Attendance System Using Face Recognition

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December – 2017

Submitted in partial fulfillment of the Degree of

Bachelor of Technology

in

Computer Science Engineering

DEPARTMENT OF COMPUTER SCIENCE ENGINEERING & INFORMATION TECHNOLOGY

JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY, NOIDA

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DECLARATION

We hereby declare that this submission is my/our own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that the work titled "**Attendance System Using Facial Recognition**" submitted by "**Ayushman Mittal, Vaibhav Sharma, Yash Joshi**" of B. Tech of Jaypee Institute of Information Technology University, Noida has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of any other degree or diploma.

Signature of Supervisor

Name of Supervisor	Ms. Sonal Goyal
Designation	Assistant Professor
Date	December 12, 2017

ACKNOWLEDGEMENT

We express our sincere gratitude to Ms. Sonal Goel, Assistant Professor, Dept. of Computer Science Engineering, Jaypee Institute of Information Technology, India, for her stimulating guidance, continuous encouragement and supervision throughout the course of present work.

We also wish to extend our thanks to our classmates and seniors for their insightful comments and constructive suggestions to improve the quality of this project work.

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SUMMARY

Maintaining attendance is essential in every organization to keep check on the performance of the student/employee therefore attendance is very important thing in any organization or institution. Traditional attendance management systems are tedious, repetitive and time consuming. Extra efforts are required both from the attendance taker and the attendees. Identification of proxies is very difficult. If a large number of attendees are present, it is not possible for a single supervisor to conduct attendance using a physical attendance sheet. To overcome this problem, we have proposed an automated attendance using facial recognition method. Face is a complex multidimensional structure and needs a good computing technique for recognition. Our approach treats face recognition as a two-dimensional recognition problem. In this scheme face recognition is done by Principal Component Analysis (PCA). Face images are projected onto a face space that encodes best variation among known face images. The face space is defined by eigenface which are eigenvectors of the set of faces, which may not correspond to general facial features such as eyes, nose, lips. The eigenface approach uses the PCA for recognition of the images. The system performs by projecting pre-extracted face image onto a set of face space that represent significant variations among known face images. Face will be categorized as known or unknown face after matching with the present database.

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LIST OF FIGURES

LIST OF SYMBOLS & ACRONYMS

1. **PCA:** PRINCIPAL COMPONENT ANALYSIS
2. **SMS:** SHORT MESSAGE SERVICE
3. **NLP:** NATURAL LANGUAGE PROCESSING
4. **RFID:** RADIO FREQUENCY IDENTIFICATION

Chapter 1: Introduction

This section gives a general introduction of the project which includes the problem statement, the summary of our research and our approach to the problem.

1.1 General Introduction

Face recognition is now-a-days a widely used technology/application. Face recognition is an application capable of identifying and verifying a person through a digital image or a video frame. Facial recognition is generally used for security purposes. It is a form of a biometric test.

Using face recognition, we propose a framework or an application that can be used in organizations/institutes/classrooms to upload attendance of the employees or students. Maintaining attendance is essential in every organization to keep check on the performance of the student/employee. In traditional attendance systems, the attendance is taken physically. For example, in an institution, the attendance is taken through attendance sheets which is a very tedious and repetitive task. It also consumes a lot of time and detection of false presence is very difficult. Therefore, using facial recognition for attendance is very effective and much easier as it won't consume much time and no false attendance could be marked as the attendance would only be uploaded for those students who are physically present in the class.

Facial Recognition has four parts namely Image Acquisition, Face Detection, Feature Extraction and Face Recognition. First of all, a database is created using pictures of students of a class room. Then, Image Acquisition is the phase where an image is captured using a camera. The image is then sent to the Face Detection phase where the facial area is separated from the rest of the image or the background of the image. Then, features like eyes, nose, mouth etc. are extracted in the Feature Extraction phase which is very important for face detection and recognition. The extracted image is then compared with the already stored image and if it matches, the attendance is marked.

1.2 Current/Open Problems

1.2.1 Manual attendance systems are tedious, repetitive and time consuming.

1.2.2 Currently, only a few number of students can be marked absent/present at the same time using automated system.

1.2.3 Detection of proxies in automated systems is not very efficient.

1.3 Integrated Summary of the literature studied

Liton and Abdulla in [3] describes the face recognition system by using Principal Component Analysis. The test image is projected on the eigenface space and Euclidean distance is found. The training set image which has the least Euclidean distance is selected as the best match. Euclidean distance provides measurement of similarity between two images. If an unknown face is seen repeatedly, the weight pattern of that face image is captured and added into known faces.

In [2] they have implemented continuous monitoring and fixed seating for automatic attendance marking. In this system 2 cameras are used, one is sensing camera and other one is capturing camera. Capturing and matching of picture is done again and again this is termed as "continuous observation".

In [6], PCA is used for finding patterns in data and expressing the data as eigenvectors. 30 images of 10 persons were used as training set and image was extracted using Paul-Voila face extracting framework detection method. Increasing face angle with respect to the camera decreases detection and recognition rates.

In [4], authors proposed a research aimed to implement a system that can identify the employees in an organization, mark their attendance and handle their leave requests in an automated way. Two algorithms, PCA and Haar Cascade are used in the implementation. To handle the leave requests, a simple SMS has to be sent by the employee and NLP has been used to process that SMS.

In [7], Color based detection and Principle Component Analysis (PCA) are used for face detection feature extraction. Color based technique was implemented, which depends on the detection of the human skin color with all its different variations in the image. The skin area of the image is then segmented, and it is then passed to the recognition process. PCA is used for recognition.

In [1] authors proposed an automated attendance system using facial recognition with audio output. Facial recognition is done in three steps, firstly image acquisition is done then these images are

processed to reduce noise, sharpen edges. After these two steps face detection is done by voila jones algorithm and features are extracted to be matched with the database. Names of matched images are marked as present and rest are marked as absent, then names of absentee are converted to voice to recheck.

In [5], PAN Xiang proposed RFID card swapping and face recognition technique has been used. To enter the room, first a person has to touch his card then the system reads the information in the card and meanwhile the video camera is started to take photos of the person and match it.

1.4 Problem Statement

There are certain problems in traditional attendance systems like: Additional efforts are required from the teacher who must make sure to correctly mark attending students, which at the same time wastes a considerable amount of time from the teaching process. It can also get much more complicated if one has to deal with large group of students. Identification of proxy attendances is very difficult in traditional attendance systems.

1.5 Overview of proposed solution approach

This section describes our proposed solution in two parts. The first part being the current implementation and the second part presents our future addition to make it a better solution.

Part I

To overcome the problem stated above, we have implemented Principal Component Analysis for facial recognition. The main idea of principal component analysis (PCA) is to reduce the dimensionality of a data set consisting of many variables correlated with each other. The project is implemented in two phases:

Initialization Phase:

1. Acquire the initial set of face images called as training set.
2. Calculate the Eigen-values and Eigenvectors of the training set. These M images define the face space.

Recognition Phase:

1. Acquire a test image using a camera or take input from file.
2. Pre-process the acquired image.
3. Calculate a set of weights based on the pre-processed image and the M Eigen-faces by projecting the input image onto each of the Eigen-faces.
4. Calculate Euclidean distance between the test image and other images.
5. Find the face class with minimum Euclidean distance which shows similarity to test image.
6. Show the recognition result.

Part II

For better results and better accuracy, we propose and plan to implement an integrated solution to the problem. The approach for the solution will be a combination of principal component analysis, voila jones algorithm and skin color detection. Voila Jones is basically used for face detection. It distinguishes face from a non-face. It has high detection rate (true positive rate) and very low false positive rate. It also works well in real time. Skin color detection is also used for face detection where an image of a face and non-face is distinguished. It separates skin-pixels and non-skin-pixels. This integrated approach will solve many problems such as getting false positives, having problem working in real time, detecting whether there is even a face or not and also, it will increase the accuracy and efficiency of the solution.

Chapter 2: Analysis, Design and Modelling

This section defines the required hardware and software system specifications, functional and non-functional requirements, the architecture of the project and associated design.

2.1 Requirements Specifications

The following hardware and software specifications are required to run the project:

2.1.1 Hardware Requirements

- **Disk Space:** At least 8 GB of free memory.
- **RAM:** 4GB is recommended
- **Processor:** Any Intel or AMD x86-64 processor
- **Webcam/Camera:** Good quality camera recommended.

2.1.2 Software Requirements

- **Operating System:** Windows 7 and above, MacOS El Captain and above, Ubuntu 14.04 and above.
- **MATLAB:** MATLAB 2015 and above.

2.2 Functional Requirements

The functional requirements are:

2.2.1 Faces in images shall be detected automatically.

2.2.2 Face recognition methods shall be able to identify a sufficiently large number of faces.

2.2.3 The system shall provide detailed information about each individual result.

2.3 Non-Functional Requirements

The non-functional requirements are:

2.3.1 The application shall run on all major operating systems.

2.3.2 The system should be able to handle unexpected inputs.

2.3.3 The code should be readable and maintainable.

2.3.4 The system should accept widely used image format.

2.4 Overall architecture

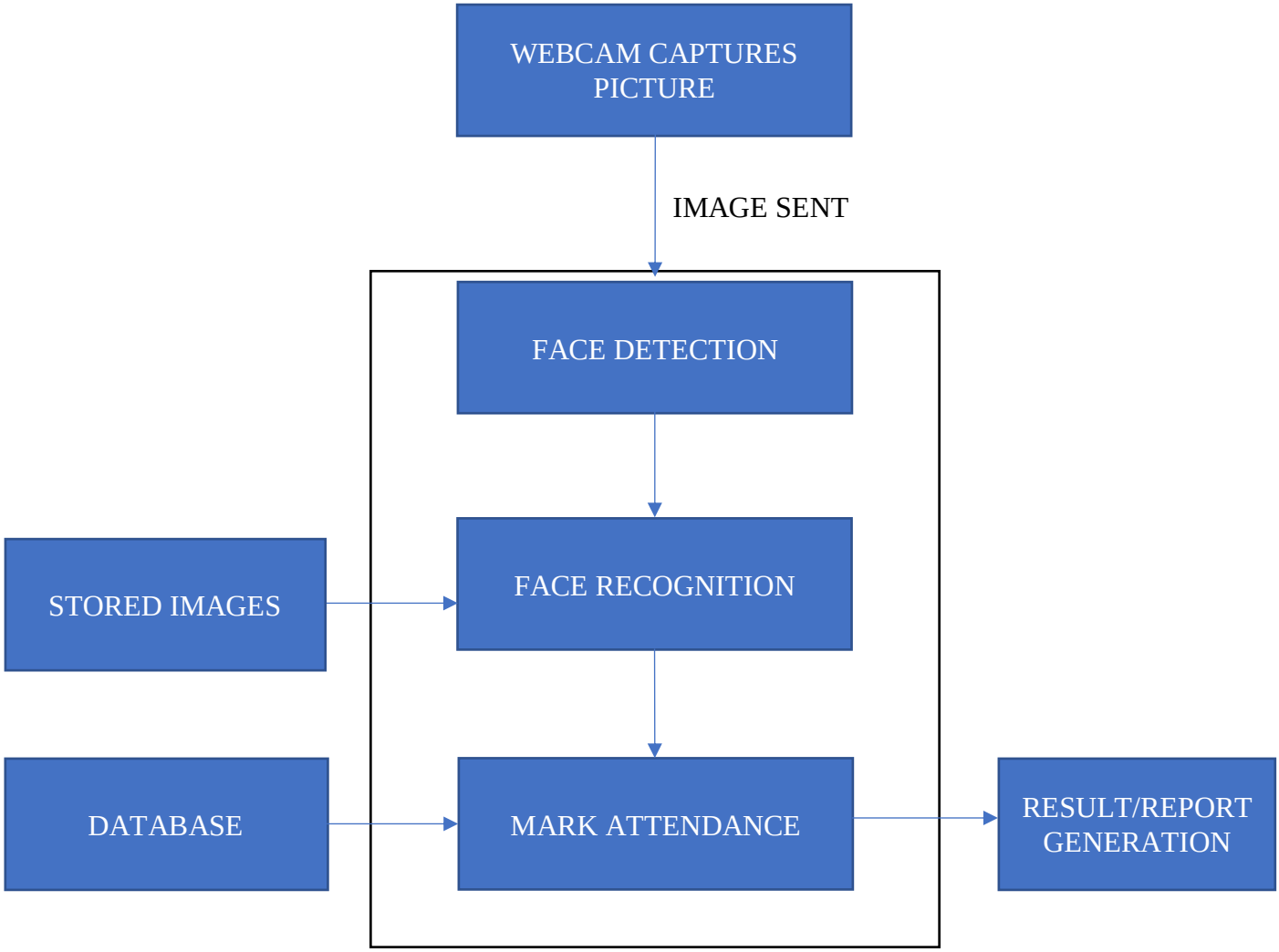


Fig. 1

2.5 Design Documentation

This section contains all the project associated diagrams i.e. Use Case Diagram, Class Diagram, Activity Diagram.

2.5.1 Use Case Diagram

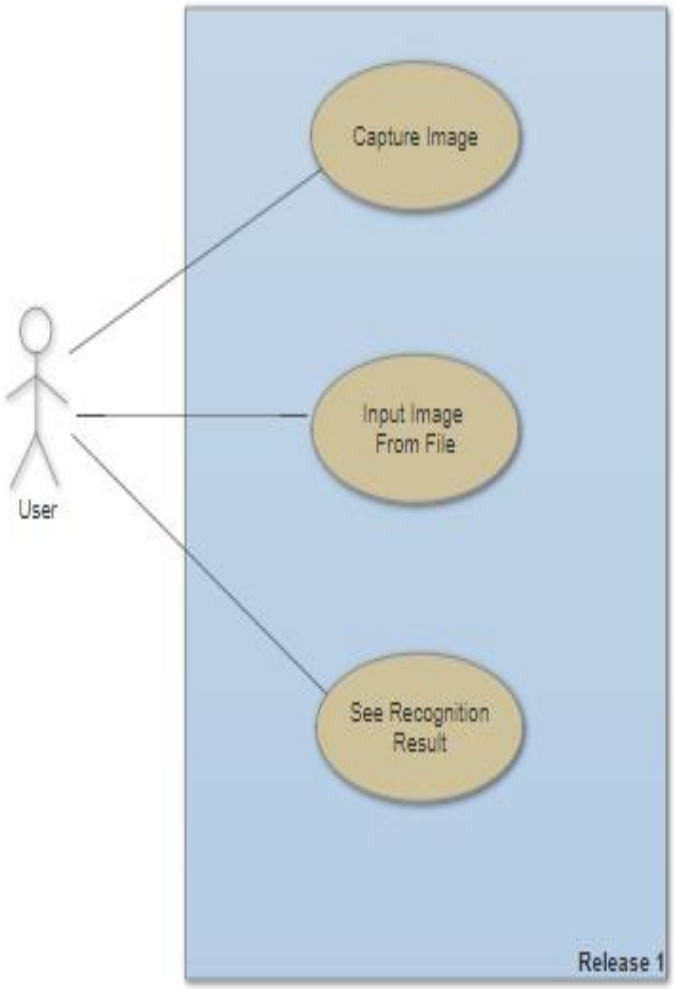


Fig. 2

2.5.2 Control Flow Diagram

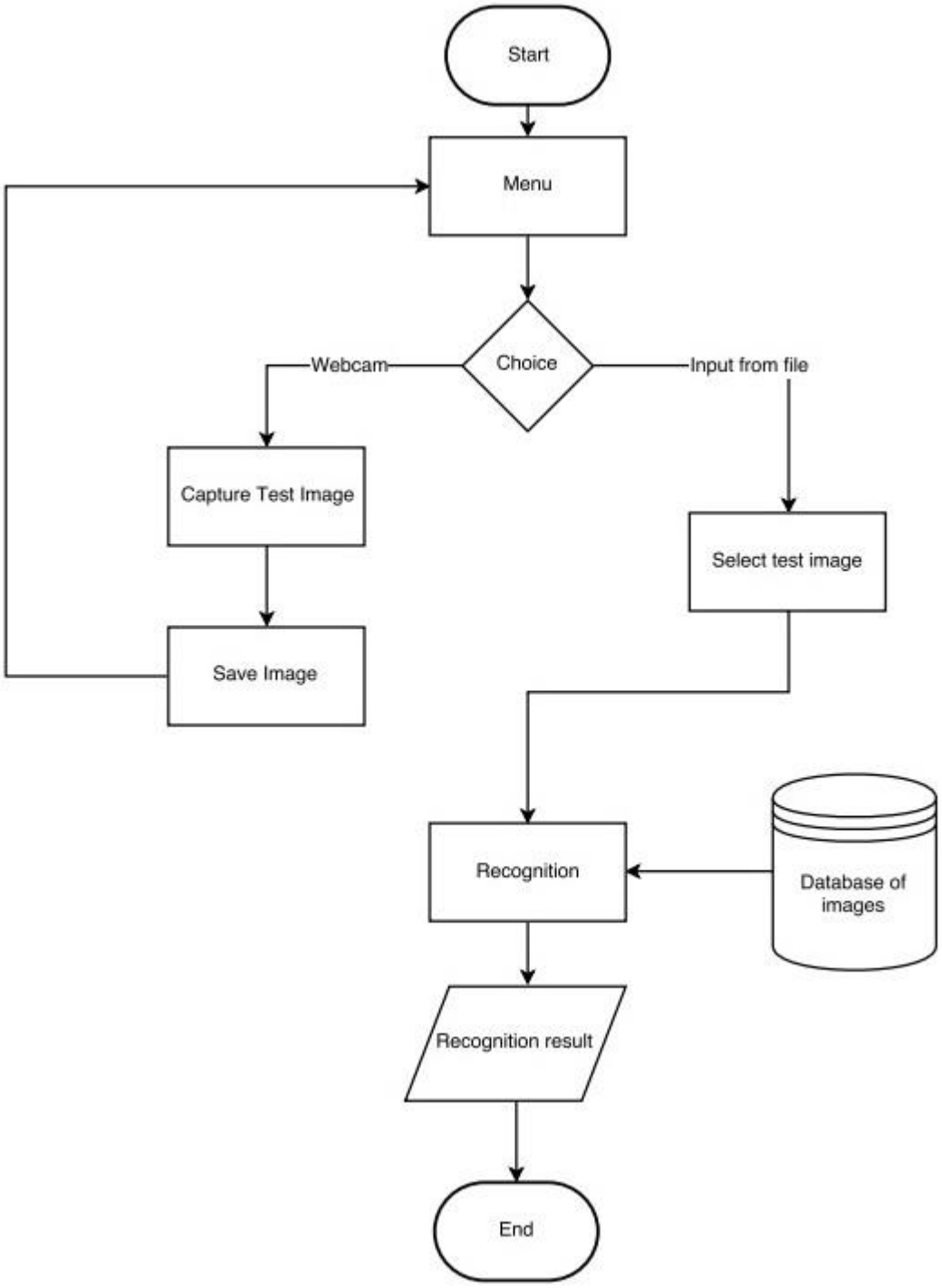


Fig. 3

2.4.3 Activity Diagram

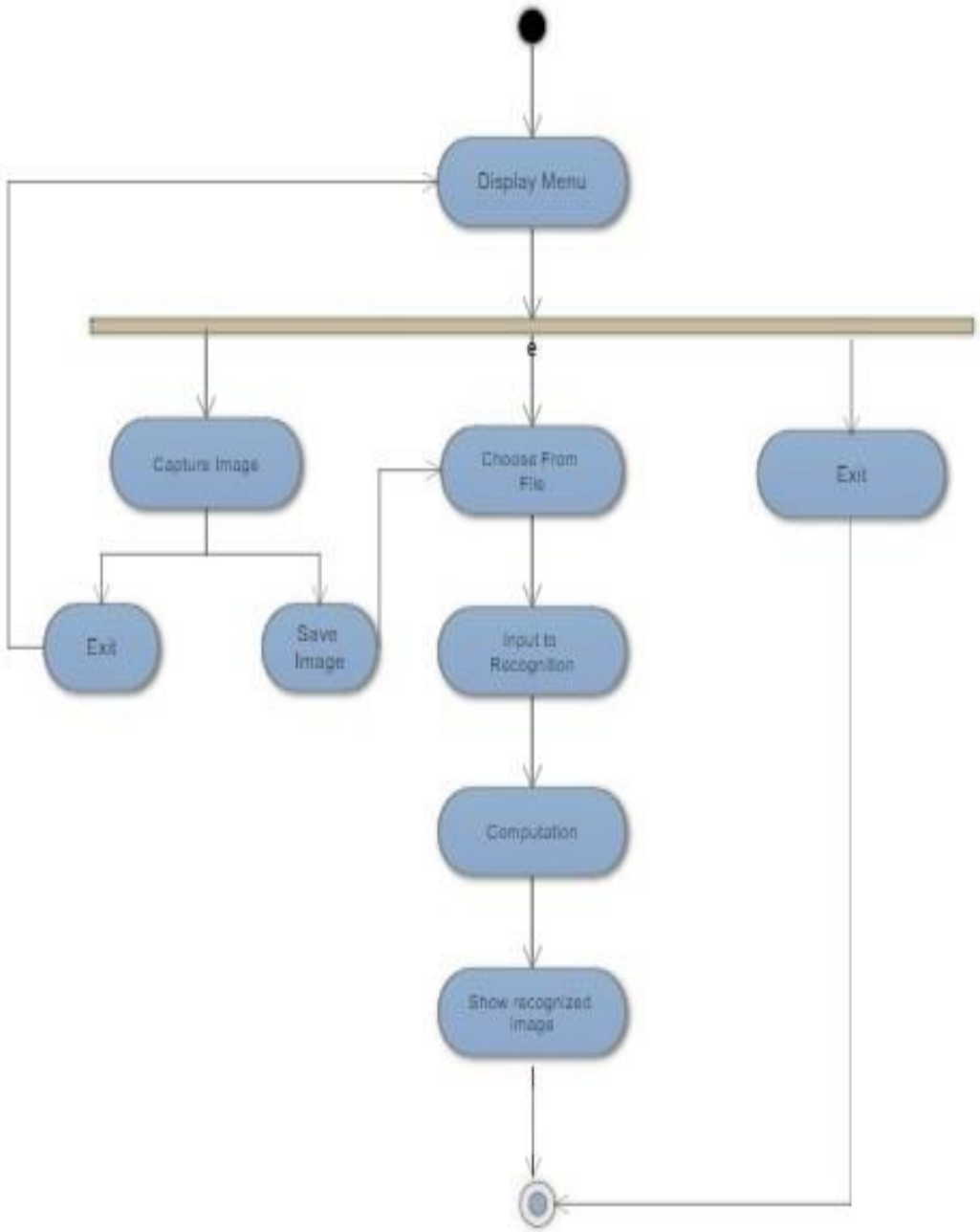


Fig. 4

2.4.4 Algorithm

The algorithm we have implemented is Principal Component Analysis. The algorithm is as follows:

1. Create Train Database.
2. Read the testing face image.
3. Compute covariance matrix of training images.
4. Compute eigenvalues and eigenvectors of the training images.
5. Calculate feature vector of test image.
6. Project the feature vector on eigenvector space of training images.
7. Calculate Euclidean distance between test feature vector and all the training feature vectors.
8. Find the face class with minimum Euclidean distance which shows similarity to test image.
9. Show the recognition result.

Chapter 3: Implementation and Testing

This section contains description of the implementation of the project, the problems faces while implementing and the testing and results of the project.

3.1 Implementation Details and Issues

The project is implemented on MATLAB. It is a 5-step process. Firstly, an image is acquired, either by using a camera or selecting an image from the file. Then the image is preprocessed. The image is converted to grayscale and it is resized to 128x128 pixels. Then the face is extracted and eigenvalues and eigen vectors are found. The image is matched with the images stored in the database and distance between them is found. The image which has the least distance from the input image is likely to be the recognized image.

There are certain issues we faced while implementation. We used a function to convert the image captured into a 128x128 sized picture. The image got converted but there was an extra padding added to all sides of the picture which increased the picture size to 300x271. Another issue we faced was when we had to install a MATLAB support package for webcam. For the webcam installed on our system, we had to find the accurate support package otherwise it continued showing an unexpected error which was very difficult to rectify as it was an 'Unknown error'.

3.2 Testing of implemented modules

We tested our project on various inputs. The tests and its results are stated below:

3.2.1 Test Case 1

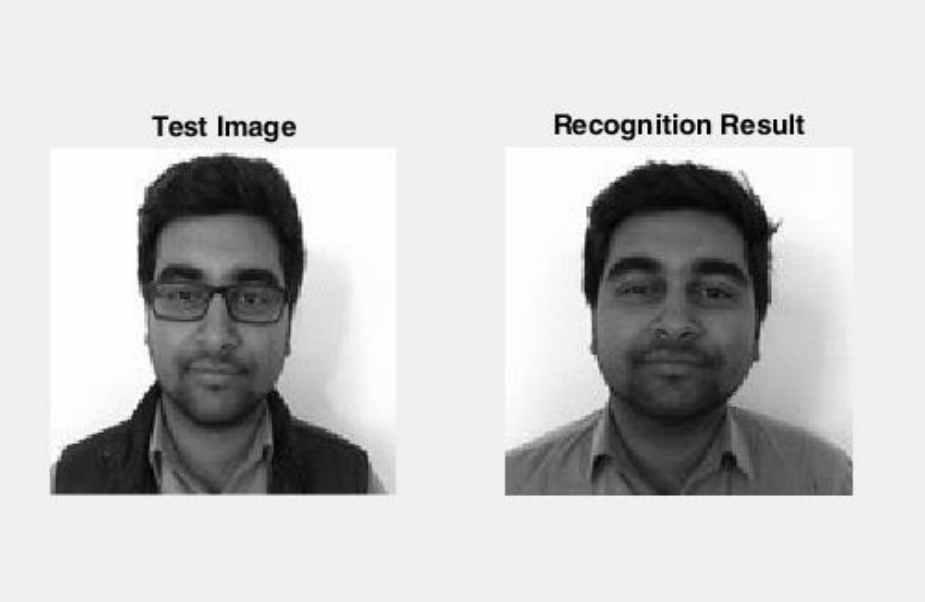
Input Image: Face with spectacles

Training Database: Images of different people including that face without spectacles.

Expected Output: Match the input image (with spectacles) with the corresponding database image (without spectacles)

Output: As expected. The person was recognized correctly. No problem was faced because of the spectacles.

Result: Pass



3.2.2 Test Case 2

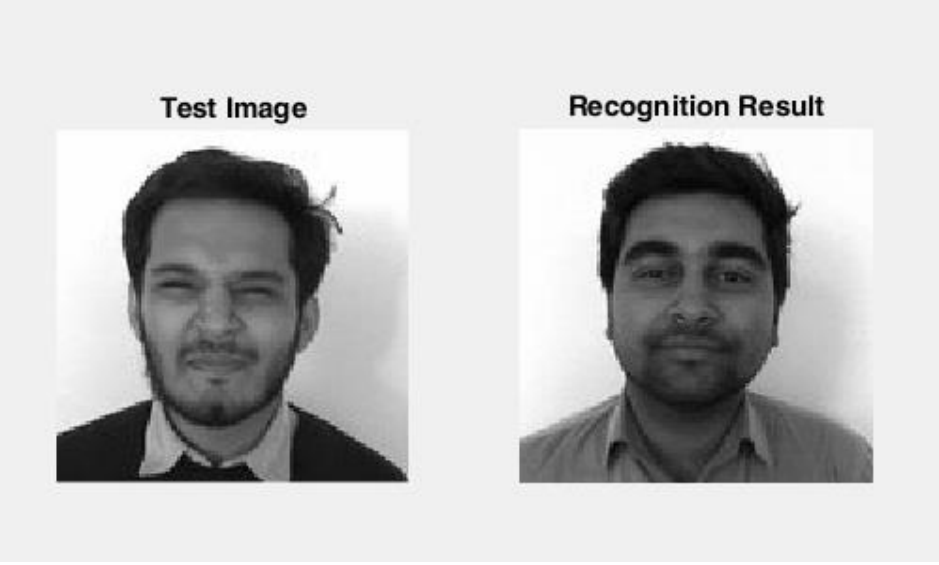
Input Image: Face with both eyes closed.

Training Database: Images of different people including that face with eyes open.

Expected Output: Match the input image (with eyes closed) with the corresponding database image (with eyes open).

Output: Not as expected. The person was not recognized correctly. The input image was matched with someone else's database image.

Result: Fail



3.2.3 Test Case 3

Input Image: Blank image with no face.

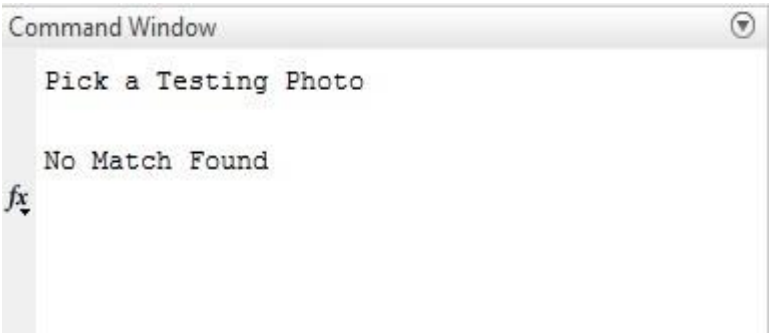
Training Database: Images of different people.

Expected Output: Shouldn't match with any image.

Output: As expected. No match found.

Result: Pass

Input Image



Output

Chapter 4: Findings and Conclusion

This section contains findings related to the algorithms used, conclusion of our project and future scope/work of the project.

4.1 Findings

During the implementation of the project, we found and analyzed certain things. It is very important to perform face detection before face recognition. If face recognition is done without face detection, the program matches a non-face image to a face image. Therefore, first facial detection should be done so that an image can be classified into a face or a non-face image. Also, we found that good lighting conditions improve the recognition process.

4.2 Conclusion

We proposed an attendance management system using facial recognition. Current automated attendance systems based on facial recognition are not entirely efficient. These systems are generally based on a single algorithm for facial recognition, but in our proposed solution we intend to increase the efficiency by using multiple algorithms. The result of our preliminary experimental work shows slight improvement over some systems.

4.3 Future Work

In future work, we intend to create an attendance system with improved face recognition effectiveness. We intend to make it a real time application which doesn't require human effort and which automatically updates attendance. To increase accuracy of the application, we will use an integrated approach that includes 3 algorithms: PCA, Voila Jones and Skin Colour Detection.

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