FACE RECOGNITION BASED ATTENDANCE SYSTEM

A Report Submitted

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in

Computer Science & Engineering

By

Ashish -2020UGCS029

Anurag Rai -2020UGCS017

Babli Murmu -2020UGCS094

COMPUTER SCIENCE AND ENGINEERING DEPARTMENT

NATIONAL INSTITUTE OF TECHNOLOGY JAMSHEDPUR

April,2023

UNDERTAKING

We declare that the work presented in this report titled "Face Recognition based Attendance System", submitted to the Computer Science and Engineering Department, National Institute of Technology Jamshedpur, for the award of the Bachelor of Technology degree in Computer Science & Engineering, is our original work. We have not plagiarized or submitted the same work for the award of any other degree. In case this undertaking is found incorrect, We accept that our degree may be unconditionally withdrawn.

April,2023

Jamshedpur

Ashish(2020UGCS029)

Anurag Rai(2020UGCS017)

Babli Murmu(2020UGCS094)

CERTIFICATE

Certified that the work contained in the report titled "Face Recognition based Attendance System", by Ashish(2020UGCS029), Anurag Rai(2020UGCS017), Babli Murmu(2020UGCS094), has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

Dr. Mantosh Biswas

Computer Science and Engineering Dept.

NIT Jamshedpur

April, 2023

PREFACE

Face recognition-based attendance system is a cutting-edge technology that has revolutionized the traditional attendance taking process in various organizations. This system uses advanced facial recognition algorithms to capture and recognize faces, thereby allowing employees to mark their attendance quickly and efficiently. The system can also keep track of attendance data in real-time, making it easier for managers to monitor and manage their employees' attendance. The use of face recognition technology in attendance systems offers several benefits, including reducing the time and effort required to take attendance, minimizing errors, and enhancing security. It also provides greater accuracy and reliability in attendance tracking, making it an ideal solution for organizations of all sizes and types. In this report, we will explore the various aspects of face recognition based attendance systems, including how they work, their benefits and limitations, and their applications in different industries.

ACKNOWLEDGEMENTS

We would like to express our heartfelt gratitude and appreciation to every teaching and non-teaching staff, professors, and every person who has contributed to the successful completion of our project on face recognition-based attendance system.

First and foremost, we would like to extend our deepest thanks to our project supervisor, Dr. Mantosh Bishwas Sir, for his guidance, valuable insights, and unwavering support throughout the project. His encouragement and expertise have been instrumental in making this project a reality.

We would also like to acknowledge the contribution of our team members who worked tirelessly to ensure that the system was developed to the best of our abilities. Each team member brought their unique skills and expertise to the project, and their collaboration and commitment were essential to its success.

Finally, we would like to thank all those who participated in the testing and evaluation of the face recognition attendance system. Your feedback and suggestions have been invaluable in improving the system and ensuring its accuracy and reliability.

Thank you all for your unwavering support and contributions. We hope that this system will provide a valuable and efficient solution to the attendance management process.

Contents

Chapter 1

INTRODUCTION

The management of attendance has become an important task for every enterprise, whether it's an educational institution or a business. The problem arises when the traditional attendance systems that rely on manual entry or card swipes became time-consuming and prone to errors and exhausting as well [5]. There is no doubt that traditional attendance marking is tedious and time-consuming. In addition, it is an extra burden and time consuming if the faculty takes an attendance manually by calling the every name [2]. Therefore, an automated attendance system ia there to solve such problems. Although systems are categorized into two types:1. Manual, and 2. Automated attendance system [3]. The Manual attendance system is also an automatic system, but its main disadvantage is hygiene and its failing to meet the time constraint. This is where face recognition technology comes in, offering a more efficient and accurate way to solve such problem and track attendance.

A face recognition-based attendance system using Python and OpenCV is an innovative solution to this traditional paper-based attendance system used in educational institutes and workplaces. This computer vision application uses a camera to capture the faces of individuals entering a particular location and then compares those faces to a pre-existing database of faces to determine the identity of each person. If the identity is recognized, the system marks the person as present in the attendance register. The face recognition technology used in this system is based on deep learning algorithms that analyze and identify the unique features of a person's face, such as the distance between the eyes, the shape of the nose, and the structure of the jawline. The technology works by creating a mathematical model of the face and comparing it to a database of previously stored models to identify the individual.

OpenCV is a popular open-source computer vision library that provides a comprehensive set of tools and algorithms for image and video processing. Python is a powerful programming language that is widely used in the field of machine learning and computer vision. Python and OpenCV are commonly used together for implementing computer vision applications, including face recognition.

Two of the most popular algorithms in OpenCV used for face recognition-based attendance system. One of the most popular face detection algorithms used for the attendance System is Haar Cascade Classifier [7].And for face recognition algorithms the Local Binary Patterns Histograms (LBPH) algorithm [9] is used. This algorithm works by analyzing the patterns in a person's facial features, such as texture and shape, and generating a unique code that can be used to identify them. The LBPH algorithm is particularly well-suited for attendance management because it is robust to changes in lighting conditions, facial expressions, and pose. This means that even if a person is wearing a mask or has changed their hairstyle, the algorithm can still accurately recognize them.

With the implementation of a face recognition attendance system using the LBPH algorithm, organizations can streamline their attendance management processes and reduce the risk of errors and fraud. This technology has the potential to revolutionize attendance tracking [10], making it more efficient and accurate than ever before[12].

Chapter 2

LITERATURE SURVEY

Face recognition-based attendance systems are becoming increasingly popular due to their ability to accurately and efficiently capture attendance data without the need for physical contact or manual recording. A research paper titled "Design and Implementation of Face Recognition-Based Attendance System" by S.A. Ganiyu, A.A. Raheem, and A. Idowu (published in the Journal of Computer Science & Information Technology in 2019) [4] provides an overview of the development and implementation of such a system.

The system described in the paper utilizes a webcam to capture images of individuals' faces, which are then analyzed using machine learning algorithms to identify and recognize the individuals. The system is designed to work in real-time, allowing for instantaneous capture and processing of attendance data. The researchers conducted a series of experiments to evaluate the performance of the system in terms of accuracy, speed, and efficiency. The results showed that the system was able to achieve a high level of accuracy in recognizing individuals' faces, with an overall recognition rate of 94.8%. The system was also found to be highly efficient, with an average processing time of less than one second per face.

Moreover, Few surveys on Face recognition based attendance system, some of the accuracy results of the systems are given below as follows: “Automated Attendance System using Face Recognition” by G.kumari and A.Singh(2018)[5],in this research paper the authors proposed a face recognition based attendance system that utilizes the Eigenface algorithm for face recognition and MySQL database for data storage. The system achieved an accuracy rate of 98% in attendance marking. Another Research paper “Automated Attendance System based on Face Recognition using Principal Component Analysis” by N.Ravi and S.Rajagopal(2018).

The system achieved an accuracy rate of 98% in attendance marking.

“Automated Attendance System using Face Recognition and Raspberry Pi” by S.V. Dhanasekaran and K.Radha(2019)[1], in this research paper , the author proposes a face recognition based attendance system that utilizes the Raspberry Pi and OpenCV libraries for face recognition and data storage. The system achieved an accuracy rate of 94.2%.
Some other few research paper: “An efficient attendance system using face recognition and IoT” by S.Anandhakumar and S.Sridhar(2021) by A.Darak et al.(2021)[7[,this paper proposed an attendance system that utilizes face recognition and Internet of Things(IoT) for attendance marking. The system achieved an accuracy rate of 96.5% in attendance marking. “Smart Attendance System using Face Recognition and Cloud Storage” by V.Mani et al.(2021)[8] proposes a face recognition based attendance system that utilizes cloud storage for the efficient data management. The system achieved an accuracy rate of 94% in attendance marking. “Attendance Management System using Deep Learning based on Face Recognition”, this paper proposed a face recognition-based attendance system that utilizes pre-trained VGG face models for face recognition. The system achieved an accuracy rate of over 95% in attendance marking.

Altogether, this research paper demonstrates the potential of face recognition-based attendance systems as a viable alternative to traditional attendance tracking methods, in various settings and highlights the different techniques and technologies utilized in developing these attendance systems based on face recognition. By eliminating the need for manual recording and reducing the potential for errors, such systems can help streamline attendance management processes and improve overall efficiency in educational and workplace settings.

Chapter 3

METHODS

This section discusses the different stages involved typically in a face recognition-based attendance system. The detailed descriptions of the algorithms used in every process for Face Recognition based attendance.

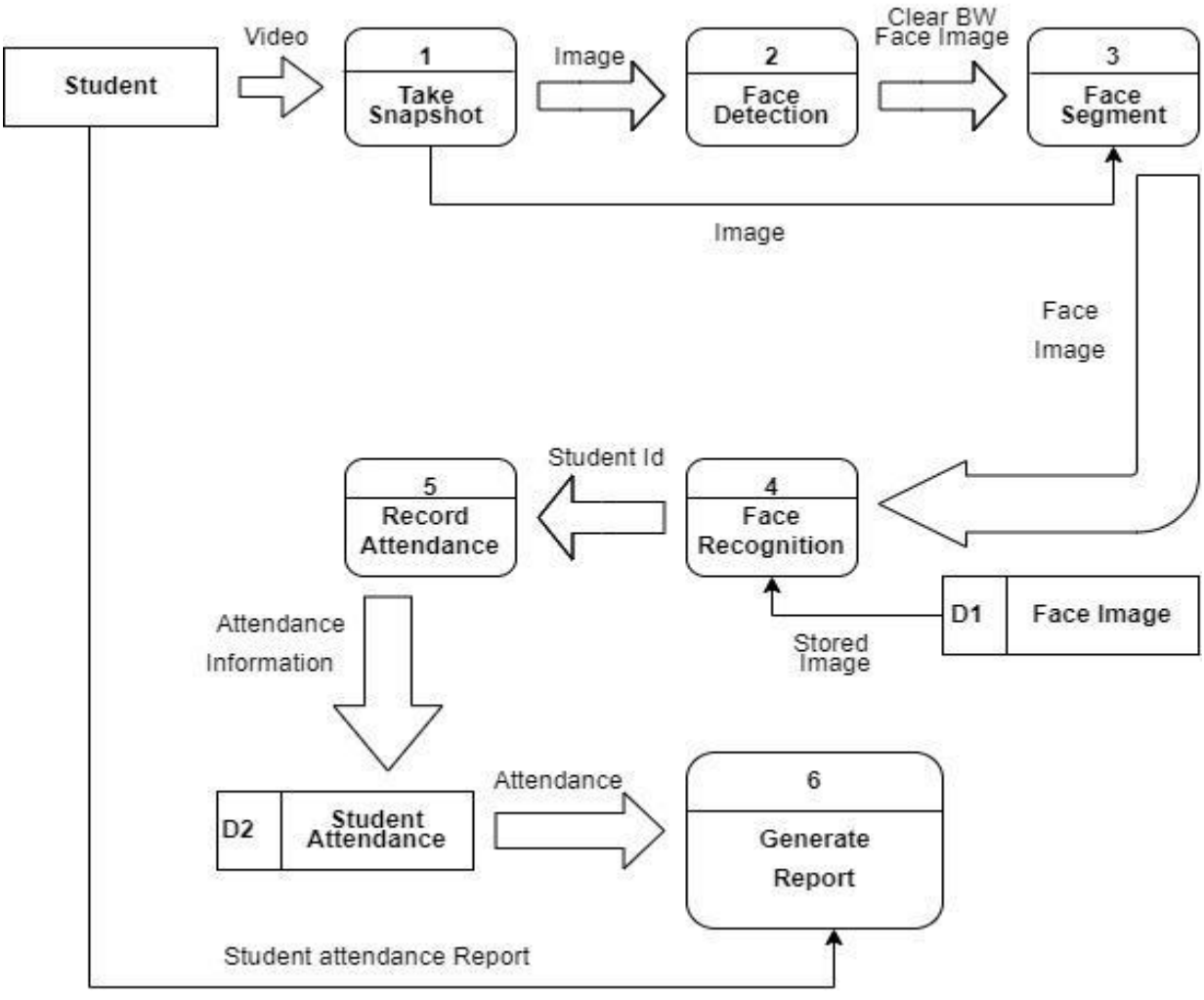

Figure 3.1 different stages while taking attendance

Step 1: Data Collection - Collection of large datasets of image required of the individuals using this face recognition-based attendance system The dataset contains the images of an individuals with varying facial features, poses, and lighting conditions for training the face detection and recognition model. The images are collected using camera, webcam. These images further undergo preprocessing. The images are preprocessed by converting it to grayscale, normalizing the illumination, and applying noise reduction techniques. This preprocessing enhances the quality of images and reduces the effect of lighting variations.

Step 2: Face Detection - The preprocessed images are then fed into a face detection algorithm. An algorithm Haar-Cascade Classifier is used here for face detection in image and also identifies the regions of interest(ROIs) for each face. Although for creating new Haar Cascade classifier training is required before its used for face detection i.e. Haar Cascades needs to be trained to detect the faces. This is known as feature extraction. An xml file-haarcascade_frontalface_default is used for training data in a haar cascade classifier .

Step 3: Face Segmentation - Face Segmentation involves isolating the face region from the rest of the image. A boosting Technique called Adaboost is used for the elimination of irrelevant regions of images. This boosting technique improves the accuracy of face recognition.

Step 4: Feature Extraction - Extract features using the Local Binary Pattern Histogram (LBPH) algorithm from each segmented face image. LBPH extracts features, by dividing the image into a grid of cells and computing a local binary pattern histogram for each cell. A texture analysis technique called Local Binary Pattern (LBP) encodes the relationship between the intensity values of each pixel and its surrounding pixels.

Step 5: Training Model - Extracted features are needed to be trained to recognize the faces. This can be done by LBPH algorithm available in OpenCV. The trained model can be used to recognize faces in real -time.

Step 6: Face Recognition - Recognition of face images is the final task in which Haar cascade classifier and training recognizer are used. The LBPH algorithm as a training recognizer is applied for the face recognition based attendance system. If the face is recognized , automatically the attendance is marked.

Step 7: Attendance Tracking - After the processing of Face recognition, the attendance is tracked. If the system recognizes the faces in an image, it marks the present attendance else on unrecognizing the face it obtain the unfound result. The marked attendance of being present is updated on database and as a result it shows the total number and list of students present with a time, and its respective dates.

Chapter 4

METHODOLOGY

OpenCV provides several algorithms other than Haar Cascade Classifier and Local Binary Pattern Histogram (LBPH) for face recognition that can be used in attendance systems. Some of these algorithms are: -

Eigenfaces: - Eigenfaces is a machine learning-based algorithm for face recognition. It works by reducing the dimensionality of the image and creating a low-dimensional representation of the face. The algorithm compares the low-dimensional representation of the detected face with a database of known faces to recognize the individual.

Fisher faces: - Fisher faces is another machine learning-based algorithm for face recognition that works by finding a linear transformation that maximizes the ratio of the between-class variance to the within-class variance. This transformation can be used to project the high-dimensional image onto a lower-dimensional space for recognition.

Deep Learning: - Deep Learning is a subfield of machine learning that uses neural networks with multiple layers to learn and recognize patterns in data. In face recognition-based attendance systems, deep learning-based algorithms, such as Convolutional Neural Networks (CNNs), are widely used for recognition.

In general, OpenCV provides a wide range of algorithms for face recognition that can be used in attendance systems, and the choice of algorithm depends on factors such as accuracy, speed, and available resources.

Haar Cascades OpenCV (Object Detection)-Haar Cascade is a rapid object detection algorithm in images, irrespective of their scale in image and location. The numbers of positive and negative images of faces and non-faces respectively are required to train the Haar-Cascade classifier. Haar Classifier features work in a similar fashion to feature maps of regular CNN.

The haar cascade algorithm in OpenCV works as follows-The haar cascade algorithm make use of a kind of filter to perform feature extraction from the given image. An image is examined only in one portion at a time with these filters. After that, the intensity of the pixels in the white portion and in the black portion is added.

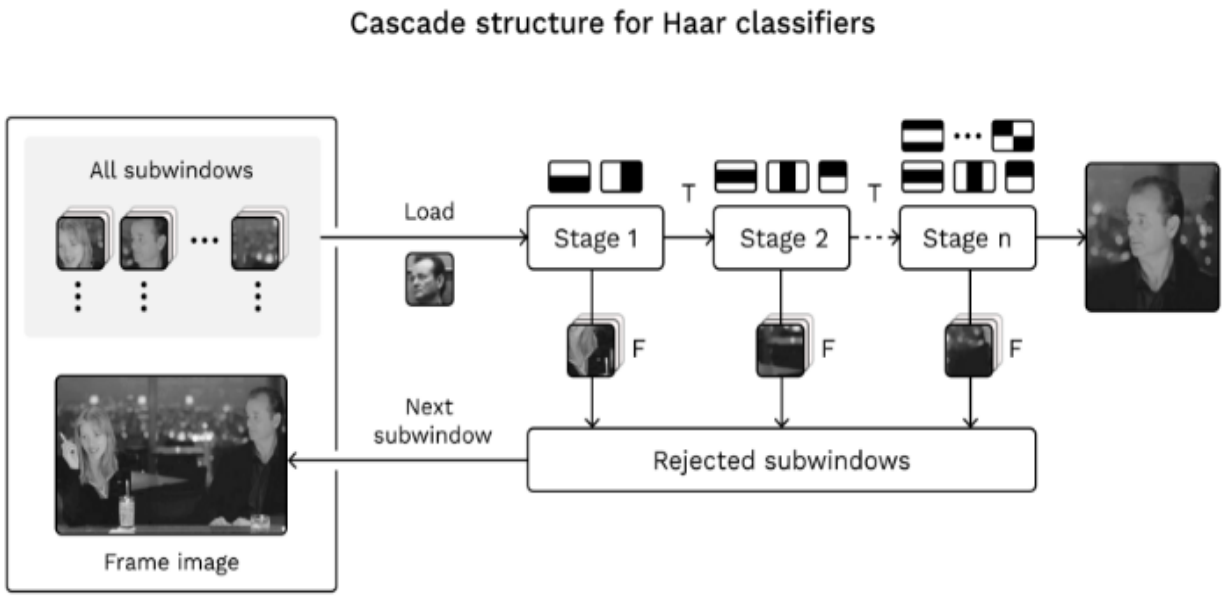

Fig 4.1 : work flow of haar-cascade algorithm

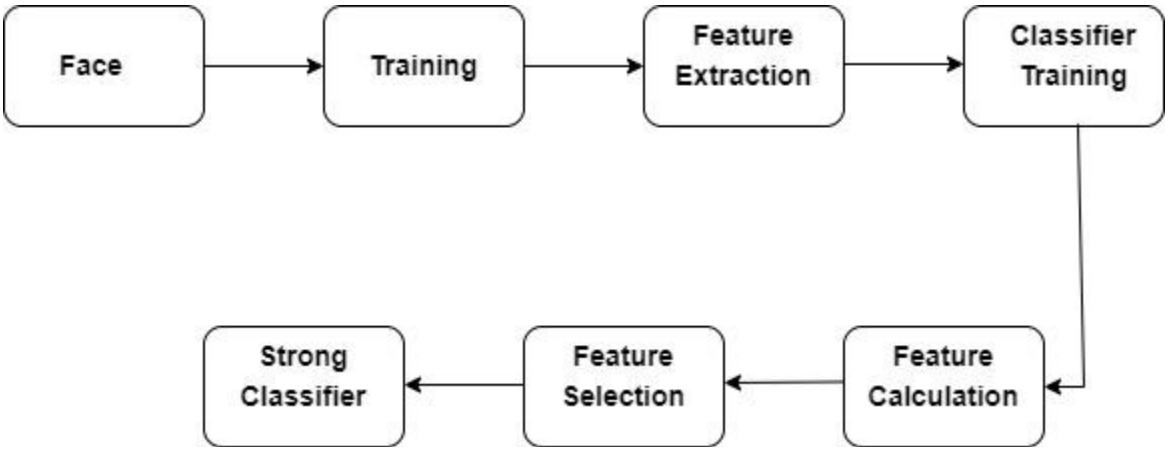

Fig 4.2. Flowchart of Haar Cascade for Face detection

The Haar Cascade algorithm is used for face detection in the face recognition attendance system. It scans the pattern of images from light and dark regions for the detection of face in an image.This algorithm uses a trained classifier for distinguishing the regions containing face and not.

LBPH OpenCV (Face Recognition)- The LBPH is designed for face recognition of humans and its texture classification labels the pixels of an image by thresholding the neighborhood of each pixel and its results considered in a binary number. The main advantage of it is illumination invariant.

The relative difference between the pixel values on changing the lighting of the scene are relatively the same. Basically, used only for recognition of face due to its discriminative power and computational simplicity. The step involved to achieve this are:-

➔ creating dataset -> acquisition of face-> extraction of features -> classification

Feature Extraction-The feature extraction algorithm used in the face recognition attendance system is the LBPH algorithm. The LBPH algorithm extracts features from the region of interests (ROIs) on a face by dividing the ROI into smaller cells and computing the local binary pattern of each cell. The LBPH algorithm then calculates a histogram of the binary patterns and uses it as the feature vector for the face.

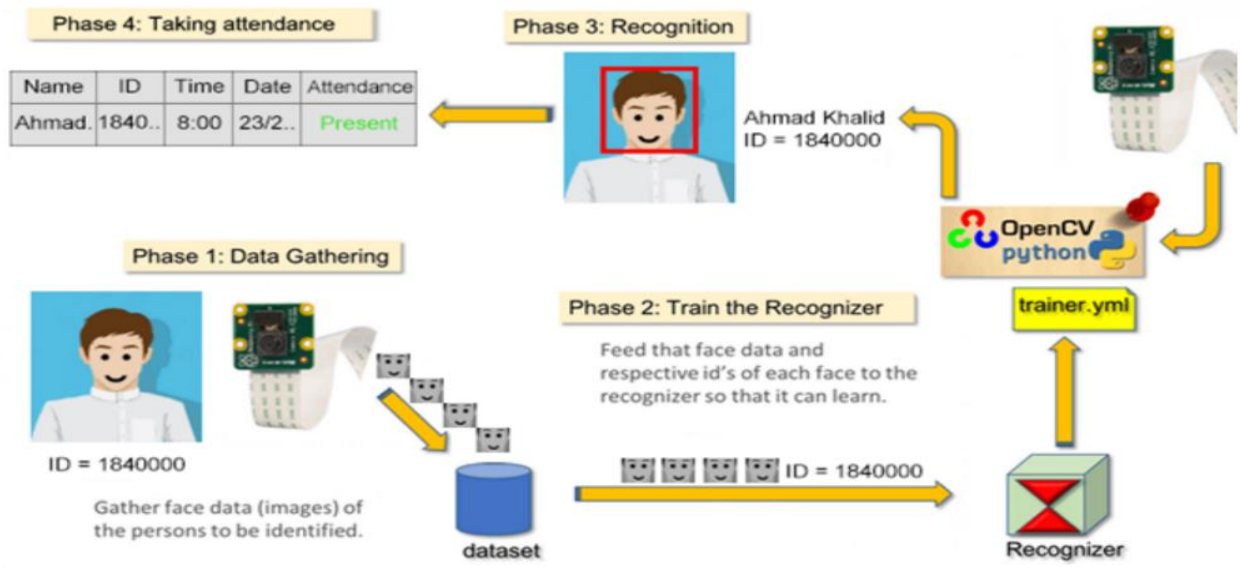

Fig 4.3. Analysis phase of Face Recognition based attendance

The analysis phase of a face recognition-based attendance system is a crucial step in the process of accurately identifying and recording attendance data. In this phase, the system processes and analyzes the input images of faces to extract relevant features and compare them with the stored reference data.

The analysis phase typically involves several phases, including: Gathering of data in which the dataset of images is collected for the person to be identified. The next phase is the training of the recognizer in which the feed that face data and respective ids of each face to the recognizer so that it can learn. Recognition is the another phase after training. The attendance taking is the last phase of face recognition-based attendance system.

Chapter 5

RESULT AND SIMULATION

The implementation of the “Face recognition-based Attendance system” using Python and OpenCV is successfully completed. The Attendance system for students is done without any errors in the system. In this OpenCV, Haar Cascade Classifier and LBPH algorithm plays an important role in the paper as it is a platform. The proposed system outputs are shown below.

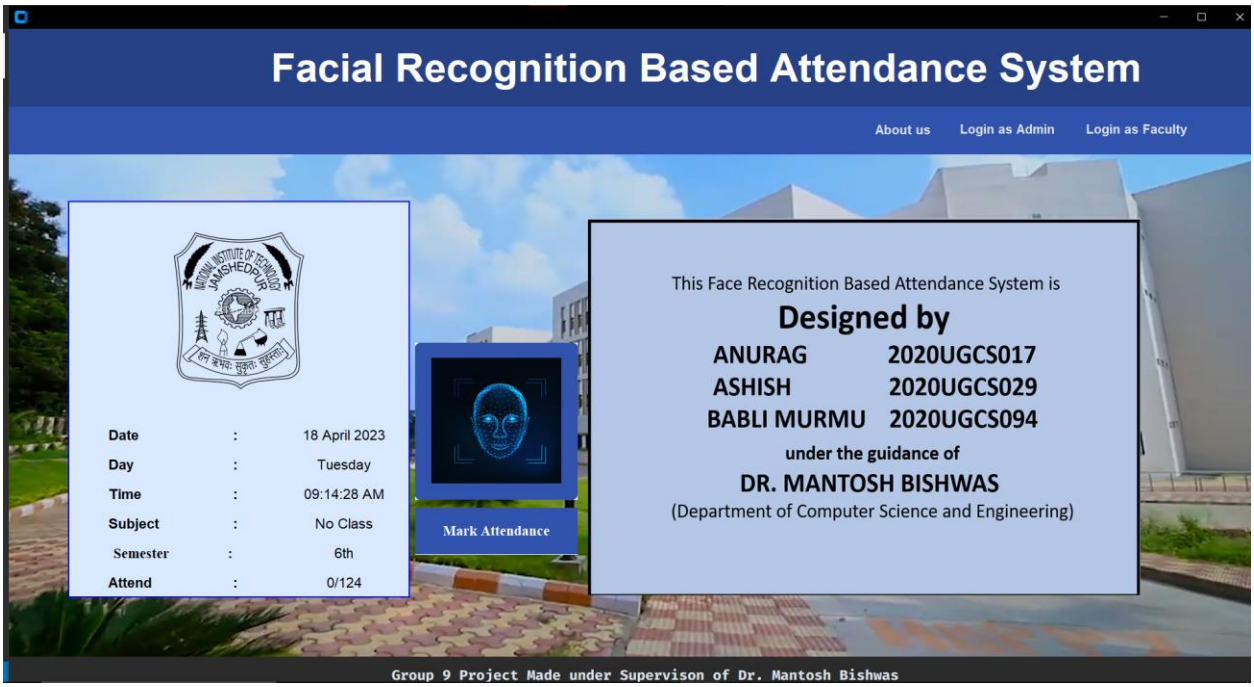

Fig 5.1 Home page UI of Face Recognition based attendance system

Initially a real-time or static image inputted for the collection of attendance, as shown in below figure 5.2.

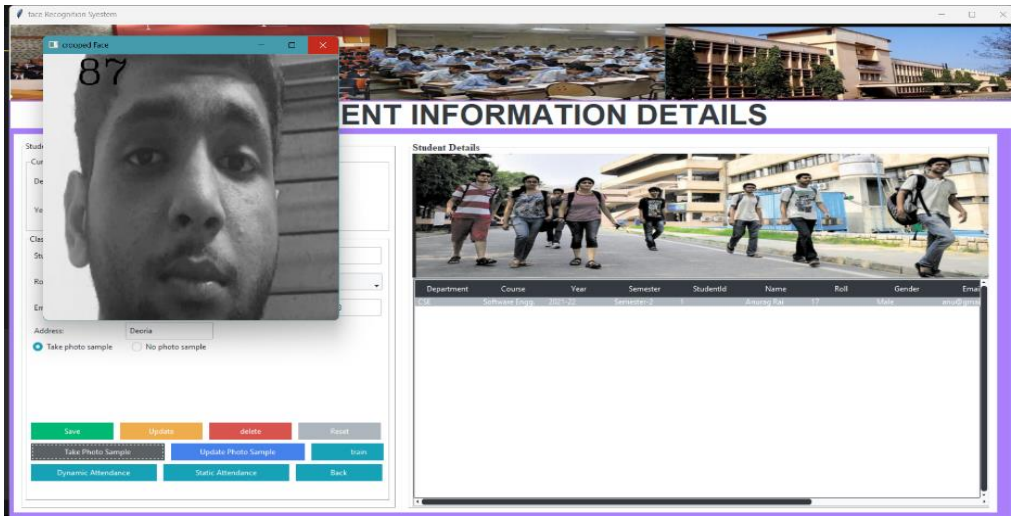

Fig 5.2 Taking Input from the Camera for the Training of Images.

The input image. captured in a system in which the system detects the multiple faces of students and automatically makes a square boundary, shown in fig 5.3.

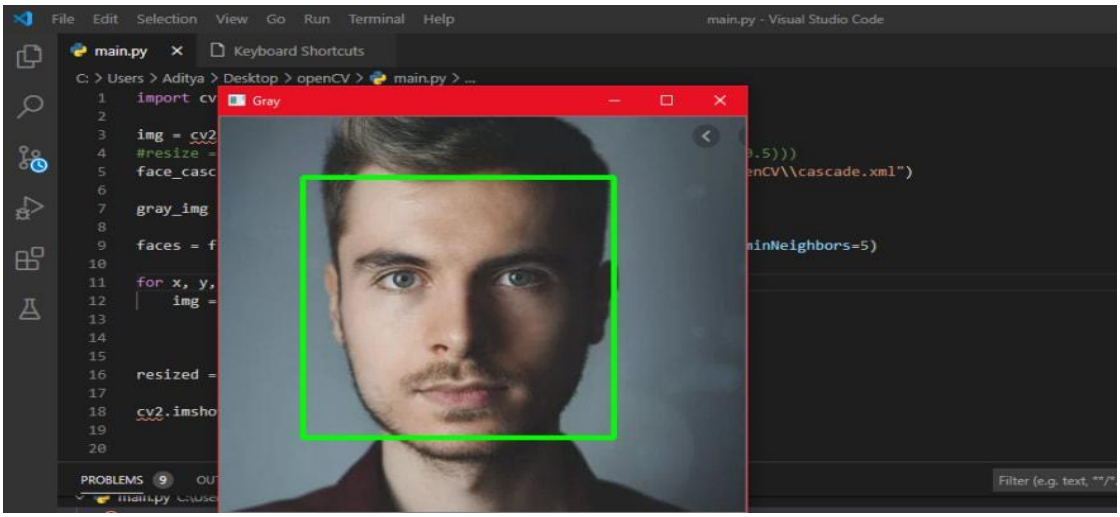

Fig 5.3 Face Detection in input images

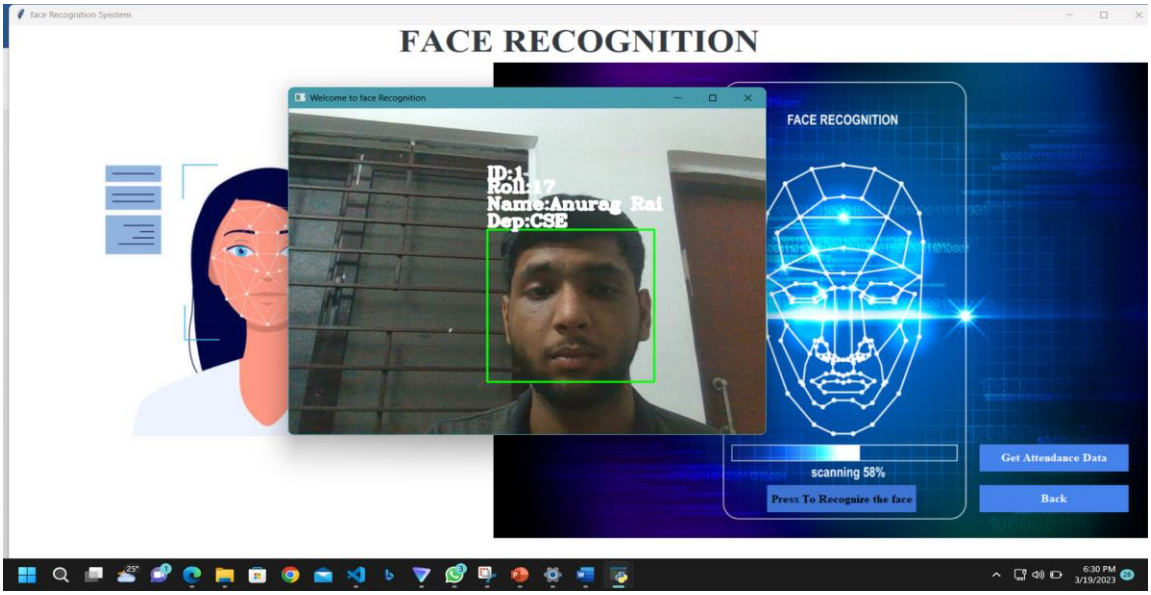

Fig 5.4 Face Recognized for attendance system from trained data

The above fig 5.4 is showing the result of a face being detected and added to the database. On the recognized faces the name of an individual appears on its boundary region , while it results unfound with marked red boundary on the faces it doesn't recognize as shown in fig 5.5.

Fig 5.5 Results for Trained Data and Untrained Data i.e The Detected and Recognized Image is the Trained One and Just Detected Image is the Untrained Image.

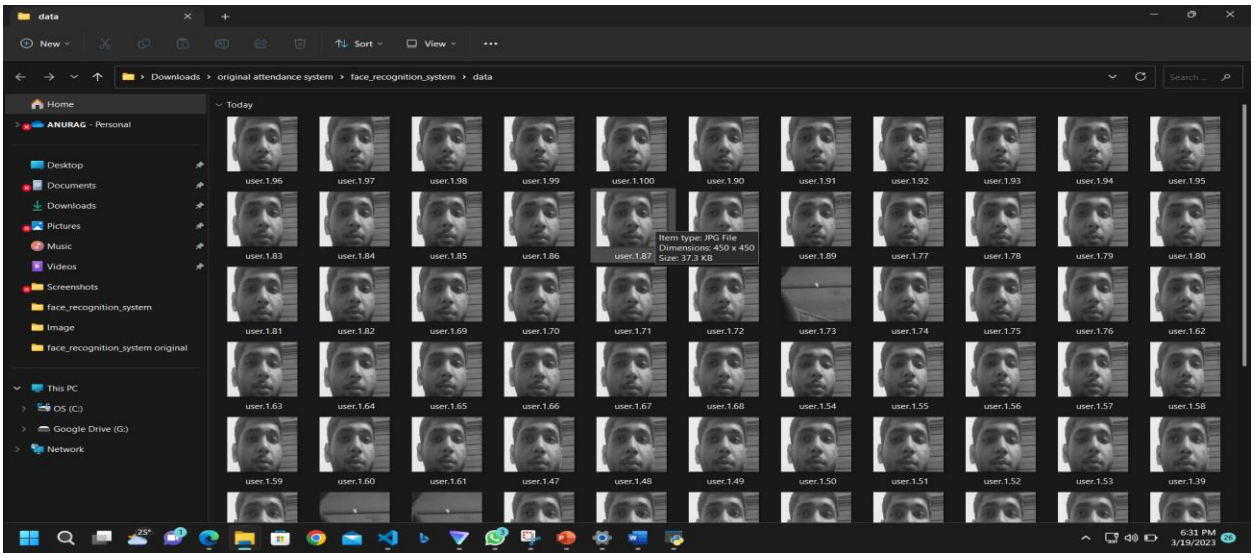

Fig 5.6 Set of Some Trained Images from The Database

Below fig.5.7 shows the histogram of the ratio between present and absent students. This ratio shown is different for different subject of Course.

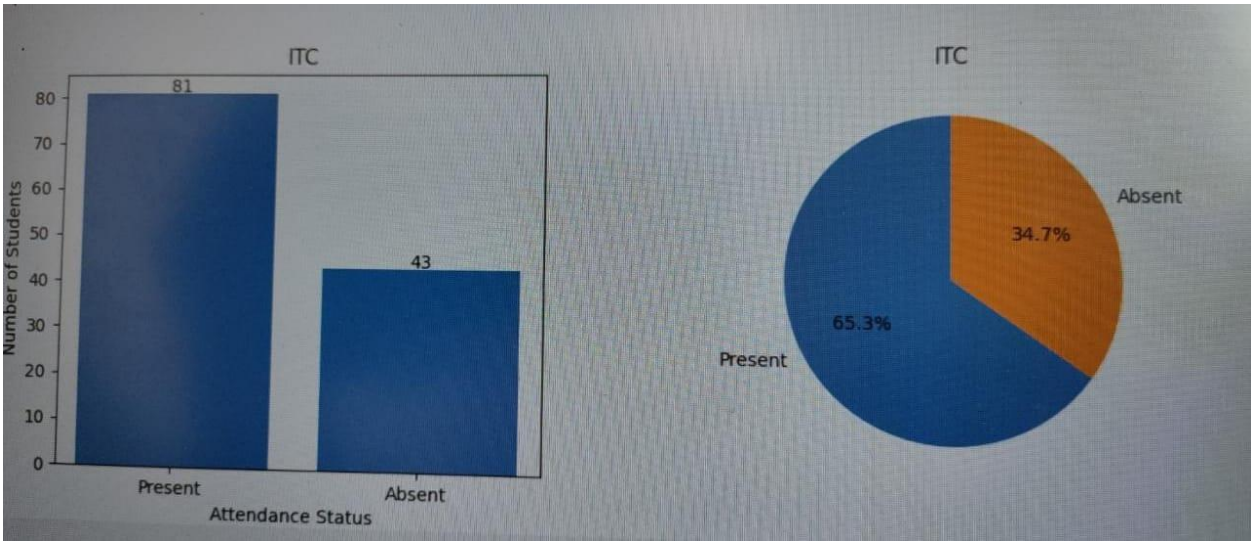

Fig 5.7 Above figure shows the histogram of an attendance

Below shown figure 5.8 takes input of the timetable of course subjects from the Admin Panel. According to which the working of system processes .i.e. attendance taken at any particular time by the registered Professor with their assigned courses.

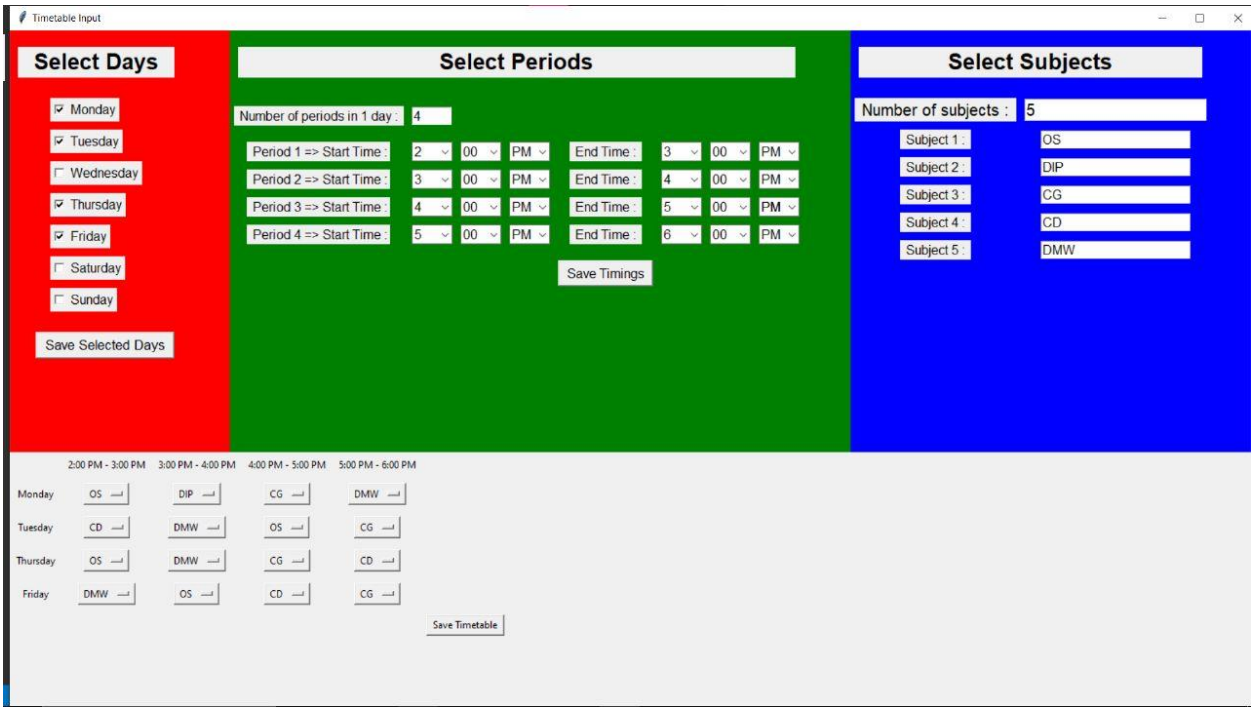

Fig 5.8 Above figure shows input timetable from GUI and save in database

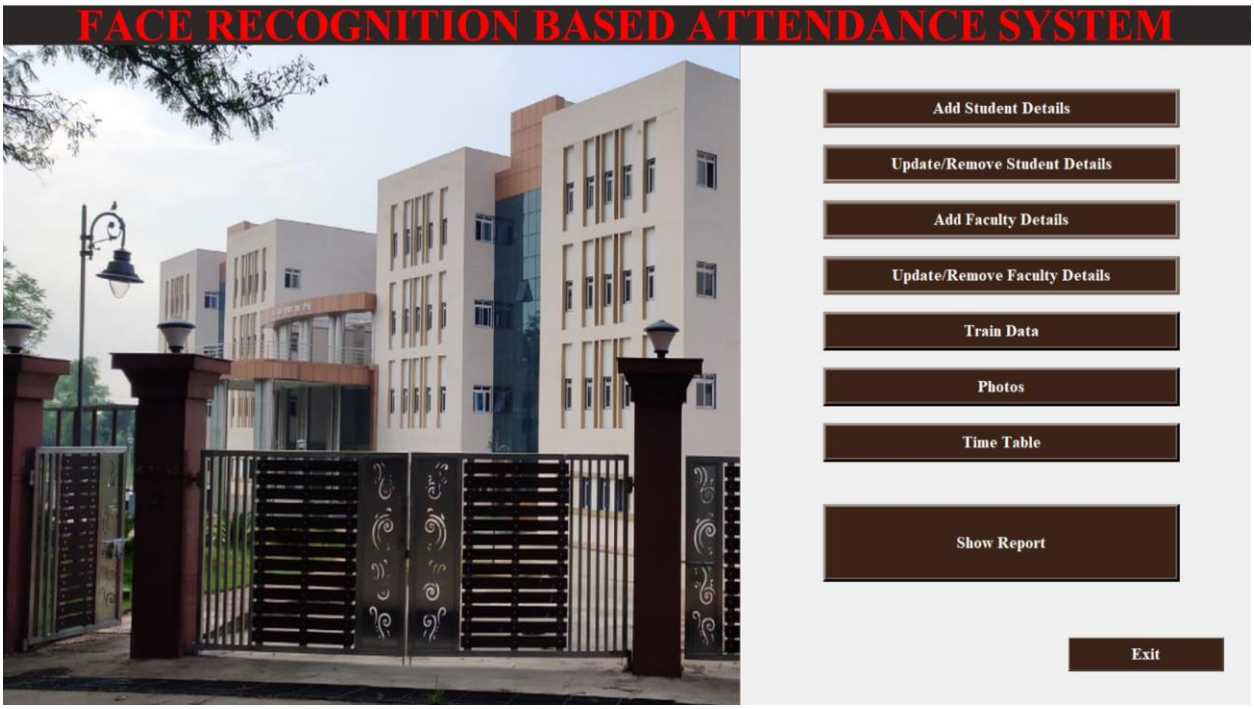

Fig 5.9 Admin Panel

Above shown figure 5.9 is the admin Panel , which can be open by click on Login as Admin button from Home Page and Here admin has many functionalities as shown in image.

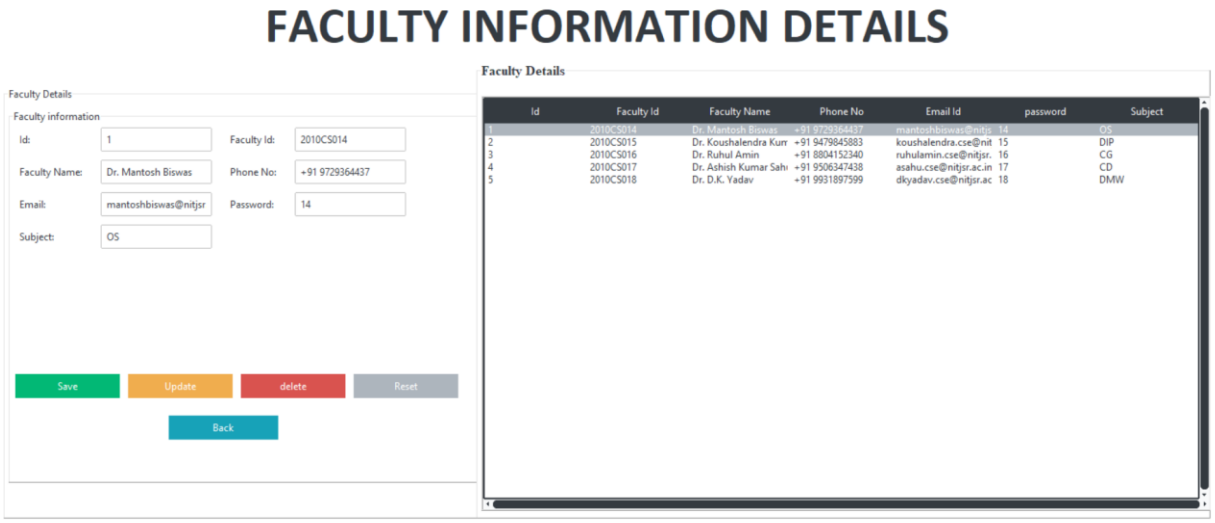

Fig 5.10 GUI to add/update/reset/delete faculty details

Above shown figure 5.10 add, update, reset, delete any faculty details from admin Panel. No one other than admin can do these operations. Only admin after authentication can do such type of operation.

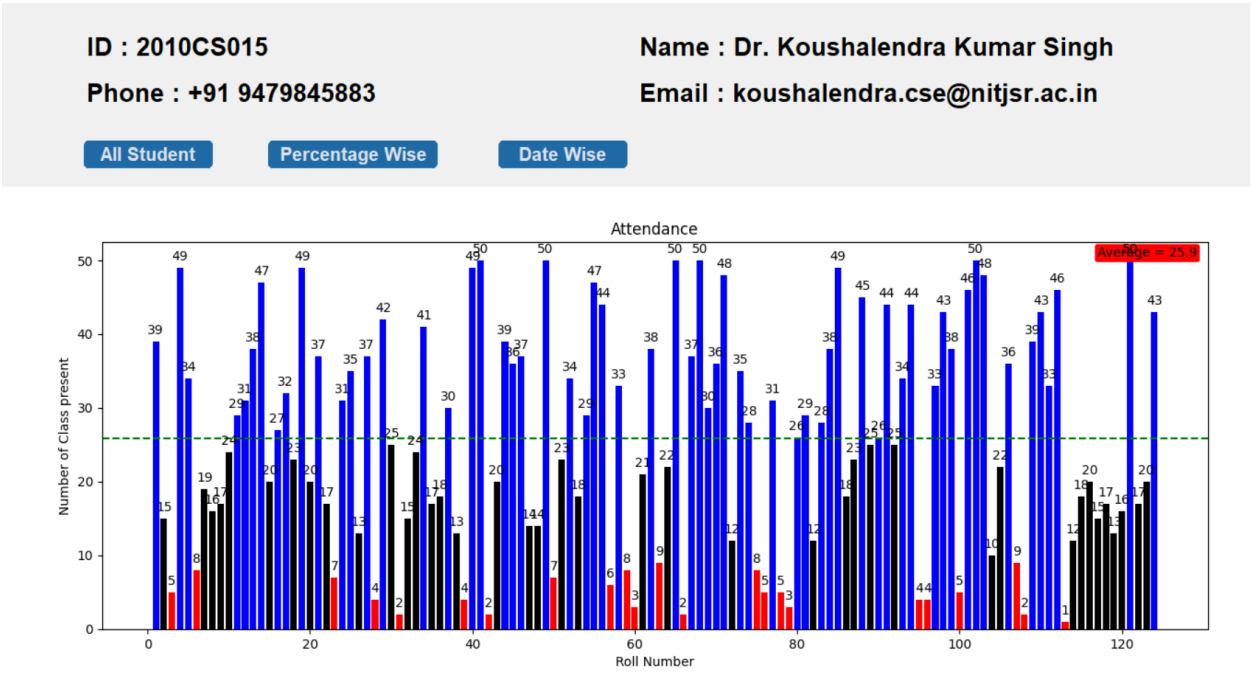

Fig 5.11 Report of All student of a particular Subject

Above shown figure 5.11 show report of all students that how many days student was present in a particular subject. This report will be generated for all subject teacher individually for respective subject.

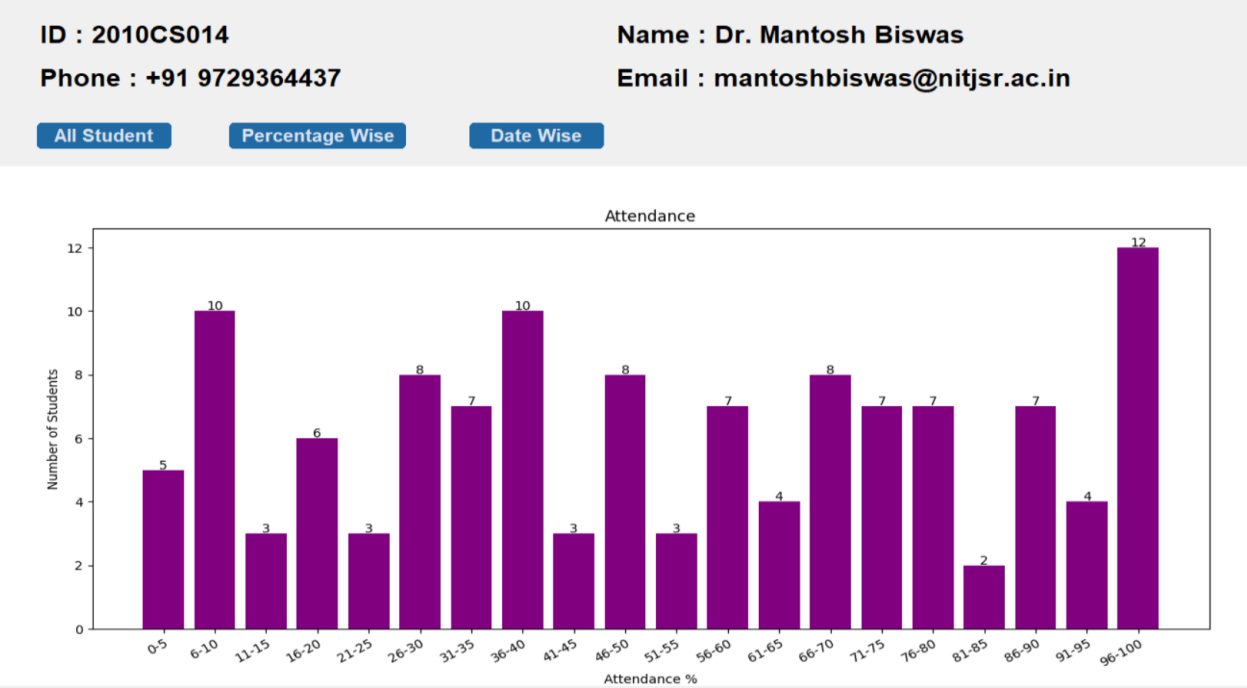

Fig 5.12 Report of a particular Subject percentage wise

Above shown figure 5.12 show Report of attendance percentage wise that how many students were present in that particular range.

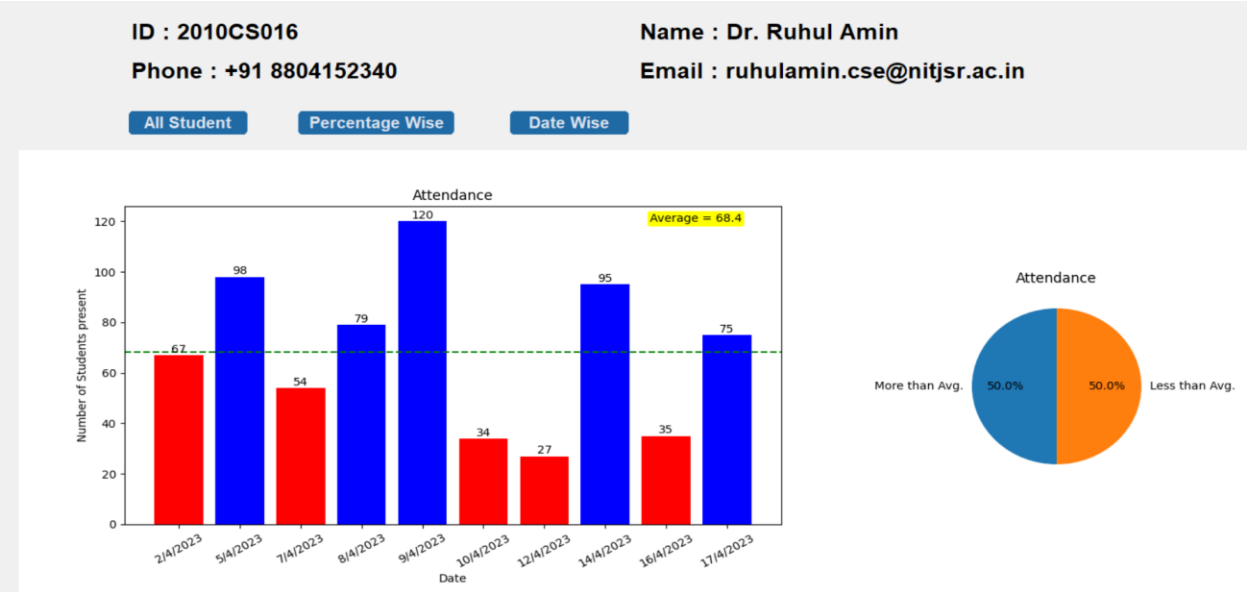

Fig 5.13 Report of a particular Subject Date wise

Above shown figure 5.13 show report of number of students present on any date in a particular subject.

Chapter 6

CONCLUSION & FUTURE WORK

This paper presents a simplified approach to designing an efficient platform for managing an attendance of classes using face recognition method. The main objective of this proposed system is to take an attendance at a time via face Id. The system includes the following methods: detection of faces of students via camera or webcam, then recognizes the faces. The system marks the attendance if the face recognized else results unfound. At least, the attendance record is updated on Excel sheet. This program offers an innovative approach to the problem of managing attendance in tertiary institutions. By integrating facial recognition technology into the application, attendance management becomes more efficient and effective.

Face recognition-based attendance system is proposed to be used in basically large areas i.e. Seminar Halls or auditorium. The poor lighting of rooms can result in poor image quality that hinders system performance, but this can be countered by improving video quality or implementing certain algorithms later on. As technology improves, face recognition-based attendance systems appear to have a bright future. Further enhancing the accuracy and functionality of these systems can be achieved by integrating other technologies such as artificial intelligence and machine learning.

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