Automated Classroom Attendance System

Project

Done
By

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Abstract

The face of a human is crucial for conveying identity. Computer scientists, Neuro scientists, and psychologists, all exploits this human feature using image processing techniques for commercial, and law enforcement applications. Likewise, this feature can be invited into classrooms to maintain records of students' attendance. Con- temporary traditional way of recording attendance involves human intervention and requires cooperation of the students which is hectic and contribute towards waste of class time. An automated real-time classroom attendance system detects students from still image or video frame coming from a digital camera, and marks his/her attendance by recognizing them. The system utilizes Viola–Jones object detection framework which is capable of processing images extremely rapidly with high detection rates. In the next stage, the detected face in the image is recognized using Local Binary Patterns Histogram.

Keywords– Computer vision; face detection; face recognition; feature extraction; image processing; Local Binary Patterns Histogram; object detection; Viola-Jones object detection.

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Chapter 1

Introduction

Human face is crucial for conveying identity. This human feature can be exploited to be applied in large number of real life activities like tracking employees, surveillance of criminals, finding information about celebrities and much more. But face is a dynamic object and has a high degree of variability in its appearances. For computer to be able to understand this variability in appearances of human face, face detection and face recognition methods have been introduced. These domains, over the past several years has received significantattentionandareincreasinglyusedtosolve complex human problems.

Maintenance of attendance records play a vital role in the analysis of performance of any organization. Every institute has their own method of monitoring attendance of students or staffs. In the classroom, the traditional way of marking attendance involves a human calling out the name of the students individually. This contemporary attendance marking method is hectic and time consuming, as usually 5-10 minutes is required to record the attendance, which is a wastage of useful class time . Furthermore, this traditionalattendance system is not secure altogether as it can be manipulated and altered on the wish of some naughty factors.

An automated real-time classroom attendance system performs the daily activities of attendance marking with reduced human intervention. This system based on

face detection and recognition automatically detect students' faces from still image or video frame coming from a digital camera, and marks his/her attendance by recognizing them.

1.1 Problem Statement

The main problem with the traditional attendance system is that it is subject to manipulation and there remains chances of human error during data entry. Though it is easier to implement and saves technology expenses, the organization cannot benefit from the innovations of data analysis which has huge implications. In addition to this, contemporary attendance method at classroom requires human intervention and cooperation from students which contribute towards wastage ofprecious class time.

1.2 Project Objectives

Considering the needs and challenges aforementioned, this project aims to accomplish the following:

1. Accurately match detected students faces to those on the database.
2. Develop an intuitive user interface for navigation of functionalities within system.

1.3 Motivation:-

The project focuses on marking attendance based on face detection and recognition techniques, and storing the result in a database system that allows efficient retrieval of attendance data whenever required. Due to scope of project and time constraint, this system is not able to address many of the management features such as report generation that are desired in the attendance 'management' system. The developed system requires a student to stand in a predefined area to maximize the detection and recognition rate which can still be a little hectic process.

1.4 Scope and Limitations

The project focuses on marking attendance based on face detection and recognition

techniques, and storing the result in a database system that allows efficient retrieval of attendance data whenever required. Due to scope of project and time constraint, this system is not able to address many of the management features such as report generation that are desired in the attendance 'management' system. The developed system requires a student to stand in a predefined area to maximize the detection and recognition rate which can still be a little hectic process.

1.5 Report Organization

This document presents the workflow for the realization ofthe classroomattendance system and it is organized into five chapters. This introductory chapter explains problem statement, objectives, significance, and scope and limitation of the project.

Chapter 2 summarizes studieson prior works in the field of attendance system.

It highlights how attendance system has evolved over time and major technological innovations facilitating the system in present days.

Chapter 3 provides an account of tools and frameworks that are used for development of the system.

Chapter 4 presents brief summaries about the system implementation. It highlights how different tools and frameworks discussed in chapter 3 are utilized.

Chapter 5 highlights the deliverables and schedule of the project.

Finally, chapter 6 is the conclusion. Further work that can be done to extend the present systems are also explained.

Chapter 2 LiteratureReview

Traditionally student attendance in institutes is taken manually on attendance sheets. This is not a very efficient method because it is susceptible to proxy attendance of absent students. This paper implements an Automatic Attendance System based on face recognition that marks the presence of students by detecting their faces against its trained set, from the image of everyone sitting in the classroom. Camera fixed in the classroom captures the faces of everyone present there and submits those images to this system, which then processes them to detect and identify individual faces and mark their attendance for that class in the master database. Haar Cascade classifier has been used to detect faces by capturing features on the images like eye, nose etc. This system is accurate and prevents any fake attendance. The proposed method is evaluated against principal component analysis (PCA) and other techniques like the local binary patterns histogram (LBPH). It is observed that the accuracy of the proposed system is better than those of the latter ones

S. Kumar, S. Varun, S.P.K. Eswaran, Class room attendance system using KNN. Int. J. Comput. Sci. Technol. 10(1), 9–12 (2019)

In the recent years, human face recognition, a technique that detects and identifies human faces is gaining importance in the field of biometrics. The human face is a highly intricate and dynamic structure with characteristics that can adversely change with time but it is also the feature that best distinguishes a person. Humans can recognize thousands of faces learned throughout their lifetime and identify familiar faces at a glance even after years of separation. This skill is quite robust, despite large changes in the visual stimulus due to viewing conditions, expression, aging, and distractions such as glasses or changes in hairstyle. Computational models of face recognition, in particular, are interesting because a computer that can recognize faces could contribute to a wide variety of problems, including criminal identification, security systems, image and film processing, and human computer interaction. Thus these models add not only to theoretical insights but also to practical applications. Developing such a computational model is a quite difficult task.

Bhaskar Gupta - INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Facial biometric is among the fastest growing biometric areas, but building an automated system for human face recognition is a challenge because humans are not well skilled in recognition numerous unknown

faces. In recent years, much work has been carried out in face recognition, which has become successful in actual applications . Face recognition can be divided into two main methods: two dimensional (2D) and three dimensional (3D). 2D and 3D refer to the actual dimension in a computer workspace. 2D is "flat", using the horizontal and vertical (X and Y) dimension, the image has only two dimensions. While 3D adds the depth (Z) dimension. This third dimension allows for rotation and visualization from multiple perspectives. Many face recognition methods including their modifications have been developed . Identifying weather, a face is known or unknown can be accomplished by comparing a person's face from a dataset of faces. Research interest in face recognition is rapidly increasing given the many laws and commercial applications of face recognition.

Nawaf Hazim Barnouti - Face Recognition Using Eigen-Face Implemented On DSP Processor - March-April, 2016

Face is a complex multidimensional structure and needs good computing techniques for recognition. The face is our primary and _rst focus of attention in social life playing an important role in identity of individual. We can recognize a number of faces learned throughout our lifespan and identify that faces at a glance even after years. There may be variations in faces due to aging and distractions like beard, glasses or change of hairstyles. Face recognition is an integral part of biometrics. In biometrics basic traits of human is matched to the existing data and depending on result of matching identification of a human being is traced. Facial features are extracted and implemented through algorithms which are efficient and some modifications are done to improve the existing algorithm models. Computers that detect and recognize faces could be applied to a wide variety of practical applications including criminal identification, security systems, identity verification etc. Face detection and recognition is used in many places nowadays, in websites hosting images and social networking sites.

KARRI ANILKUMAR- 2013 - National Institute of technology, Rourkela

Face detection is defined as the process of extracting faces from scenes. So, the system positively identifies a certain image region as face. This procedure has many application like face tracking, pose estimation or compression. The next step feature extraction involves obtaining relevant facial features from the data. These features could be certain face regions, variations, angles or measures which can be human relevant (eg. eyes spacing) or not. This phase has other applications like facial feature tracking or emotion recognition. Finally the system does emotion recognition the face in a identification task, the system would be report an identity from database.This phase involves a comparison method, a classification algorithm .

Chapter 3

Methodology

The classroom attendance system consists of a graphical user interface to interact with different functionalities that is provided by the system. The use case diagram for the system is shown below:

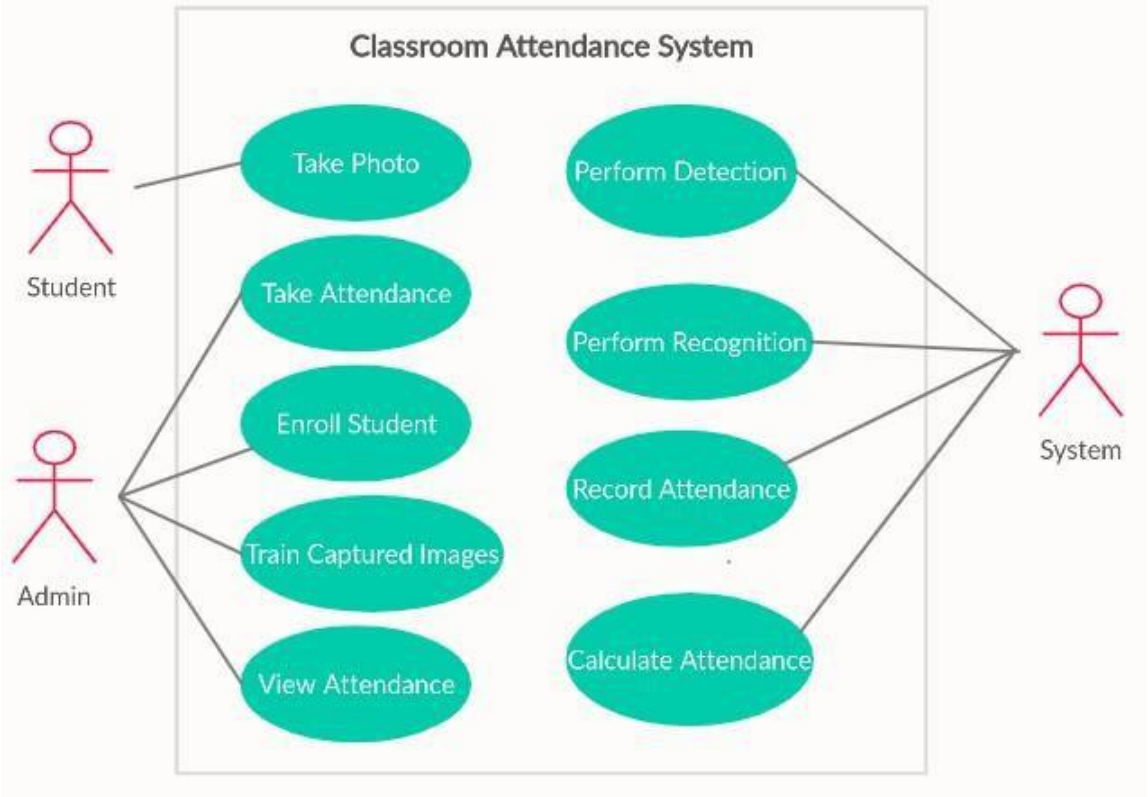


Figure 3.1: Use case diagram for Classroom Attendance System

The system consists of two actors: students, and admission officer, also known as admin. Admission officer is responsible for entering details of students into the system, whereas student volunteers to appear in front of camera to record the attendance. The system then detects and recognizes student.

The development of the system discussed above requires the use of different tools and frameworks. In the sections below, software process and necessary tools and frameworks whilst development of the software are discussed.

3.1 Agile Software Development

Agile software development [5] follows a series of experiments, as opposed to one linear project in which entire projects are pre-planned then fully built out before they are tested. The iterative approach in Agile development methodology allows to gather more frequent user feedback from clients earlier in the process, keeping the projects aligned, on track and relevant.

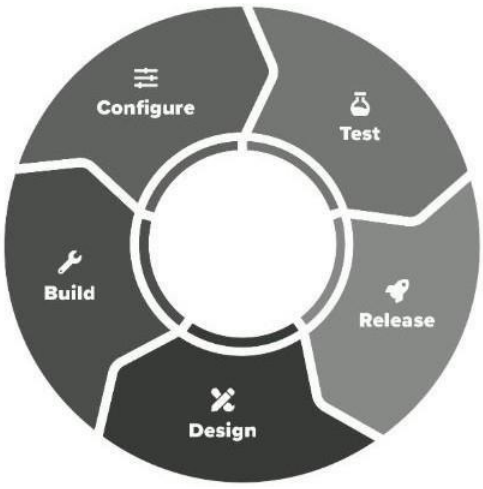


Figure 3.2: Agile development methodology

Kanban (Trello more specifically) framework of Agile software development was used during which the work was assigned to different members in a team and divided into "sprints". The sprints are the basic unit of progress delineated by a specific time-

frameusually2-3 weekswhichmayconsistofseveraltasks. Kanban boardswereused to record the tasks which were labelled as "Things To Do", "Doing" and "Done".

Figure 3.3: Sprints during development of project

3.2 Face Detection and Recognition

Face detection and localization from images is a key problem and a necessary first step in face recognition systems, with the purpose of localizing and extracting the face region from the background. The human face is a dynamic object and has a high degree of variability in its appearance, which makes face detection a difficult problem in computer vision. It is an essential step in face recognition. During the past several years, a wide variety of face detection and localization techniques have been growing fast.

Figure 3.4: Basic steps in face recognition

Categorizationoffacedetectionmaydepend on differentcriteria. Intermsofmodeling processused, theapproachestofacedetectionmayfallintotwomaincategories:
(1) local feature-based ones; (2) global methods. Their face detection regions are re- quired by the comparative matching between the detecting region and constructed

template based on modeling. In the former ones, salient features such as the eyes, nose, and mouth are first located. Various measurements of these facial components are used to construct feature vectors. These approaches to face recognition basically rely on the detection and characterization of above individual facial features and their geometrical relationships. The latter ones, on the other hand, take a holistic view towards face recognition without explicitly finding facial features. They involve encoding the entire facial image and treating the resulting facial code as a point in a high-dimensional space and assume that all faces are constrained to particular positions, orientations, and scales.

3.2.1 Viola–Jones object detection

The Viola-Jones algorithm [6] is a widely used mechanism for object detection [7]. The main property of this algorithm is that it is capable of processing images extremely rapidly and achieving high detection rates. This is distinguished by three key contributions. The first is "Integral Image" which allows the features used by detector to be computed very quickly. The second is a learning algorithm, based on AdaBoost, which selects a small number of critical visual features from larger set and yields extremely efficient classifiers. The third contribution is a method for combining increasingly more complex classifiers in a cascade which allows background regions of the image to be quickly discarded while spending more computation on promising object-live regions.

3.2.2 Local Binary Patterns Histogram (LBPH)

LBP, introduced by Ojala et al. [8], is described as an ordered set of binary comparisons of pixel intensities between the center pixel and its surrounding pixels. It is used for extracting unique and useful features from pre-processed images and is the most efficient and newest approach for face recognition. With LBP it is possible to describe the texture and shape of a digital image [9]. Each pixel of an image is labeled with

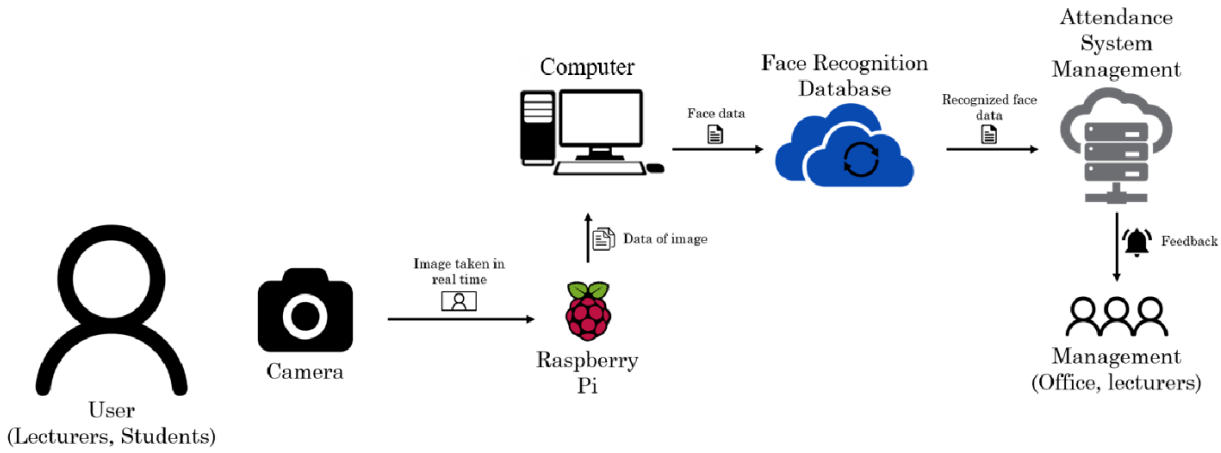
an LBP code which is obtained by converting the binary code into decimal one. First it will divide the image to several small blocks from which the features are extracted. Then it will start calculating the LBP histograms for each block from the obtained features. After that it will combine all LBP histograms for that image to obtain one concatenated vector. Images can then be compared by measuring the similarity (distance) between their histograms. Several studies and research work indicates that face recognition using the LBP method provides very good results with different facial expressions, different lightening conditions, image rotation and aging of persons. Speed and discrimination performance of an LBP system is also magnificent.

3.3 Technology and Frameworks

Git

An open source distributed version control system called Git has been used through the project development process. It helps us in tracking changes in programs and coordinating work on those programs among the project team members.

Architecture of the project:-



Python

Python is an interpreted, high-level, general-purpose programming language. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Kivy GUI framework has been used for designing the graphical user interface.

OpenCV

OpenCV is an open source computer vision and machine learning software library. It includes state-of-the-art computer vision and machine learning algorithms such as Viola-Jones and local binary pattern histogram.

CSV file

After having sufficient images in the database, those images will then be inserted into a training mechanism. There are generally 3 different types of training mechanism provided in OpenCV 3.4 which are EigenFaces, FisherFaces, and Local Binary Patterns Histograms (LBPH).

Chapter 4

System Implementation

The realization of classroom attendance system utilizes various tools and frameworks. In following section, implementation details of the system are briefly discussed.

4.1 Image Acquisition

Figure 4.1: Image acquisition

Classroom Attendance System uses computers' camera to capture training images. For a single student 100 training images are captured. Each training image is converted from RGB mode to Gray-scale. These training images are feed forwarded to the system for further processing.

4.2 Image Preprocessing

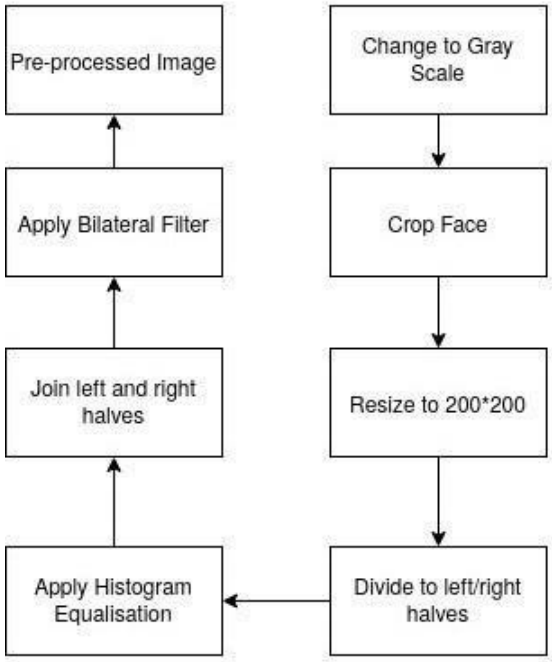


Figure 4.2: Preprocessing image after acquisition

4.2.1 Histogram Equalization

The resized image may have strong lighting on one side and weak lighting on the other. This has an enormous effect on the face-recognition algorithm. So histogram equalization is performed separately on the left and right halves of the face. For that, the resized image is cut into two halves and histogram equalization is performed on both halves separately. After that, the left and right halves are concatenated.

4.2.2 Bilateral Filter

A bilateral Filter is a non-linear, edge-preserving, and noise-reducing smoothing filter for images. It replaces the intensity of each pixel with a weighted average ofintensity

values from nearby pixels. The system uses bilateralFilter method provided by OpenCV with sigmaColor value 75, sigmaSpace value 75 and diameter of 15 pixels.

4.3 Face Detection

After the image is taken and converted to gray-scale, Haar Cascade is used to iden- tify the faces through the images. haarcascade_frontal_face_default.xml - a haar cascade designed by OpenCV is used to identify the coordinate of rectangle sur- rounding the face. Using this coordinate, the face is cropped from the image which removes unnecessary portion or background. Finally the cropped face is resized to 200 x 200 and is saved with *.jpg format.

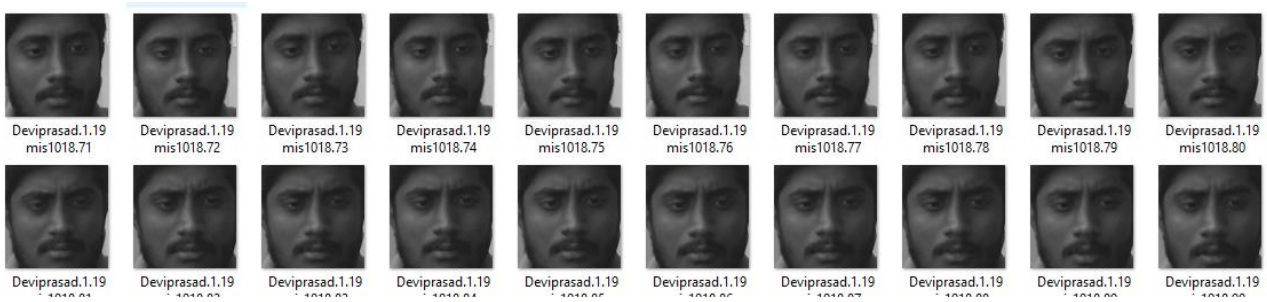


Figure 4.3: Detected faces after preprocessing

4.4 Image Recognition

For image recognition, the image is acquired, processed as described before. It is then feed into the trained model which returns "label" and "confidence". Based on the "label" and "confidence", attendance is recorded.

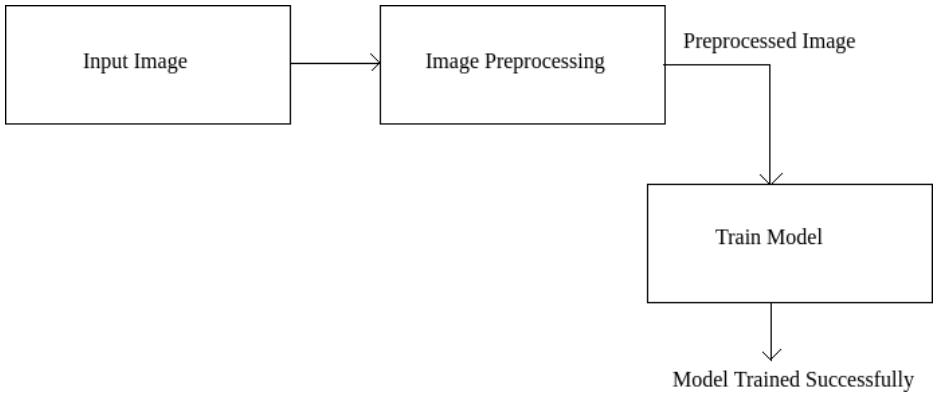


Figure 4.4: Training model for face recognition

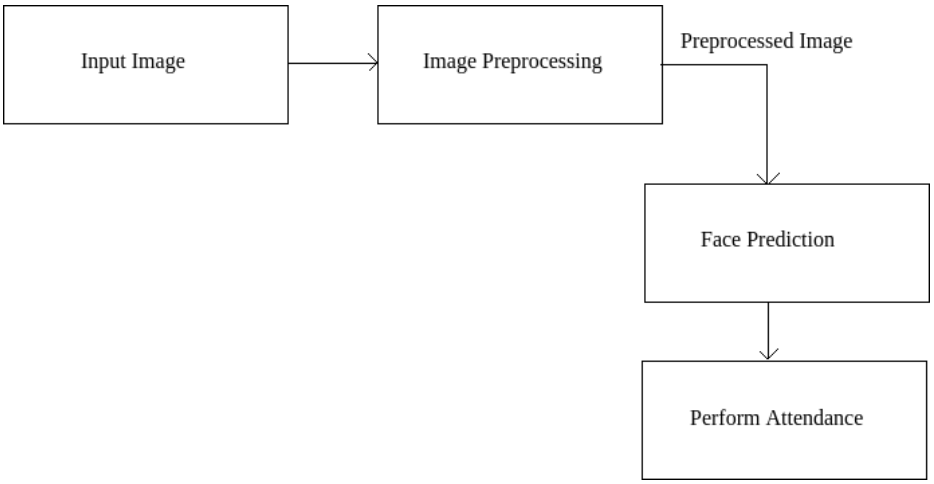


Figure 4.5: Performing face recognition

4.5 Database Integration

Opencv stores student information and record of student attendance in the form of document.

4.6 GUI Development

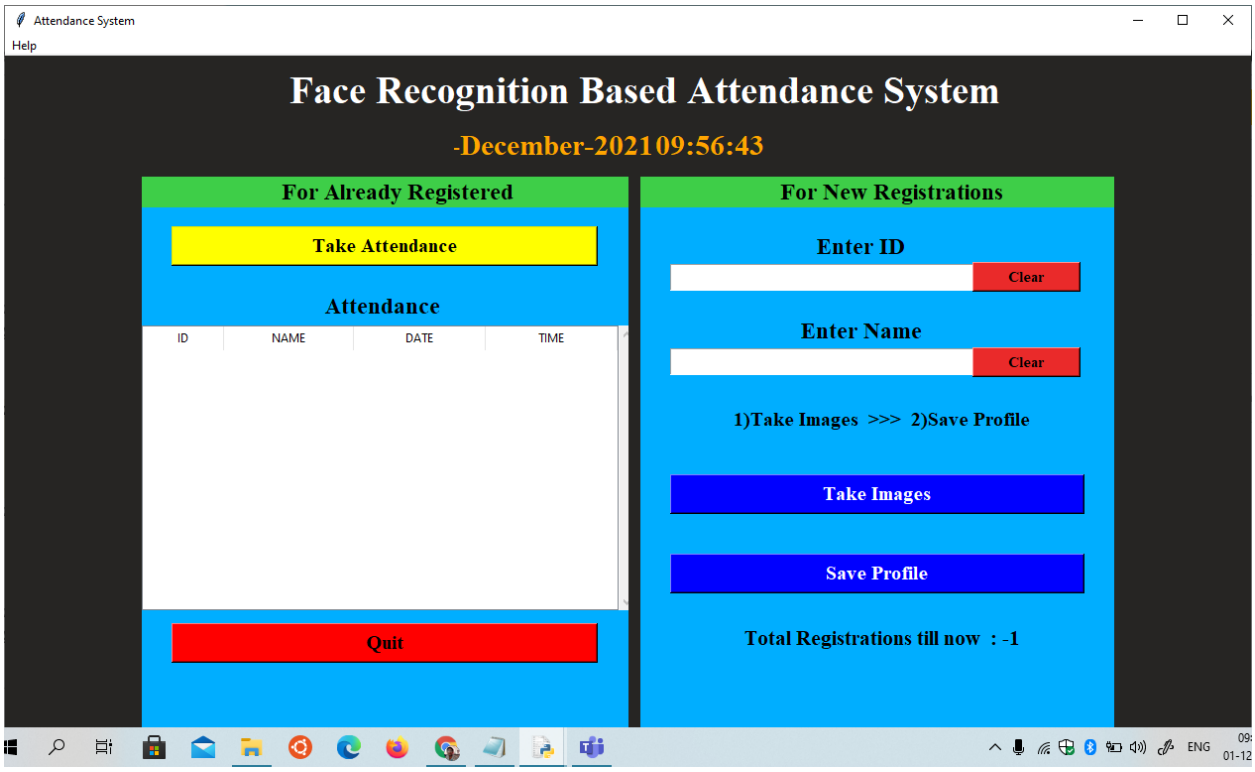
This system uses kivymdwhich is an extension of Kivy, Python library for developing mobile apps and application sofware. Kivymdfollows the Material Design developed

	A	B	C	D	E	F
1	SERIAL NO.		ID		NAME	
2	0		1		Dellip	
3						
4	1		19mis1018		Deviprasad	
5						
6						

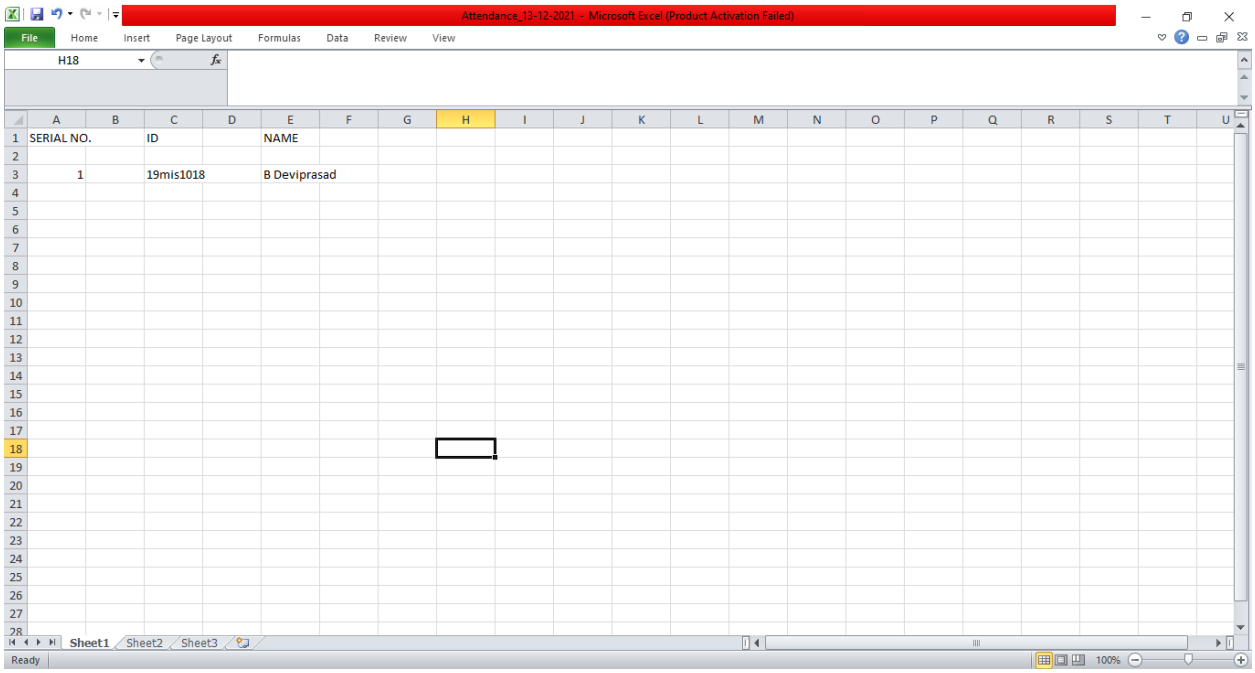
Figure 4.6: Registered students list

by Google for creation ofvarious elements inuser interface which could be text fields, labels, and etc.

Figure 4.7: Landing screen of Classroom Attendance System



Result:-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Chapter 5

Deliverable and Schedule

5.1 Deliverable

The project delivers an automated real-time classroom attendance system which per- forms daily activities of attendance marking with reduced human intervention. This attendance system replaces the contemporary hectic, insecure, time consuming process with automatic face detection and recognition based attendance system.

1. Record student attendance with minimal human intervention using machine learning algorithms for face detection and recognition.
2. Provide a graphical user interface to maximize user experience.

The source code of the project will be made open via GitHub by which related scholars can benefit. This also enables other people in the community to submit feedback and raise issues, so system can be improvised based on issues and feedback on the repository.

5.2 Task and schedule

The completion of the project took over two and half months period and work for initial requirement gathering and analysis began as soon as proposal got accepted.

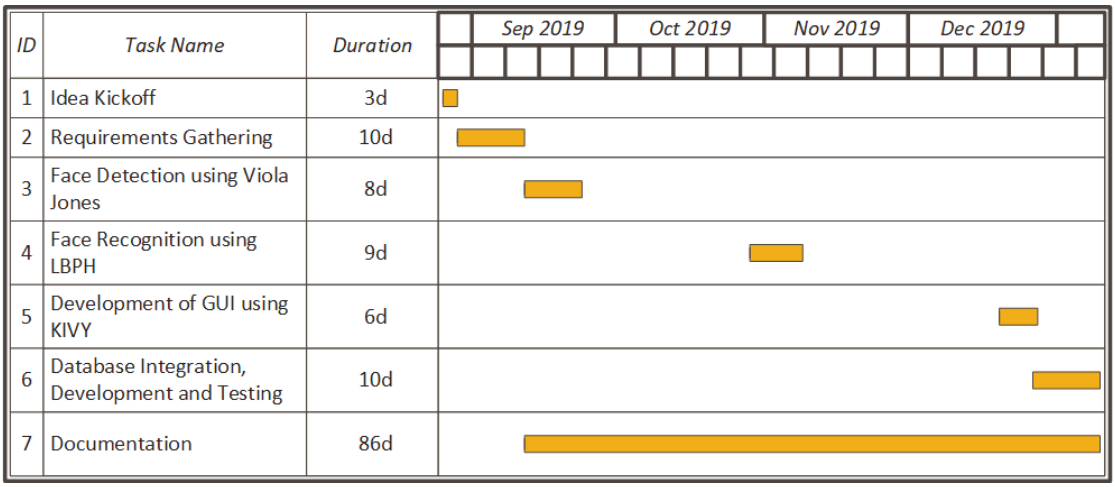

Figure 5.1: Gantt chart

The project was broken down into small modules and task being uniformly di- vided among project members. The development of system proceeded with the direct participation of all the team members. The use of Agile development methodology ensures that testing is done simultaneously at each sprints, ensuring delivery of the project by deadline.

Chapter 6 Conclusion

The completion of the project resulted in a software product that is able to automate the classroom attendance. The software doesn't require any sort of human interven- tion, which saves the precious class time. Moreover, the GUI built on top of the system helps the users to easily navigate through records which used to be hectic and time consuming process in traditional attendance system.

6.1 Future Work

The system in the future can be made able to detect and recognize the student in real-time from the feed coming from CCTV. Students behavior and their engagement in classroom at various lectures could be enhanced using artificial intelligence for the better delivery of class materials to the students.

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