uncorrelated variables called principal components, related to the original variables by an orthogonal transformation. This transformation is defined in such a way that the first principal component has as high a variance as possible (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it be orthogonal to the preceding components. PCA is sensitive to the relative scaling of the original variables. Depending on the field of application, it is also named the discrete Karhunen–Loève transform (KLT), the Hotelling transform or proper orthogonal decomposition (POD). The major advantage of PCA is that the eigenface approach helps reducing the size of the database required for recognition of a test image. The trained images are not stored as raw images rather they are stored as their weights which are found out projecting each and every trained image to the set of eigenfaces obtained.

-THE EIGENFACE APPROACH: In the language of information theory, the relevant information in a face needs to be extracted, encoded efficiently and one face encoding is compared with the similarly encoded database. The trick behind extracting such kind of information is to capture as many variations as possible from the set of training images.Mathematically, the principal components of the distribution of faces are found out using the eigenface approach. First the eigenvectors of the covariance matrix of the set of face images is found out and then they are sorted according to their corresponding eigenvalues. Then a threshold eigenvalue is taken into account and eigenvectors with eigenvalues less than that threshold values are discarded. So ultimately the eigenvectors having the most significant eigenvalues are selected. Then the set of face images are projected into the significant eigenvectors to obtain a set called eigenfaces.

Every face has a contribution to the eigenfaces obtained. The best M eigenfaces from a M dimensional subspace is called “face space”Each individual face can be represented exactly as the linear combination of “eigenfaces” or each face can also be approximated using those significant eigenfaces obtained using the most significant eight values.

-ADVANTAGES OF PCA:

1. It’s the simplest approach which can be used for data compression and face recognition.
2. Operates at a faster rate.

-LIMITATIONS OF PCA:

1. Requires full frontal display of faces
2. Not sensitive to lighting conditions, position of faces.
3. Considers every face in the database as a different image. Faces of the same person are not classified in classes.

PROGRAM :-

```
clear all
clc
%Detect objects using Viola-Jones Algorithm

%To detect Face
FDetect = vision.CascadeObjectDetector;

%Read the input image
I = imread('C:\Users\abhis\Downloads\msn4.jpg');

%Returns Bounding Box values based on number of objects
BB = step(FDetect,I);

figure,
imshow(I); hold on
for i = 1:size(BB,1)
    rectangle('Position',BB(i,:),'LineWidth',5,'LineStyle','-
','EdgeColor','r');
end
title('Face Detection');
hold off;
%To detect Nose
NoseDetect = vision.CascadeObjectDetector('Nose','MergeThreshold',16);



BB=step(NoseDetect,I);


figure,
imshow(I); hold on
for i = 1:size(BB,1)
    rectangle('Position',BB(i,:),'LineWidth',4,'LineStyle','-
','EdgeColor','b');
end
title('Nose Detection');
hold off;
```

```
%To detect Mouth
MouthDetect = vision.CascadeObjectDetector('Mouth','MergeThreshold',16);

BB=step(MouthDetect,I);


figure,
imshow(I); hold on
for i = 1:size(BB,1)
 rectangle('Position',BB(i,:),'LineWidth',4,'LineStyle','-
','EdgeColor','r');
end
title('Mouth Detection');
hold off;
%To detect Eyes
EyeDetect = vision.CascadeObjectDetector('EyePairBig');

%Read the input Image
I = imread('C:\Users\abhis\Downloads\hp1.jpg');

BB=step(EyeDetect,I);



figure,imshow(I);
rectangle('Position',BB,'LineWidth',4,'LineStyle','-','EdgeColor','b');
title('Eyes Detection');
Eyes=imcrop(I,BB);
figure,imshow(Eyes);
```

OUTPUT:-

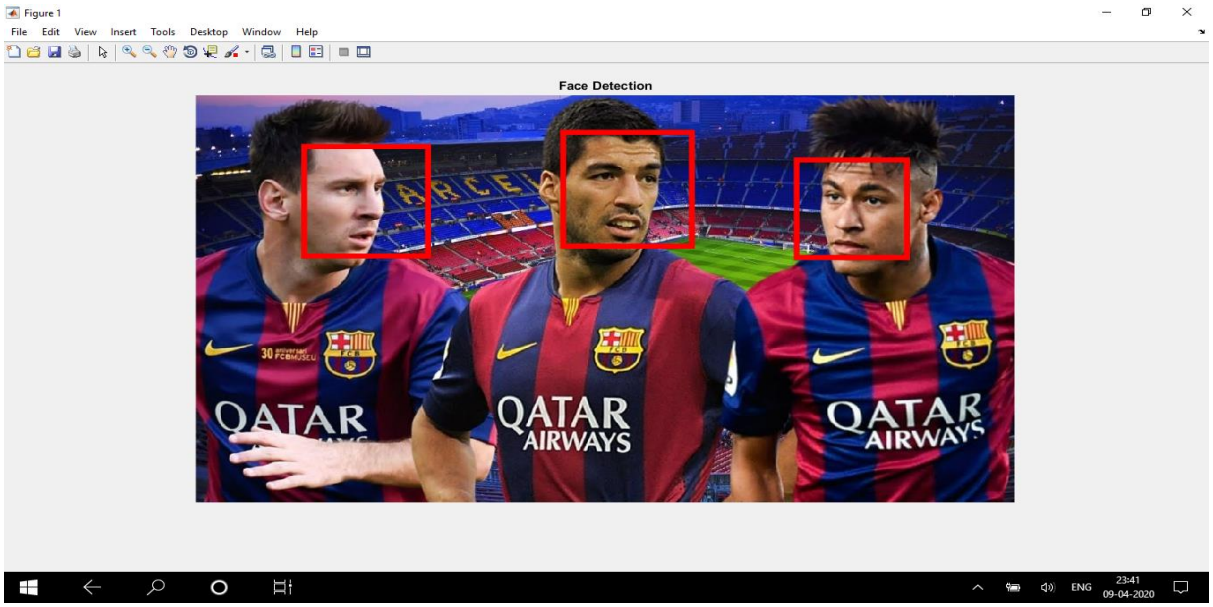
Figure 1
File Edit View Insert Tools Desktop Window Help
Face Detection
QATAR
QATAR AIRWAYS
QATAR AIRWAYS
ENG
23:41
09-04-2020

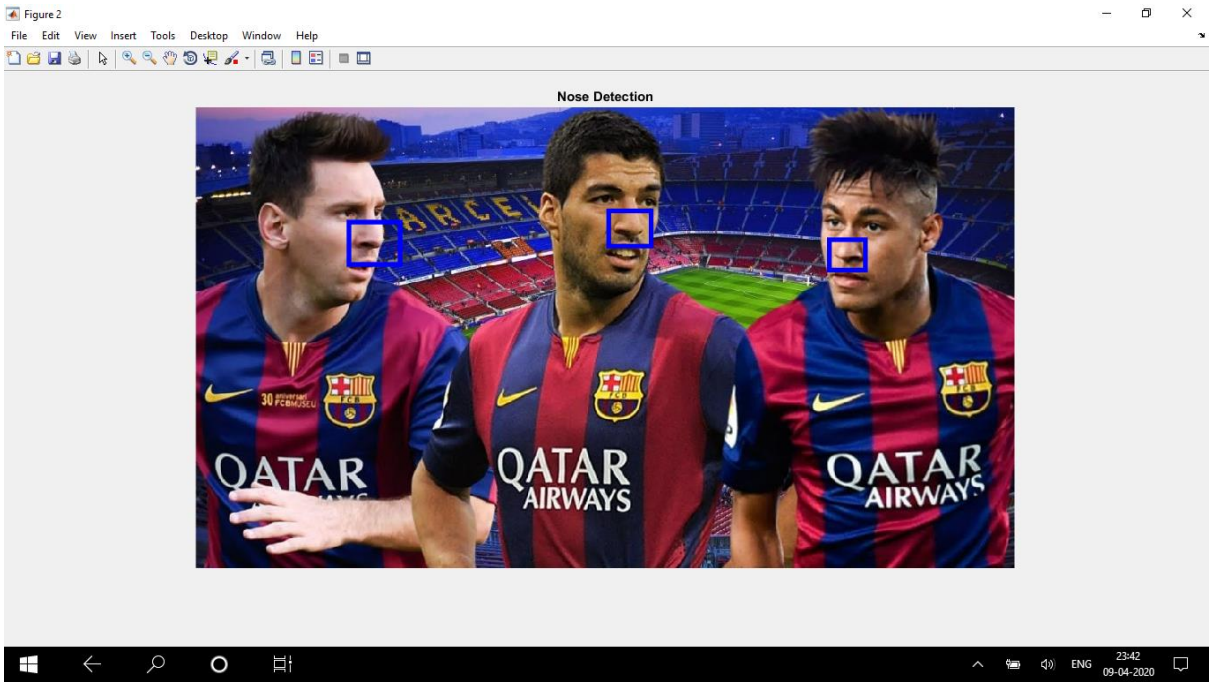
Figure 2
File Edit View Insert Tools Desktop Window Help
Nose Detection
QATAR
QATAR AIRWAYS
QATAR AIRWAYS
ENG
23:42
09-04-2020

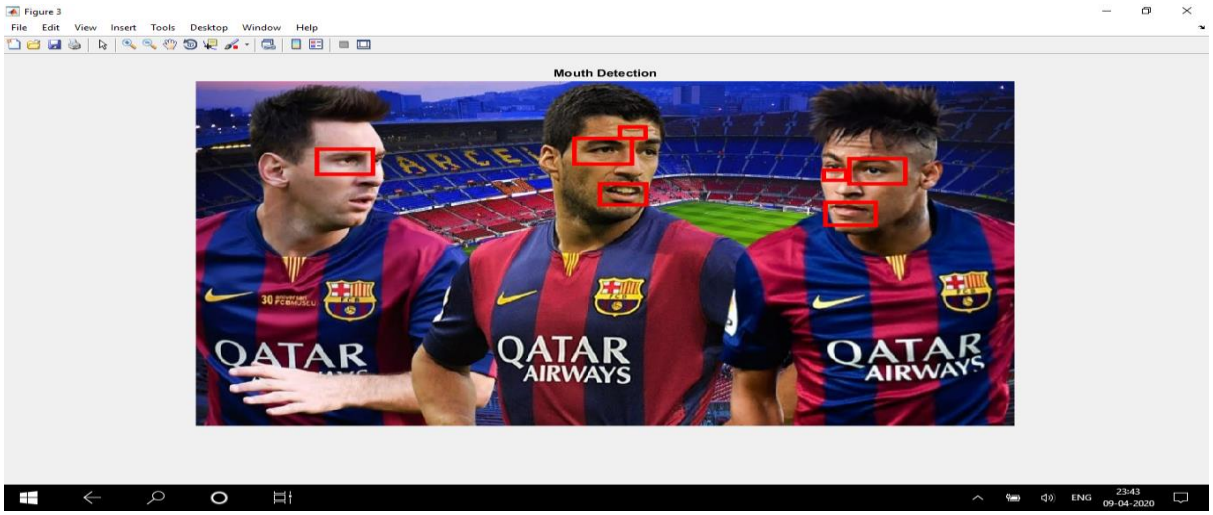
Figure 3
File Edit View Insert Tools Desktop Window Help
Mouth Detection
QATAR
QATAR AIRWAYS
QATAR AIRWAYS
ENG 23:43 09-04-2020

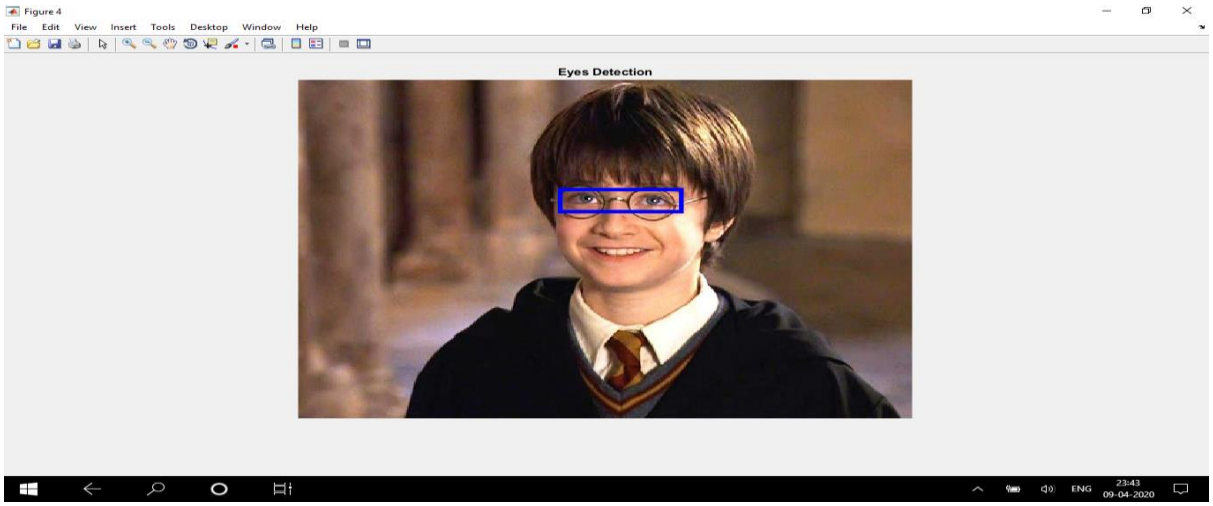
Figure 4
File Edit View Insert Tools Desktop Window Help
Eyes Detection
ENG 23:43 09-04-2020

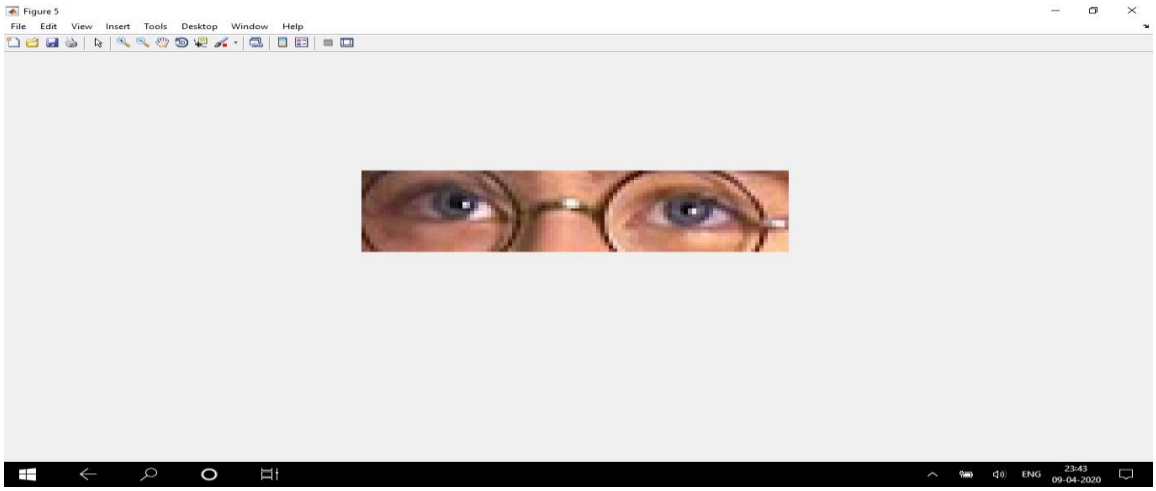
Figure 5
File Edit View Insert Tools Desktop Window Help
ENG 23:43 09-04-2020

CONCLUSION:

We have presented a face detection algorithm for color images that uses color segmentation, connected component analysis and multi-layer template-matching. Our method uses the color information in HSV space, compensates for the luminance condition of the image, and overcomes the difficulty of separating faces that are connected together using image morphology processing. Finally, an enhanced version of the template-matching algorithm is used to detect all human faces and reject the non-faces such as hands and clothes. Experimental results have shown that our approach detected 164 out of 165 faces present in the seven project training images (half faces are classified as non-faces). The only one missing face is due to very dark glasses. No false alarms are raised in any of the seven images.The average run time on ISE lab workstation is ~12 seconds.Future work will be focused on verifying the algorithm performance against general images and studying the required modifications to make the algorithm robust with any image.

APPLICATIONS :

- Track school attendance
- Smarter advertising
- Unlock phones
- Facilitate secure transactions
- Validate identity at ATMs

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https://www.mathworks.com/discovery/face-recognition.html