AN ENGINEERING PROJECT REPORT

On

Face Recognition Attendance System

Submitted By:

Mahesh Bhatt (190111)

Devraj Chaudhary (190144)

Sahil Poudel (190147)

Sandip Subedi (190148)

Submitted To:

The Department of Information and Communications Technology

in partial fulfillment of requirement for the degree of

Bachelor of Engineering in Information and Technology

Cosmos College of Management & Technology

(Affiliated to Pokhara University)

Tutepani, Lalitpur, Nepal

Date of submission:2080/06/07

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CERTIFICATE

The undersigned certify that they have read & recommended to the Department Information and Communications Technology, a project work entitled “Face Recognition Attendance System” submitted by (Mahesh Bhatt (1901111), Devraj Chaudhary (190144), Sahil Poudel (190147), Sandip Subedi (190148)) in partial fulfillment of the requirements for the degree of Bachelor of Engineering.

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ACKNOWLEDGEMENT

We would like to express our sincere special thanks to our Project Professor Dr.Baburam Dawadi, Head Department of IT and Computer Engineering Mr.Bibek Rupakheti who had given their valuable time and given us a chance to learn something, also we would like to thank our Asst. Professor & Deputy Head Department of Information and Communication Technology Er.Chirangibi Pandey for his support and help despite having a busy schedule and thanks to our respected teacher Er.Ranjan Raj Aryal for his great guidelines. Also we would thank all those people who gave us the golden opportunity to work in this wonderful project on the topic Face Recognition Attendance System, which we hope would help us in doing a lot of Research and let us to know about so many new things about existing technology and programming language, we would be really thankful to them.

Secondly, we would also like to thank my parents and friends who helped me a lot in finalizing this project topic and hope it will be completed in time.

ABSTRACT

The aim of this project proposal is to develop a face recognition attendance system that can efficiently track and record attendance in various settings such as educational institutions, workplaces, and events. The proposed system will leverage advanced computer vision techniques and machine learning algorithms to accurately identify individuals by analyzing their facial features.

Traditional attendance systems, such as manual sign-in sheets or card-based systems, are prone to errors, time-consuming, and can be easily manipulated. In contrast, the face recognition attendance system offers several advantages, including improved accuracy, convenience, and real-time monitoring.

The proposed system will consist of three main components: face detection, face recognition, and attendance management. The face detection module will be responsible for identifying and extracting faces from images or video streams. It will employ state-of-the-art algorithms to handle variations in lighting conditions, poses, and occlusions.

Overall, this project aims to develop an intelligent face recognition attendance system that will enhance attendance management and improve overall productivity. The successful implementation of this system will pave the way for a more advanced and reliable approach to attendance tracking, benefiting educational institutions, workplaces, and event organizers alike.

LIST OF FIGURES

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The traditional method of taking attendance in classrooms, offices, and other institutions involves using paper and pen, which can be tedious, time-consuming, and prone to errors. As technology has advanced, many schools and organizations are adopting automated attendance systems that utilize biometric identification techniques such as face recognition to take attendance. The Face Recognition Attendance System (FRAS) is one such system that uses facial recognition technology to record the attendance of individuals.

The FRAS is an innovative solution that provides a secure and efficient way of taking attendance. It eliminates the need for physical attendance registers, reduces the risk of errors, and saves valuable time for both teachers and students. This system works by capturing an image of the face of the individual, which is then matched with a pre-registered image in the database. Once the system confirms a match, it records the attendance of the individual.

This proposal aims to develop a Face Recognition Attendance System that will be used in educational institutions and workplaces to automate the attendance process. The proposed system will be designed to be user-friendly, cost-effective, and efficient. It will utilize modern computer vision and machine learning algorithms to ensure high accuracy and reliability. The system will also be customizable to meet the unique requirements of different organizations and will integrate with existing infrastructure seamlessly.

In this proposal, we will discuss the features, benefits, and implementation plan of the proposed FRAS. We will also provide an overview of the technology used, data security measures, and the ethical considerations involved in deploying such a system. Our goal is to demonstrate that the FRAS is a viable solution that can help institutions streamline their attendance processes, save time and resources, and improve overall productivity.

1.2 Problem Statements:

- The traditional method of taking attendance using paper and pen is time-consuming, prone to errors, and can be easily manipulated.
- Manual attendance records also require teachers or administrators to spend a considerable amount of time maintaining them.

- Contactless attendance systems are needed to ensure the safety and well-being of students and employees during the COVID-19 pandemic.
- Current attendance systems that use RFID or barcode scanners require physical contact, which increases the risk of transmission of the virus.
- Face recognition technology can accurately identify individuals based on their facial features and does not require physical contact.
- The proposed Face Recognition Attendance System aims to provide an accurate, efficient, and secure contactless solution.

1.3 Objective:

- To detect the face segment from the video frame.
- To extract the useful features from the face detected.
- To classify the features in order to recognize the face detected.
- To record the attendance of the identified student.

CHAPTER 2

LITERATURE REVIEW

2.1 Attendance System:

Arun Katara et al. (2017) mentioned disadvantages of RFID (Radio Frequency Identification) card system, fingerprint system and iris recognition system. RFID card system is implemented due to its simplicity. However, the user tends to help their friends to check in as long as they have their friend's ID card. The fingerprint system is indeed effective but not efficient because it takes time for the verification process so the user has to line up and perform the verification one by one. However for face recognition, the human face is always exposed and contain less information compared to iris. Iris recognition system which contains more detail might invade the privacy of the user. Voice recognition is available, but it is less accurate compared to other methods. Hence, face recognition system is suggested to be implemented in the attendance system.

Digital Image Processing:

Digital Image Processing is the processing of images which are digital in nature by a digital computer. Digital image processing techniques are motivated by three major applications mainly:

● Improvement of pictorial information for human perception

● Image processing for autonomous machine application

● Efficient storage and transmission.

Face Recognition

Face Recognition is a visual pattern recognition problem, where the face, represented as a three dimensional object that is subject to varying illumination, 13 pose and other factors, needs to be identified based on acquired images. Face Recognition is therefore simply the task of identifying an already detected face as a known or unknown face and in more advanced cases telling exactly whose face it is.

Steps in Digital Image Processing:

Digital image processing involves the following basic tasks:

● Image Acquisition - An imaging sensor and the capability to digitize the signal produced by the sensor.

● Preprocessing – Enhances the image quality, filtering, contrast enhancement etc.

● Segmentation – Partitions an input image into constituent parts of objects. 12

● Description/feature Selection – extracts the description of image objects suitable for further computer processing.

● Recognition and Interpretation – Assigning a label to the object based on the information provided by its descriptor. Interpretation assigns meaning to a set of labelled objects.

● Knowledge Base – This helps for efficient processing as well as inter module cooperation.

Local Binary Pattern Histogram

Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number.

It was first described in 1994 (LBP) and has since been found to be a powerful feature for texture classification.. Using the LBP combined with histograms we can represent the face images with a simple data vector.

LBPH algorithm work step by step:

LBPH algorithm work in 5 steps.

1. **Parameters:** the LBPH uses 4 parameters:

- **Radius:** the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.
- **Neighbors:** the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.
- **Grid X:** the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.
- **Grid Y:** the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.

2. **Training the Algorithm:** First, we need to train the algorithm. To do so, we need to use a dataset with the facial images of the people we want to recognize. We need to also set an ID (it may be a number or the name of the person) for each image, so the algorithm will use this information to recognize an input image and give you an output. Images of the same person must have the same ID. With the training set already constructed, let’s see the LBPH computational steps.

3. **Applying the LBP operation:** The first computational step of the LBPH is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. To do so, the algorithm uses a concept of a sliding window, based on the parameters radius and neighbors.

The image below shows this procedure:

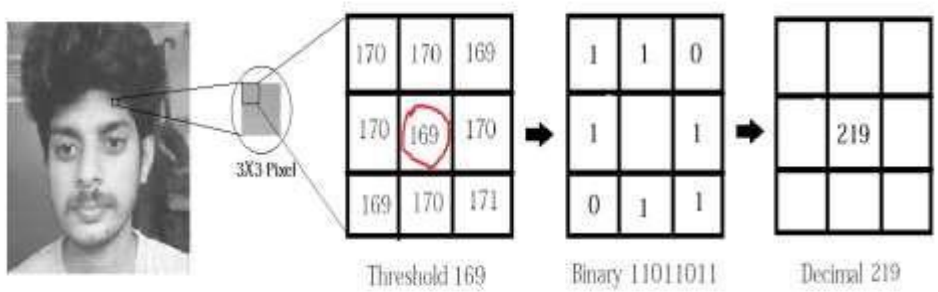


Figure 2.4: LBP Operation

Based on the image above, let’s break it into several small steps so we can understand it easily:

- Suppose we have a facial image in grayscale.
- We can get part of this image as a window of 3x3 pixels.
- It can also be represented as a 3x3 matrix containing the intensity of each pixel (0~255).
- Then, we need to take the central value of the matrix to be used as the threshold.
- This value will be used to define the new values from the 8 neighbors.
- For each neighbor of the central value (threshold), we set a new binary value. We set 1 for values equal or higher than the threshold and 0 for values lower than the threshold.
- Now, the matrix will contain only binary values (ignoring the central value). We need to concatenate each binary value from each position from the matrix line by line into a new binary value (e.g. 10001101). Note: some authors use other approaches to concatenate the binary values (e.g. clockwise direction), but the final result will be the same.
- Then, we convert this binary value to a decimal value and set it to the central value of the matrix, which is actually a pixel from the original image.
- At the end of this procedure (LBP procedure), we have a new image which represents better the characteristics of the original image.

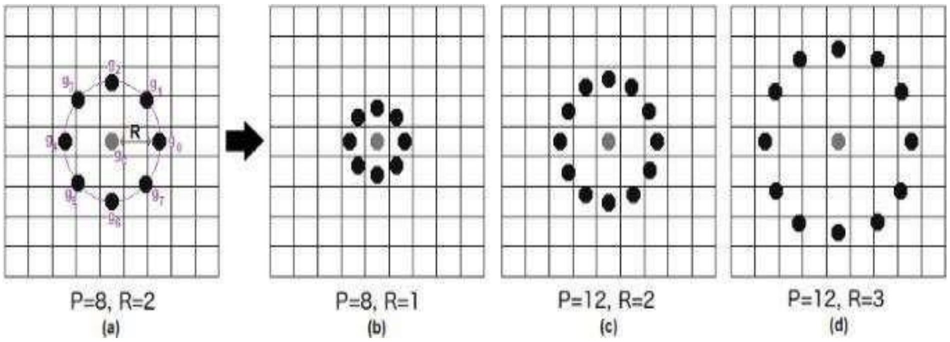


Figure 2.5: The LBP operation Radius Change

It can be done by using bilinear interpolation. If some data point is between the pixels, it uses the values from the 4 nearest pixels (2x2) to estimate the value of the new data point.

4.**Extracting the Histograms:** Now, using the image generated in the last step, we can use the Grid X and Grid Y parameters to divide the image into multiple grids, as can be seen in the following image:

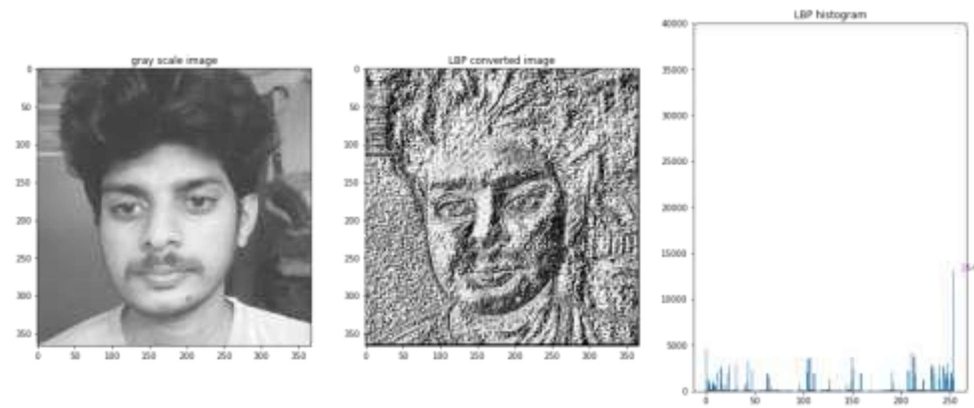


Figure 2.6: Extracting The Histogram

Based on the image above, we can extract the histogram of each region as follows:

- As we have an image in grayscale, each histogram (from each grid) will contain only 256 positions (0~255) representing the occurrences of each pixel intensity.
- Then, we need to concatenate each histogram to create a new and bigger histogram. Supposing we have 8x8 grids, we will have 8x8x256=16.384 positions in the final histogram. The final histogram represents the characteristics of the image original image.

5.**Performing the face recognition:** In this step, the algorithm is already trained. Each histogram created is used to represent each image from the training dataset. So, given an input image, we perform the steps again for this new image and creates a histogram which represents the image.

- So to find the image that matches the input image we just need to compare two histograms and return the image with the closest histogram.
- We can use various approaches to compare the histograms (calculate the distance between two histograms), for example: Euclidean distance, chi-square, absolute value, etc. In this example, we can use the **Euclidean distance** (which is quite known) based on the following formula:

$$D = \sqrt{\sum_{i=1}^{n}(hist1_i - hist2_i)^2}$$

- So the algorithm output is the ID from the image with the closest histogram. The algorithm should also return the calculated distance, which can be used as a 'confidence' measurement.
- We can then use a threshold and the 'confidence' to automatically estimate if the algorithm has correctly recognized the image. We can assume that the algorithm has successfully recognized if the confidence is lower than the threshold defined.

Advantages of using LBPH:

- Easy access in opencv library.
- Robustness to Illumination Variations.
- Computational Efficiency
- Dimensionality Reduction
- Availability of Training Data

Haar-Cascade Algorithm:

The Haar cascade algorithm is a popular method for face detection in computer vision. Here are some important points to understand about the Haar cascade algorithm for face detection:

- Haar Features: The algorithm uses Haar-like features to identify regions of an image that are likely to contain faces. Haar features are simple rectangular filters that compute the difference between the sum of pixel intensities in adjacent rectangular regions.

- Integral Images: To efficiently compute Haar-like features, the algorithm uses integral images. Integral images allow for fast calculation of the sum of pixel intensities within any rectangular region of an image.
- Training: The Haar cascade algorithm is a machine learning-based approach. It requires training a cascade classifier using a large dataset of positive and negative examples. Positive examples are images containing faces, while negative examples are images without faces.
- Cascade Classifier: The training process of the Haar cascade algorithm results in a cascade classifier, which is a collection of weak classifiers organized in stages. Each stage consists of several weak classifiers that progressively filter out regions that are unlikely to contain faces, thereby reducing false positives.
- Adaboost: The algorithm employs the AdaBoost (Adaptive Boosting) algorithm to select the most informative features and weight them accordingly. AdaBoost assigns higher importance to misclassified examples in each iteration, allowing the algorithm to focus on challenging regions for improved accuracy.
- Sliding Window: During the detection phase, the Haar cascade algorithm uses a sliding window approach. It scans the image at different scales and positions, applying the cascade classifier to each window to determine if it contains a face.
- False Positive Reduction: The cascade classifier is designed to minimize false positives by efficiently rejecting non-face regions early in the detection process. This is achieved by setting different thresholds at each stage of the classifier, with more complex features being evaluated only on regions that pass previous stages.
- Performance Trade-off: The Haar cascade algorithm offers a trade-off between detection accuracy and computational efficiency. By employing a cascade of classifiers and early rejection of non-face regions, it can process images quickly but may occasionally miss detecting faces or produce false positives.
- OpenCV Implementation: The Haar cascade algorithm is commonly implemented using computer vision libraries such as OpenCV. OpenCV provides pre-trained Haar cascade classifiers for face detection, making it easy to integrate this functionality into various applications

CHAPTER 3
REQUIREMENT ANALYSIS

3.1 Feasibility study:

The purpose of this feasibility study is to assess the viability and potential success of implementing a Face Recognition Attendance System within an organization. The system aims to automate the attendance tracking process by utilizing facial recognition technology, eliminating the need for manual attendance taking methods. This study will evaluate the technical, economic, and operational aspects of the proposed project.

Technical Feasibility:

a. Facial Recognition Technology

b. Hardware and Software Requirements

c. Data Security and Privacy

Economic Feasibility:

a. Cost-Benefit Analysis

b. Return on Investment (ROI)

Operational Feasibility:

a. User Acceptance

b. System Scalability

c. Training and Support

3.2 System Requirements:

3.2.1.Hardware Requirement

- Laptop or PC
- Windows 7 or higher
- I3 processor system or higher
- 4 GB RAM or higher
- 100 GB ROM or higher

3.2.2.Software Requirement

1. Python
2. Sublime text Editor/py-charm/vs-code
3. OpenCV: We used OpenCV dependency for python . OpenCV is library where there are lots of image processing functions are available. This is very useful library for image processing. Even one can get expected outcome without writing a single code. The

library is cross-platform and free for use under the open-source BSD license. Example of some supported functions are given bellow:

- Derivation: Gradient/Laplacian computing, contours delimitation
- Hough transforms: lines, segments, circles, and geometrical shapes detection
- Histograms: computing, equalization, and object localization with back projection algorithm
- Segmentation: thresholding,distance transform,foreground/background detection, watershed segmentation
- Filtering: linear and nonlinear filters, morphological operations
- Cascade detectors: detection of face, eye, car plates
- Interest points: detection and matching
- Video processing: optical flow, background subtraction, camshaft (object tracking)
- Photography: panoramas realization, high definition imaging (HDR), image inpainting

Python

Sublime text Editor/py-charm/vs-code

3.3 Functional Requirements:

1. User Registration:

a. The system should allow administrators to register employees or users with their relevant information, such as name, employee ID, and department.

2. Face Enrollment:

a. The system should capture and store facial images of users during the enrollment process.

3. Face Recognition:

a. The system should be capable of recognizing and identifying registered users based on their facial features.

4. Attendance Tracking:

a. The system should automatically record the attendance of users when their faces are recognized.

5. User Management:

a. Administrators should have the ability to add, edit, or delete user information and enrollment data.

CHAPTER 4
METHODOLOGY

Methodology for a Project Proposal of Face Recognition Attendance System:

1. Identify Requirements:

a. Conduct meetings and interviews with key stakeholders to understand the organization's attendance tracking needs, existing processes, and pain points.

b. Define the specific goals and objectives of implementing a Face Recognition Attendance System, such as improving efficiency, accuracy, and reducing administrative workload.

2. Research and Evaluation:

a. Conduct a thorough market research to identify available face recognition technologies, algorithms, and systems.

b. Evaluate the technical feasibility and compatibility of different face recognition solutions with the organization's infrastructure.

3. Define System Requirements:

a. Based on the identified organizational requirements and research findings, create a comprehensive list of functional and non-functional requirements for the system.

b. Specify the hardware components (e.g., cameras, servers) and software requirements (e.g., operating systems, databases) necessary for the system's implementation.

4. Design and Development:

a. Create a system architecture and design that incorporates the chosen face recognition technology and fulfills the identified requirements.

5. Testing and Validation:

a. Conduct rigorous testing of the developed system to ensure its accuracy, reliability, and compatibility with different environmental conditions.

6. Implementation and Deployment:

a. Plan the deployment strategy, considering factors such as user training, data migration, and system rollout.

7. Monitoring and Maintenance:

a. Establish a monitoring mechanism to track system performance, including recognition accuracy, attendance record integrity, and system availability.

8. Evaluation and Feedback:

a. Periodically evaluate the system's performance and its impact on the organization's attendance tracking process.

4.1 Software Process Model (Incremental Model):

Incremental Model is a process of software development where requirements divided into multiple standalone modules of the software development cycle. In this model, each module goes through the requirements, design, implementation and testing phases. Every subsequent release of the module adds function to the previous release. The process continues until the complete system achieved. The various phases of incremental model are as follows:

• Requirement analysis: In the first phase of the incremental model, the product analysis expertise identifies the requirements. And the system functional requirements are understood by the requirement analysis team. To develop the software under the incremental model, this phase performs a crucial role. • Design and Development: In this phase of the Incremental model of SDLC, the design of the system functionality and the development method are finished with success. When software develops new practicality, the incremental model uses style and development phase.

• Testing: In the incremental model, the testing phase checks the performance of each existing function as well as additional functionality. In the testing phase, the various methods are used to test the behavior of each task.

• Implementation: Implementation phase enables the coding phase of the development system. It involves the final coding that design in the designing and development phase and tests the functionality in the testing phase. After completion of this phase, the number of the product working is enhanced and upgraded up to the final system product This model is used When the requirements are superior, A project has a lengthy development schedule, When Software team are not very well skilled or trained, and When the customer demands a quick release of the product.

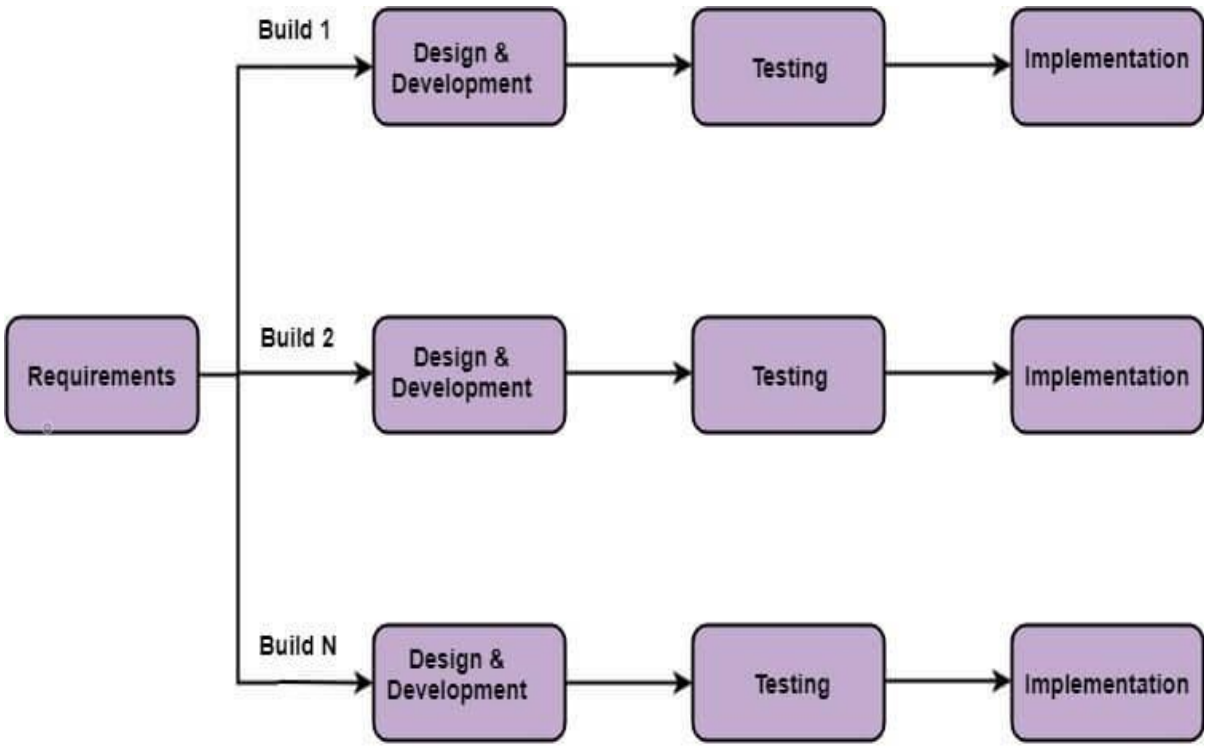
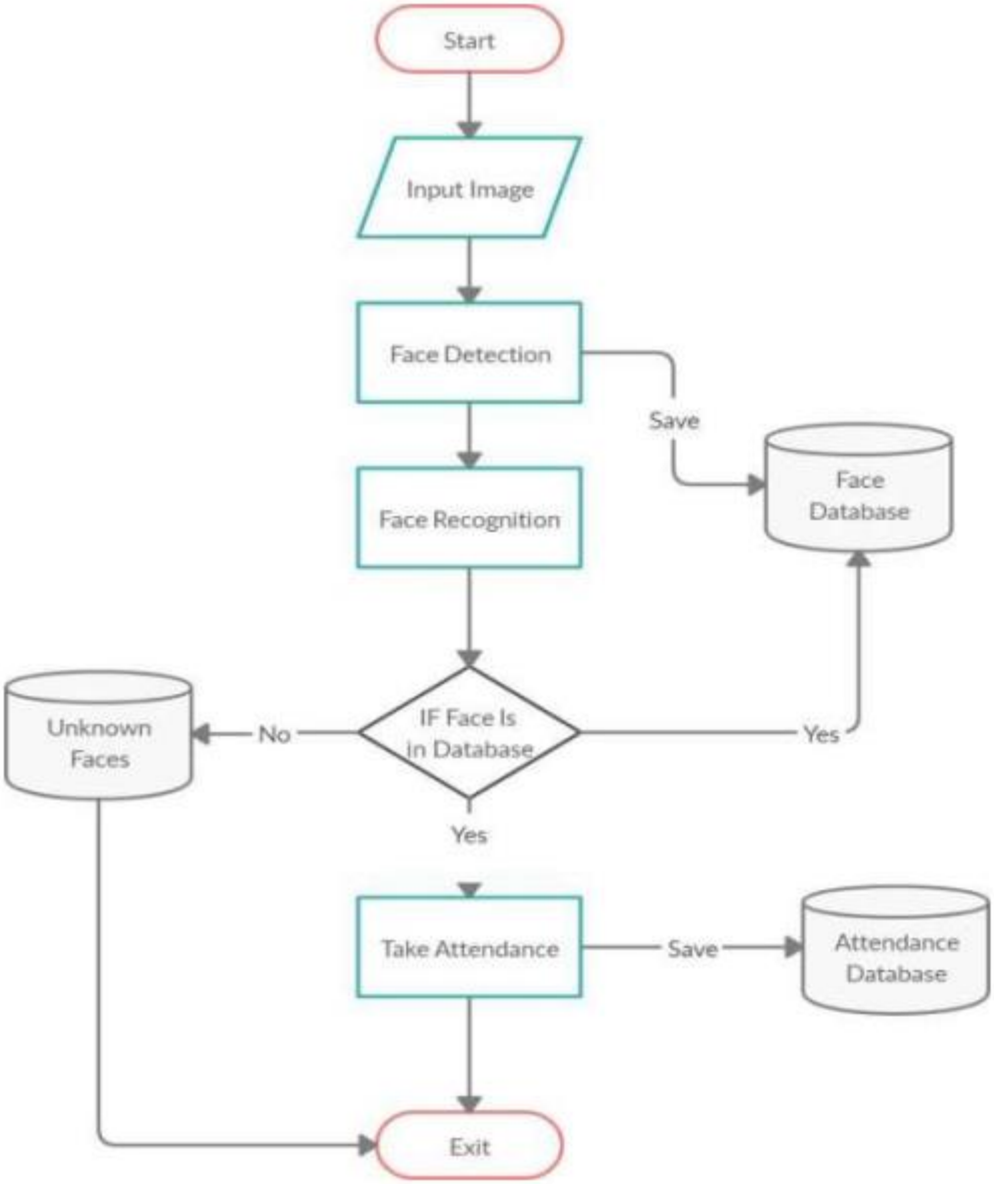


Fig: Incremental Software Process Model

4.2 FLOWCHART:



4.3 ACTIVITY DIAGRAM:

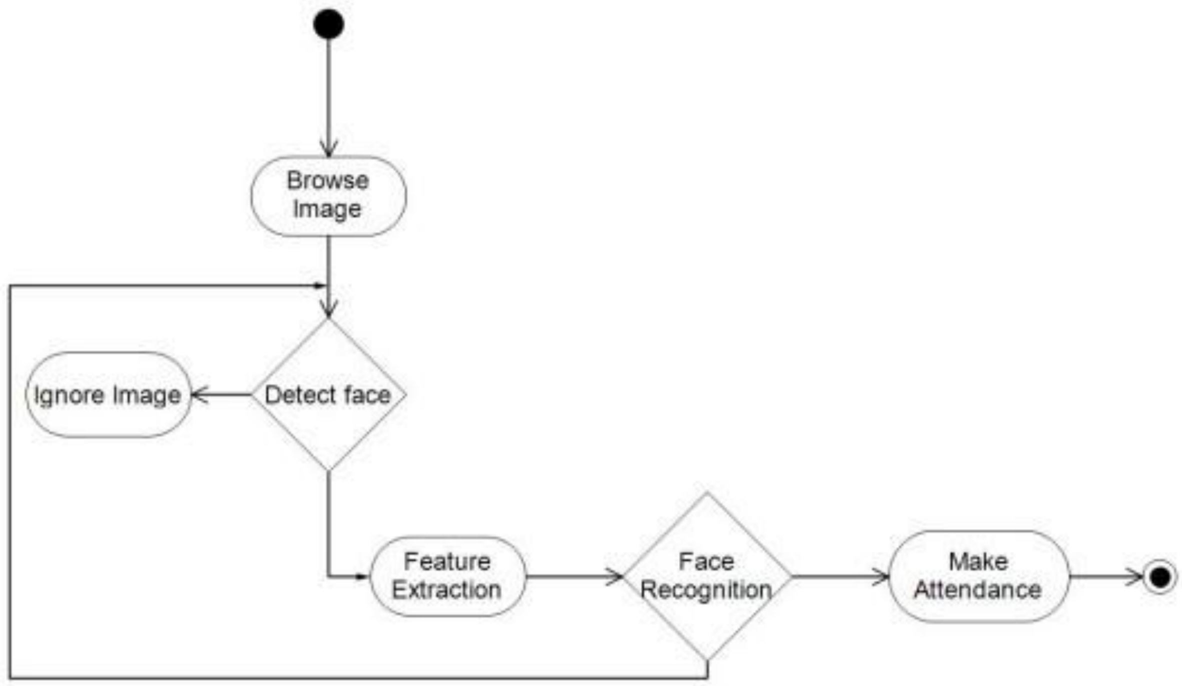


Fig: Activity Diagram of FRAS

4.4 USE CASE DIAGRAM

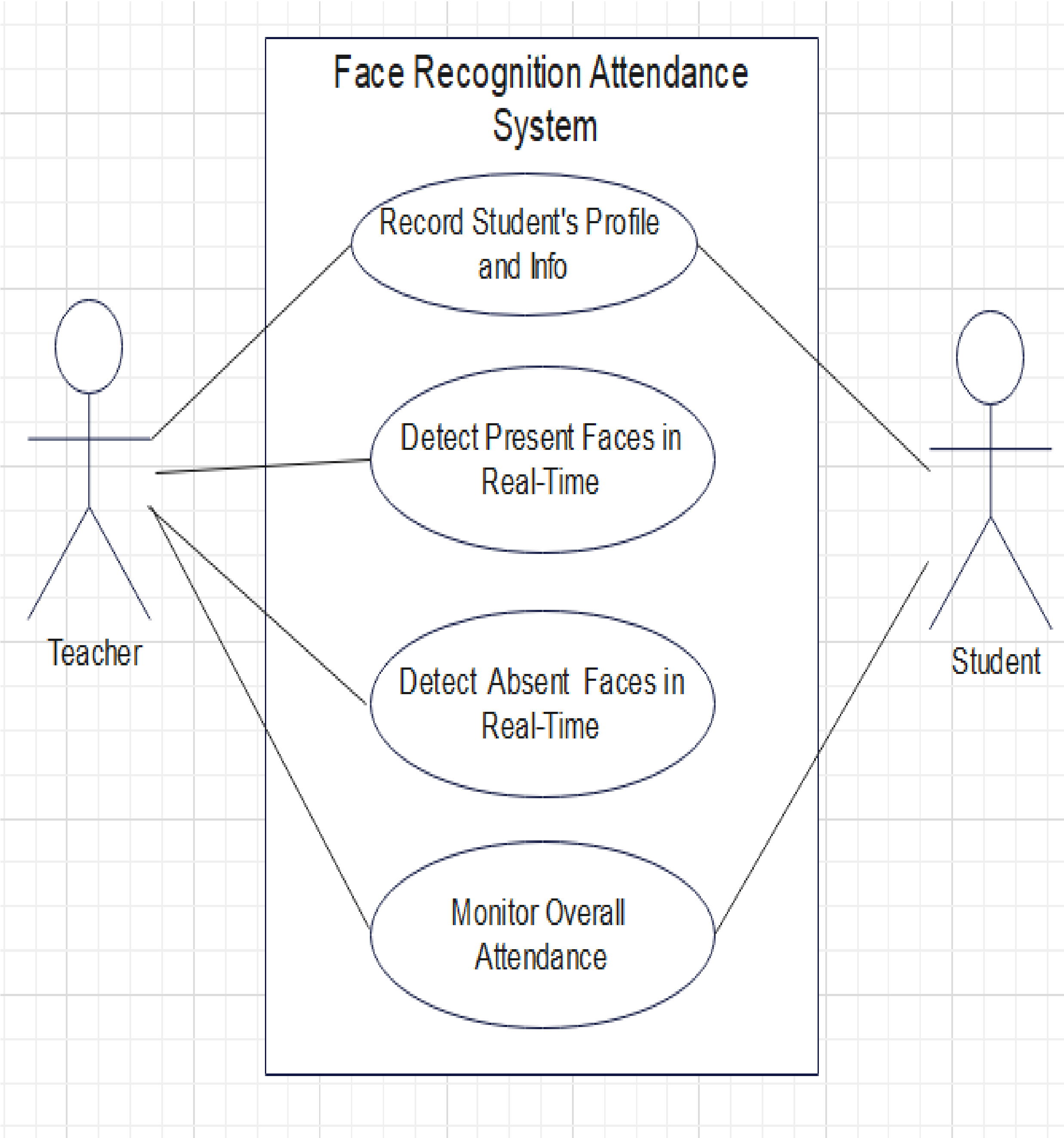


Fig: Use Case Diagram of Face Recognition Attendance System

4.5 ER-diagram

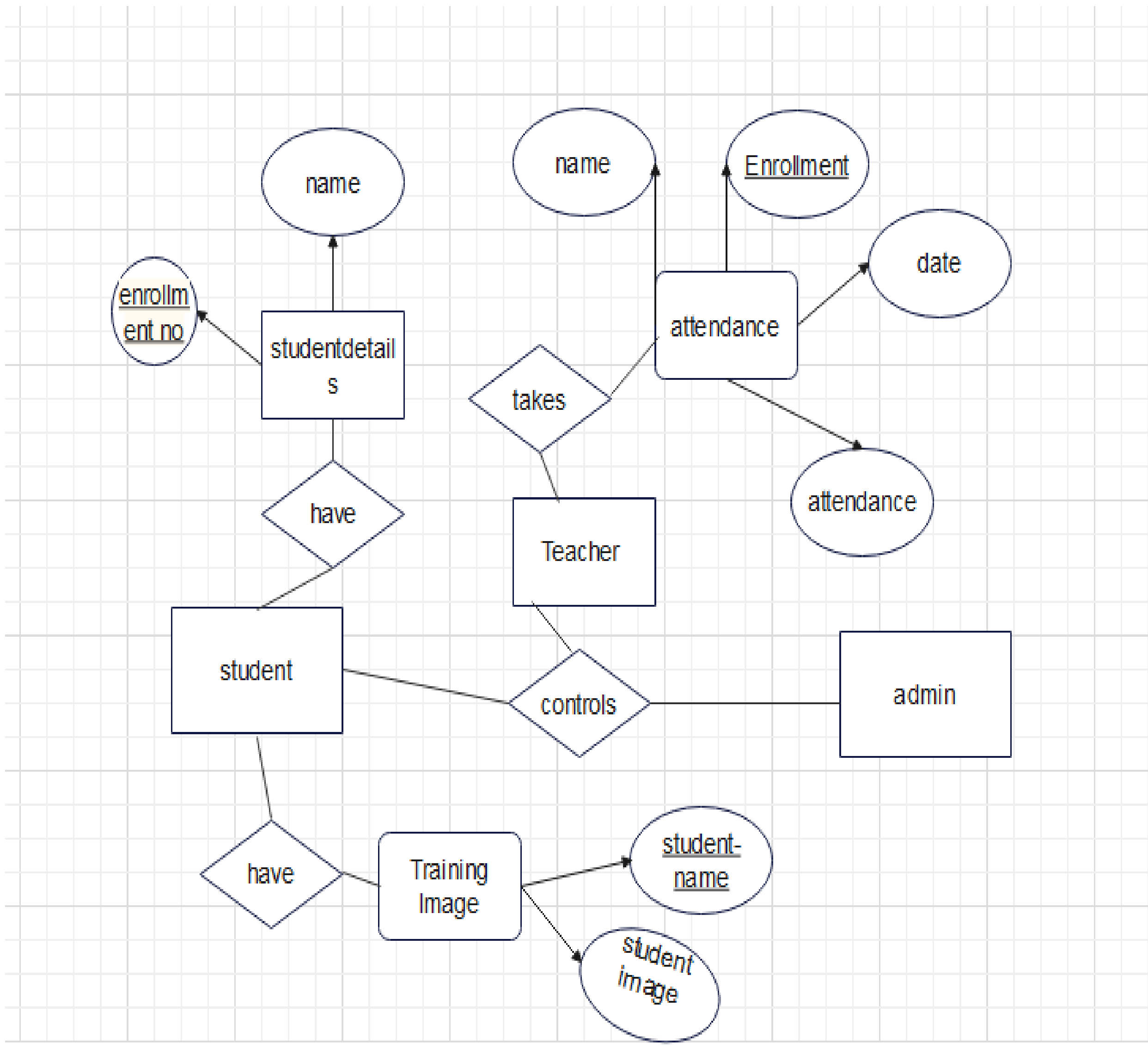


Fig: Er diagram of Face Recognition Attendance System

CHAPTER 5
RESULTS AND DISCUSSION

EXPERIMENTAL RESULTS:

Error occurs in testing 10 student image

- Illumination Variations
- Pose Variations
- Occlusions and Partial Face Coverage
- Similar Facial Features
- Limited Training Data

Taking 50 samples as a training dataset

The number of samples in the training dataset should be determined based on the following considerations:

- Limited Training Data
- Overfitting and Generalization
- Data Quality

In practice, the number of samples in the training dataset for LBP can vary widely. Some studies may use a few hundred samples, while others may use thousands or more. It is recommended to experiment with different sample sizes, evaluate the algorithm's performance using validation or testing datasets, and select a sample size that achieves the desired trade-off between accuracy, computational efficiency, and generalization.

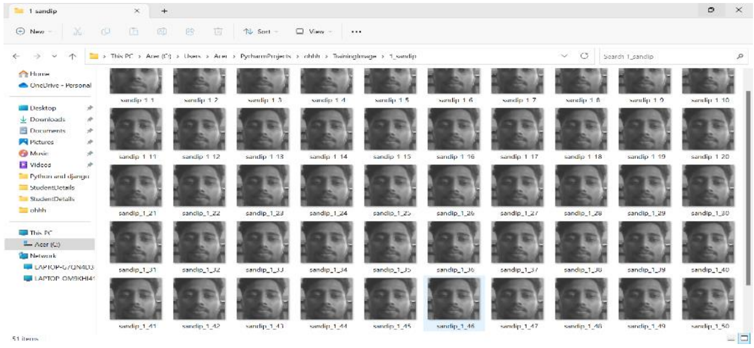


Fig: Dataset sample

Face Orientations	Detection Rate	Recognition Rate
0º (Frontal face)	98.7 %	95%
18º	80.0 %	78%
54º	59.2 %	58%
72º	0.00 %	0.00%
90º(Profile face)	0.00 %	0.00%

Fig: Experimental result

We performed a set of experiments to demonstrate the efficiency of the proposed method. 30 different images of 10 persons are used in training set. Figure 3 shows a sample binary image detected by the ExtractFace() function using Paul-Viola Face extracting Frame work detection method.

CHAPTER 6
LIMITATION AND FUTURE ENHANCEMENTS

6.1 Limitations

1. Our project is only applicable for certain number of peoples.

2. Camera quality can affect the accuracy for recognizing.

3. To detect a face, the candidate must be in an area with light; otherwise, it will not be able to detect it.

6.2 Future Enhancements

1. This project can be upgraded to many number of peoples.
2. Instead of taking the attendance of single person we can extend the system to take the attendance by cctv when the employee enters the office.
3. Can build in fully web based system.
4. Can use neural network for high accuracy.

CHAPTER 7

TIME SCHEDULE

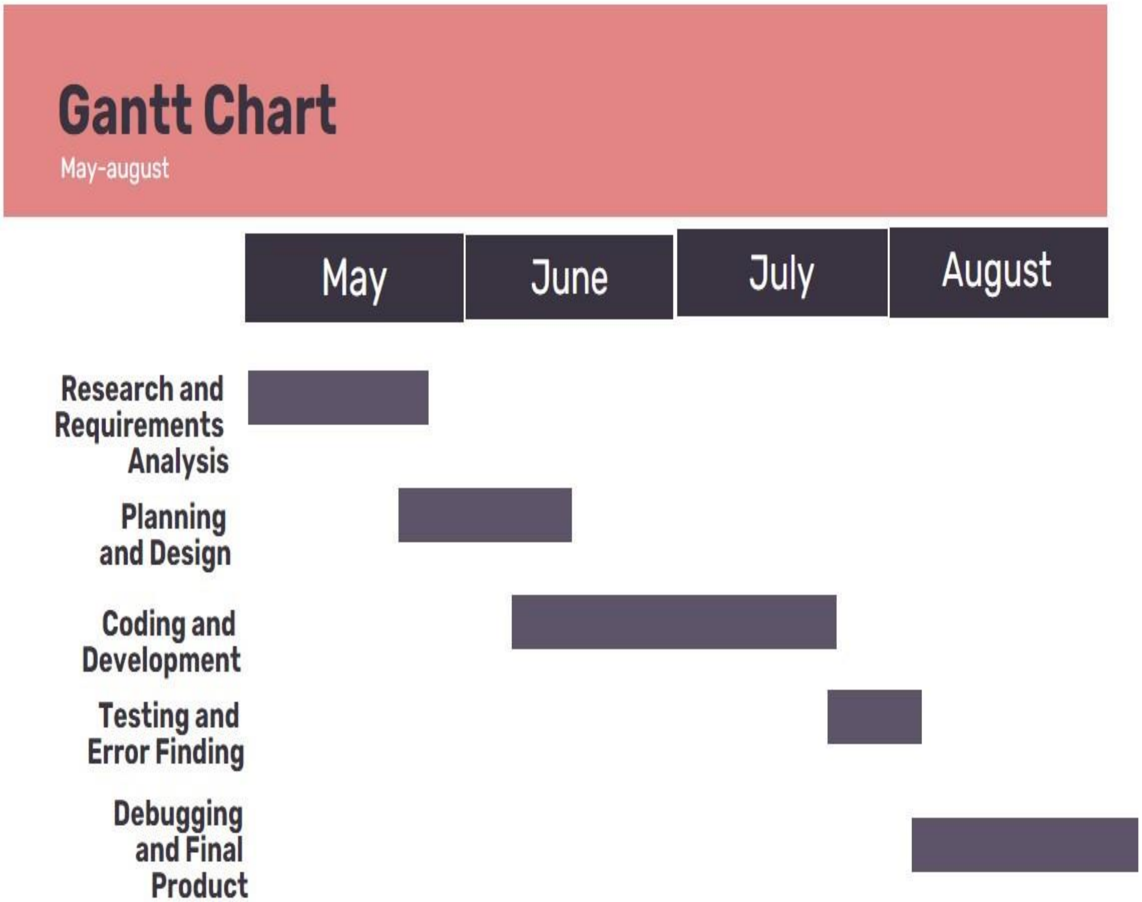


Fig: Gantt chart

CHAPTER 8

CONCLUSIONS

The project Face Recognition Attendance System is in the initial phase with the basic functionality discussed before. The purpose of the project attendance monitoring with face recognition is to minimize the errors that occur in the traditional attendance taking system. This project is mainly built using machine learning which exhibits robustness in face recognition of the person with greater accuracy. Current work is focused on the face detection algorithms from images or video frames. The aim is to automate and make a system that is useful to the organization such as an institute. The efficient and accurate method of attendance in the office environment that can replace the old manual methods. This method is secure enough, reliable and available for use. Proposed algorithm is capable of detect multiple faces, and performance of system has acceptable good results.

CHAPTER 9

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APPENDIX

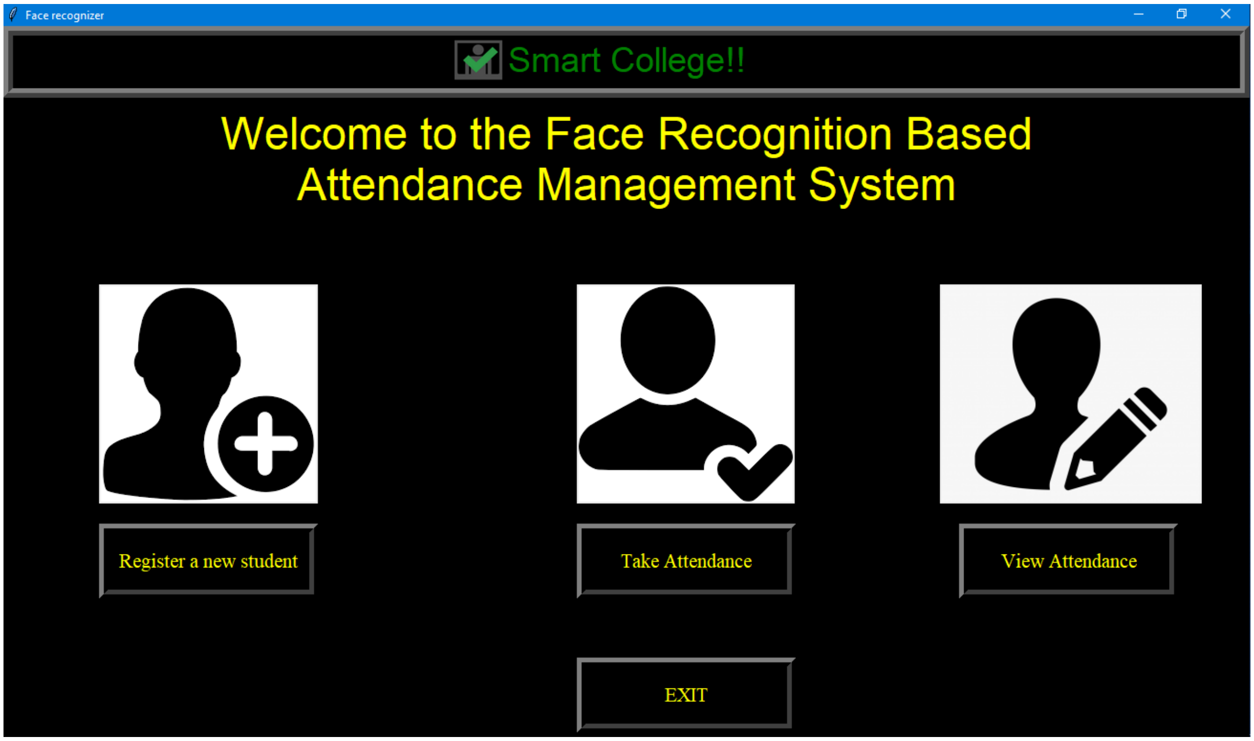

Fig:Home Page

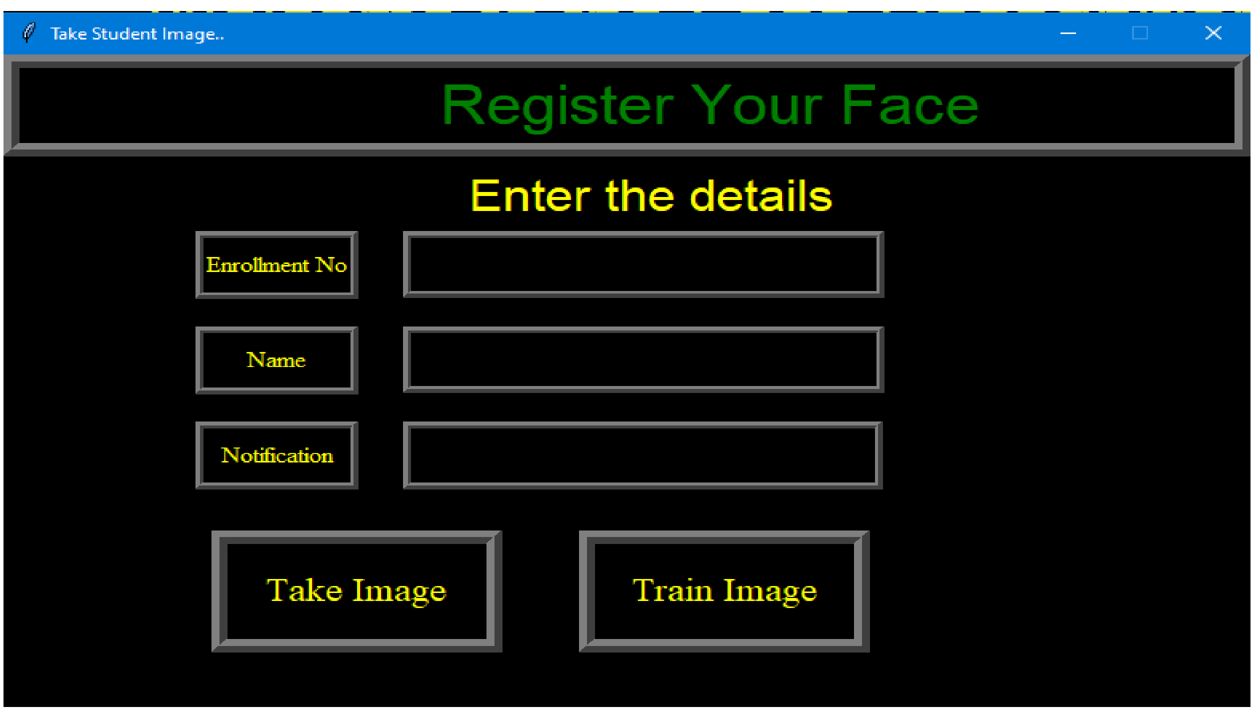

Fig:Registering Face

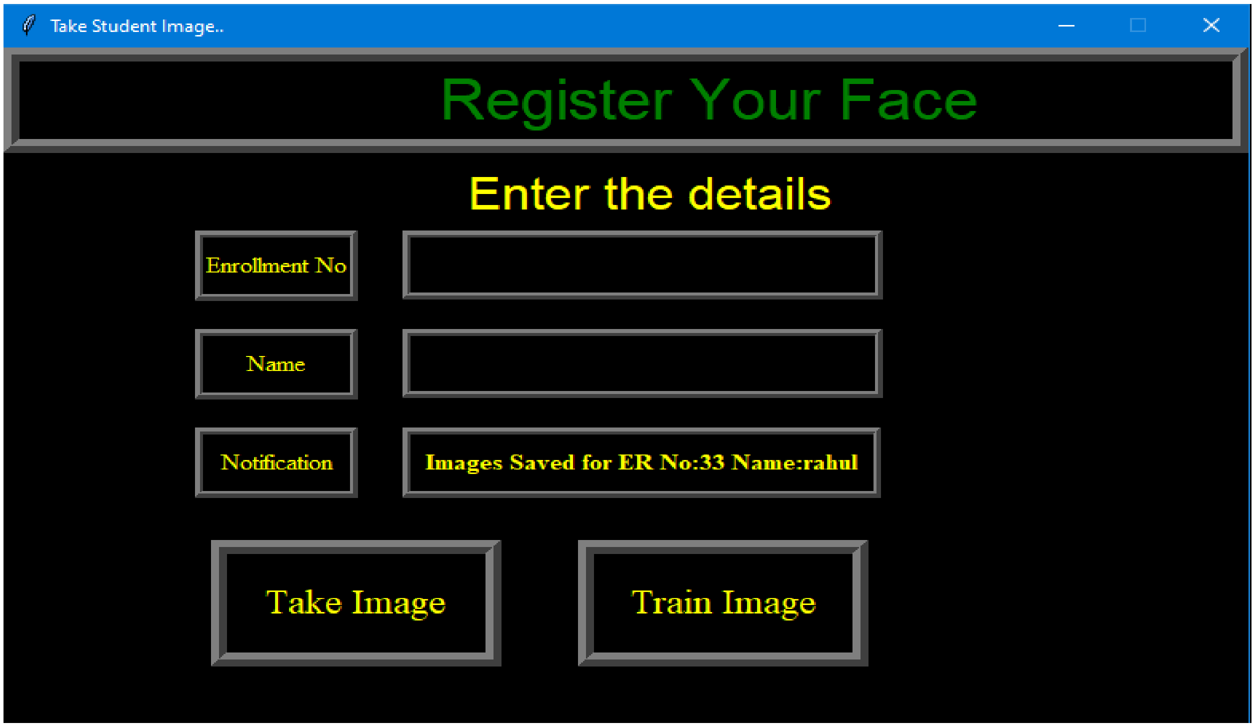

Fig:Training Face

Attendance of ai

Enrollment	Name	2020-05-26	2020-05-27	Attendance
33	['rahul']	1.0	1.0	100.0
34	['shivani']	1.0	0.0	50.0
35	['tirth']	1.0	0.0	50.0
4	['himanshu']	1.0	0.0	50.0
25	['harsh']	1.0	0.0	50.0
36	['umang']	0.0	1.0	50.0
37	['vishwa']	0.0	1.0	50.0
38	['vatsal']	0.0	1.0	50.0
17	['angith']	0.0	1.0	50.0
9	['krunal']	0.0	1.0	50.0

Fig:Attendance

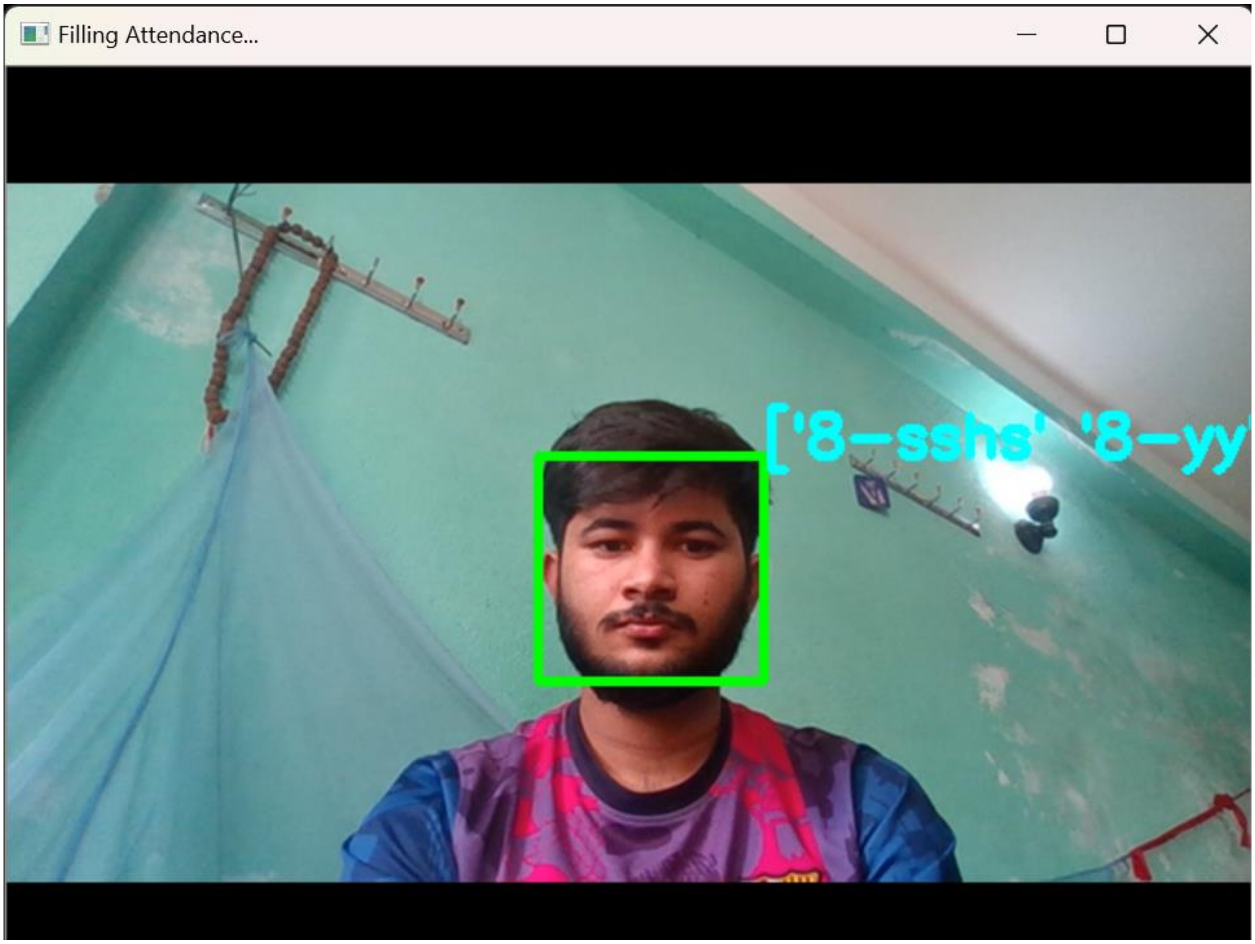

Fig:Taking Attendance