**ATTENDANCE SYSTEM USING FACIAL RECOGNITION**

**A CAPSTONE PROJECT REPORT**

*Submitted in partial fulfillment of the*

*requirement for the award of the*

*Degree of*

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**IN**

**COMPUTER SCIENCE ENGINEERING**

*by*

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**CERTIFICATE**

This is to certify that the Capstone Project work titled “**ATTENDANCE SYSTEM USING FACIAL RECOGNITION**” that is being submitted by **I SAI ABHISHEK (18BCN7116)** is in partial fulfillment of the requirements for the award of Bachelor of Technology, is a record of bonafide work done under my guidance. The contents of this Project work, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma and the same is certified.

Dr. PRIYADHARSHINI

Guide

**The thesis is satisfactory / unsatisfactory**

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**ABSTRACT**

In this digital age, where simple everyday life tasks are being automated one of such task ”Attendence marking” is still being taken manually. There should be and there should be a change in this absence in order to be faster and more efficient over time. We can use facial recognition to record the presence of everyone present in the organization. In this facial recognition, many algo-rithmes were developed to provide and capture images of someone's face, such as machine reading and in-depth study. With this algorithm system, the system can detect a person's face and record the presence of that person so that the presence functions can be more efficient and faster.

Face recognition is among the most productive image processing applications and has a pivotal role in the technical field. Recognition of the human face is an active issue for authentication purposes specifically in the context of attendance of students. Attendance system using face recognition is a procedure of recognizing students by using face biostatistics based on the high definition monitoring and other computer technologies. The development of this system is aimed to accomplish digitization of the traditional system of taking attendance by calling names and maintaining pen-paper records. Present strategies for taking attendance are tedious and time-consuming. Attendance records can be easily manipulated by manual recording. The traditional process of making attendance and present biometric systems are vulnerable to proxies. This paper is therefore proposed to tackle all these problems. The proposed system makes the use of Haar classifiers, KNN, CNN, SVM, Generative adversarial networks, and Gabor filters. After face recognition attendance reports will be generated and stored in excel format. The system is tested under various conditions like illumination, head movements, the variation of distance between the student and cameras. After vigorous testing overall complexity and accuracy are calculated. The Proposed system proved to be an efficient and robust device for taking attendance in a classroom without any time consumption and manual work. The system developed is cost-efficient and need less installation.

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**CHAPTER 1**

**INTRODUCTION**

A facial recognition system is a technology that can detect, and match a given human face from a digital image or a video against a database of faces stored in xml or json formats. It works by locating and measuring facial features such as distance between both the eyes, width of nose etc. from a given image and is commonly used to authenticate a person’s physical presence.

A picture containing shape

Description automatically generated

Figure 1 Measuring Facial Features

In just a few years, facial recognition technology has advanced considerably. According to tests conducted by the National Institute of Standards and Technology(NIST), the best face identification algorithm has an error rate of under 0.08 percent as of April 2020, compared to 4.1 percent for the major used algorithm in 2014.

Keeping a track of attendance is crucial for both teachers and students in a learning environment. As a result, marking attendance on daily basis manually is a hectic task. Also, the bio-metric systems which are more popularly used to avoid proxy consume a lot of time to mark attendance with huge class strengths. As a result, an automatic attendance system which can mark attendance by detecting the facial features can alleviate all these concerns.

* 1. **Objectives**

The following are the objectives of this project:

* Reducing time wastage during conventional class attendance marking methods.
* Automating the entire attendance system functionalities which requires minimal monitoring and has complete digital environment.
* Evidently narrowing the possibilities for marking proxy attendance.
* Encouraging the use of latest technology trends in daily lives.
  1. **Background and Literature Survey**

The process flow of a face detection and identification system starts with the ability to identify facial characteristics from a live or an image stored in the memory. The system analyses the taken image and determines the number of faces in the image using various system learnt patterns to filter out and compare them. This image processing employs several algorithms that consider face expressions and various facial structures and dimensions and compare them to a database of known features.

* 1. **Previous Work**

This is a project done by students as a final year project at University Tunku in 2018 The approach performs face recognition-based student attendance system. This method is also like others and begins with the input of an image either loaded from memory or from camera. Then it pre-processes the facial features and extracts it followed by subjective selecting and then the recognition of the facial images from known database. Both LBP and PCA feature extraction methods are studied in detail and computed in this approach to make comparisons. LBP is enhanced in this approach to reduce the illumination effect. An algorithm to combine enhanced LBP and PCA is also designed for subjective selection to increase the accuracy.

**Diagram

Description automatically generated**

Figure 2 Block Diagram of Previous Work

**1.4 Organization of the Report**

The remaining chapters of the project report are described as follows:

* Chapter 2 contains the proposed system, methodology, hardware, and software details.
* Chapter 3 gives the cost involved in the implementation of the project.
* Chapter 4 discusses the results obtained after the project was implemented.
* Chapter 5 concludes the report.
* Chapter 6 consists of codes.
* Chapter 7 gives references.

**CHAPTER 2**

**ATTENDENCE MANAGEMENT SYSTEM**

This Chapter describes the proposed system, working methodology, software, and hardware details.

**2.1 Proposed System**

The following block diagram (figure 2) shows the system architecture of this project.

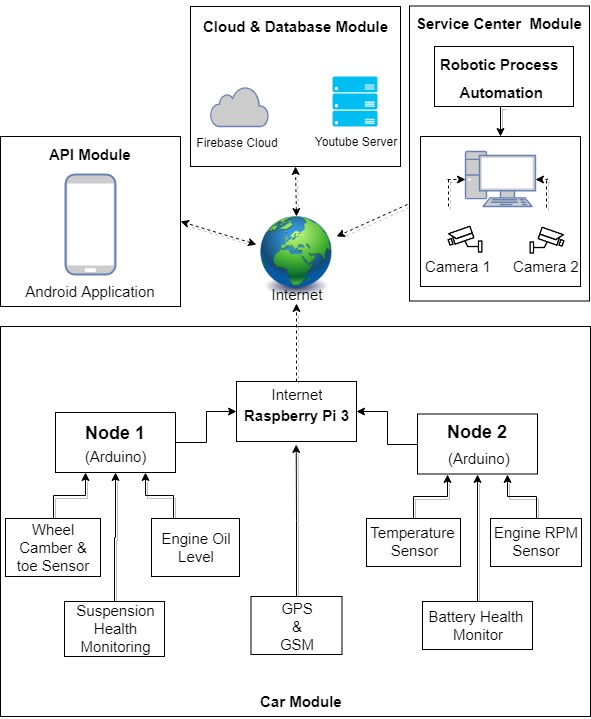


Figure System Block Diagram

**2.2 Working Methodology**

The system has two sections, python-based GUI System with image recording and attendance posting options and an online web-portal for attendance view option. Both the GUI System and web portal are linked to a SQL Server where the data will be stored and processed.

Python-based GUI System is a software application that is installed on the system admin and class handing faculty systems. This GUI System allows admin to take new images of students for new registrations or delete the images of past students and re-train the existing model accordingly. Faculty on the other hand can start taking the attendance of the class automatically by triggering the system to switch on the cameras and predict the faces recorded and mark the attendance for the same. The attendance marked is stored in the local memory of faculty system and faculty can view/edit the stored data and post the marking into the database after verification.

Online Web-Portal allows students to login and view all their attendance markings. Also, faculty and admin later can login to their respective account and can view/add/edit/delete any record as per need on the website

**2.3 Software Details**

This Section describes the software applications used for the development of system

**2.3.1 Tkinter GUI**

Tkinter (TK Interface) is a standard cross-platform package for implementing graphical user interface (GUI) using python programming language. It consists of all the required libraries as a single package and can be also used additionally with the other libraries as per requirement.

Importing Tkinter in PYTHON Ver 2.x and above

> import Tkinter as tk

> import tkFileDialog as filedialog

> import ttk

**2.3.2 OPENCV**

OpenCV is a tool for image processing and computer vision applications. It is an open-source library for tasks including face identification, objection tracking, landmark detection, and many more image recognition applications. Python, Java, and C++ are among the popular languages supported.

Installing OpenCV for WINDOWS

> pip install opencv-python

> import cv2 as cv

**2.3.3 HaarCascade Classifier**

HaarCascade Classifier is an effective approach for object detection which was proposed by Paul Viola and Michael Jones through their paper “Rapid Object Detection Using a Boosted Cascade of Simple Features” in the year 2001. This is classifier basically a machine learning based approach in which a group similar and non-similar kind of images are used to train a cascade function through which new images are detected by pattern matching. There are many huge individuals of .xml files with a lot of feature sets and each xml corresponds to a very specific type of use case or pattern to be verified. As we need to identify the facial features and detect the person in this project we will be using “**haarcascade\_frontalface\_default.xml” for the same.**

**2.3.4 XAMPP Server**

XAMPP is a popular cross-platform web server that allows programmers to write and test their code on a local web server. XAMPP is abbreviated as follows, X stands for Cross-Platform, A stands for Apache, M stands for [MY-SQL](https://www.javatpoint.com/mysql-tutorial), and the two P‘s stand for PHP and Perl respectively. It is an open-source web solution package that incorporates Apache distribution for servers and command-line executables with modules such as Apache server, [MariaDB](https://www.javatpoint.com/mariadb-tutorial), PHP, and Perl. In the current project we will be using PHP for the server-side programming and MYSQL as the database.

**2.4 Face Detection**

Detailed explanation of functioning of facial recognition system is done in this section

https://towardsdatascience.com/computer-vision-detecting-objects-using-haar-cascade-classifier-4585472829a9

**2.4.1 LBPH Algorithm**

**https://www.analyticsvidhya.com/blog/2021/07/understanding-face-recognition-using-lbph-algorithm/**

LBPH (Local Binary Pattern Histogram) is a Facial Detection algorithm used to identify the individual using his/her facial features. Every image is represented in the form of a matrix composed of rows and columns combining to form many individual cells. These individual cells are called as pixels. A single pixel is normally defined as least possible information of a bit of image. For every pixel in an image the value ranges from 0 to 255. Consider a 3X3 pixel matrix from a given image. We have a total of 9 cells in this matrix. We use LBPH algorithm to define a value to the mid cell with respective to the 8 cells around it.

Diagram

Description automatically generated

For each of the neighboring cell of the central cell, we allot a new one-bit binary value. We set 1 for values equal or higher than the threshold and 0 for values lower than the threshold. And we find the Threshold(Z) of the central cell using the formula below

**Z=∑ s(In - Ic)2^n**

Z >= 9 🡪 i=1

Z < 9 🡪 i=0

In 🡪 pixel value of the nth cell

Ic 🡪 pixel value of the central cell

Once the one-bit binary values are set we arrange them in the binary form of i0i1i2…in and the decimal equivalence is the pixel value of the central cell. After this process(LBP procedure), we have a newly formed image which represents better the characteristics of the original image with each pixel more related to each other.

Now, using the newly generated image in the previous, we can use the X and Y grid parameters to further divide the image into multiple grids and form histograms respectively as shown in the image below.Diagram

Description automatically generated

Once the histograms are formed the data is stored and to check similarity between two images, we later compare the two histograms formed of respective images and the one close distance has high similarity. In this project we will be using Euclidean Distance to compare the histograms.

Text

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**2.4.2 Training the Model**

We will be using **haarcascade\_frontalface\_default.xml to detect the face of individuals through the given image. To train the model all the images taken must be scaled down to uniform dimensions and can be done using the code in the image below.**

Text

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**Once we scale down all the images to uniform dimensions, we now use Cascade Classifier function of OpenCV to point to the path of the haarcascade\_frontal\_default.xml in the code below.**

        harcascadePath = "haarcascade\_frontalface\_default.xml"

        detector = cv2.CascadeClassifier(harcascadePath)

**Now we load all the images and convert them into grayscale. We perform this operation to remove the RGB (Red, Green, Blue) format in the image and bring down all the computations to 256 bits i.e., Black and White**

gray = cv2.cvtColor(img, cv2.COLOR\_BGR2GRAY)

**Once the images are converted to greyscale from RGB format we try to collect all the facial features in the images using an inbuilt method called detectMultiScale as below.**

faces = detector.detectMultiScale(gray, 1.3, 5)

In the above code we are trying to use face\_classifier which is an object that is loaded with haarcascade\_frontal\_default.xml file. This function detects the facial features and record in the object assigned to.

The object from the above step (i.e., faces) in our code returns four values and they are X-Coordinate, Y-Coordinate, Width, Height of the detected face and store the processed images in the memory using below code.

for (x, y, w, h) in faces:

    cv2.rectangle(img, (x, y), (x + w, y + h), (255, 0, 0), 2)

    sampleNum = sampleNum + 1

  cv2.imwrite("TrainingImage\"+Id+'.'+str(sampleNum)+".jpg",gray[y:y+h,x:x +w])

    cv2.imshow('Taking Images', img)

    if cv2.waitKey(100) & 0xFF == ord('q'):

        break

    elif sampleNum > 100:

        break

Once the images are stored we start training the model using recognizer method and save the trained data in the format of .yml using below code.

recognizer = cv2.face\_LBPHFaceRecognizer.create()

    harcascadePath = "haarcascade\_frontalface\_default.xml"

    detector = cv2.CascadeClassifier(harcascadePath)

    faces, ID = getImagesAndLabels("TrainingImage")

    try:

        recognizer.train(faces, np.array(ID))

    except:

        print(Exception while training model!)

        return

    recognizer.save("TrainingImageLabel\Trainner.yml")

On successful execution of above code, the recorded images are processed, trained and model is saved as Trainner.yml on the local drive.

**2.4.3 Recognition of the Image**

Once the model is trained and saved in the format of .yml successfully we proceed with tracking (detection) of faces in the new images given to the system. We use read() inbuilt method with the recognizer object to read the .yml data and haarcascade\_frontalface\_default.xml file to extract new face from new image.

recognizer.read("TrainingImageLabel\Trainner.yml")

harcascadePath = "haarcascade\_frontalface\_default.xml"

faceCascade = cv2.CascadeClassifier(harcascadePath)

Later on we compare two images using predict() inbuilt method with the recognizer object to get the confidence level(similarity level) of the two files and give a threshold limit such that all the images above this threshold will be accepted to be similar and below will be rejected.

gray = cv2.cvtColor(im, cv2.COLOR\_BGR2GRAY)

            faces = faceCascade.detectMultiScale(gray, 1.2, 5)

            for (x, y, w, h) in faces:

                cv2.rectangle(im, (x, y), (x + w, y + h), (225, 0, 0), 2)

                serial, conf = recognizer.predict(gray[y:y + h, x:x + w])

                if (conf > 50):

print(Accepted)

**2.5 Python GUI System**

Functionalities of the GUI System are explained in this section

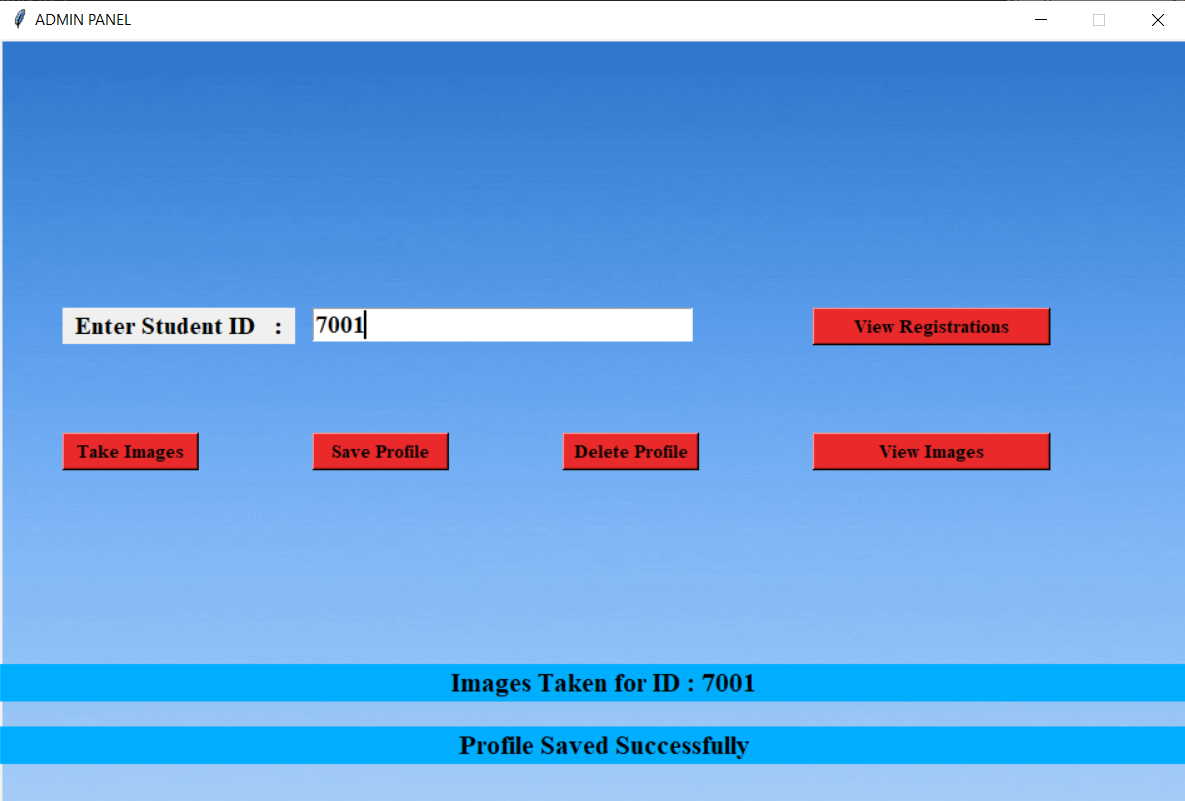
The entire graphical user interface in this project is developed using TKinter GUI Package Libraries. The first page of the system is the login page where user needs to enter his/her employee ID and password and login to their respective profiles. There are two profiles in the system, and they are Admin and Faculty. Each profile has their own functionalities in them respective to their requirements. Detailed explanation of each profile and their functionalities is given below



**Figure GUI Login Panel**

**2.5.1 Admin Panel**

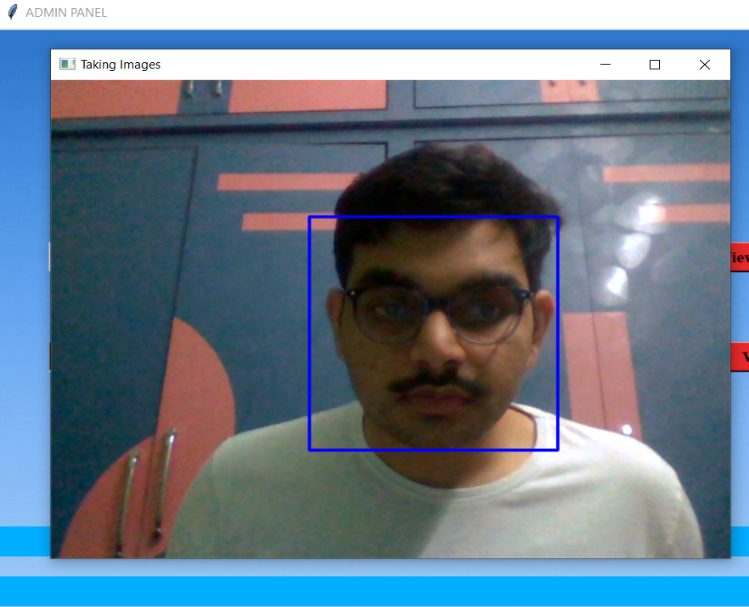
The system admin is solely responsible for maintaining class records and updating the trained model with any new changes such as addition/deletion of student images in the system. Admin can also access the images of individual student and entire registration data and trained data (.yml file) to process any necessary corrections in the system.

****

**Figure GUI Admin Panel**

Admin can enter the student ID and check if his/her images are registered and can also delete or add new registrations by using delete profile or take images option and later saving the new profile. Every time admin saves a profile the current existing .yml file gets deleted and new yml file will be generated with the current images available in the system.

To add new student details to the system Admin first selects Take Images option. A camera appears with a blue square around the detected faces. The system is now tracking the images and storing them locally.

****

**Figure New Profile Registration**

Admin can manually stop image recording by clicking on ‘q’ key on the keyboard or the system will automatically shut the camera after certain predefined time and saves the images. Once images are recorded successfully, we can proceed with the profile saving option which overrides the current existing .yml file with newly processed data.

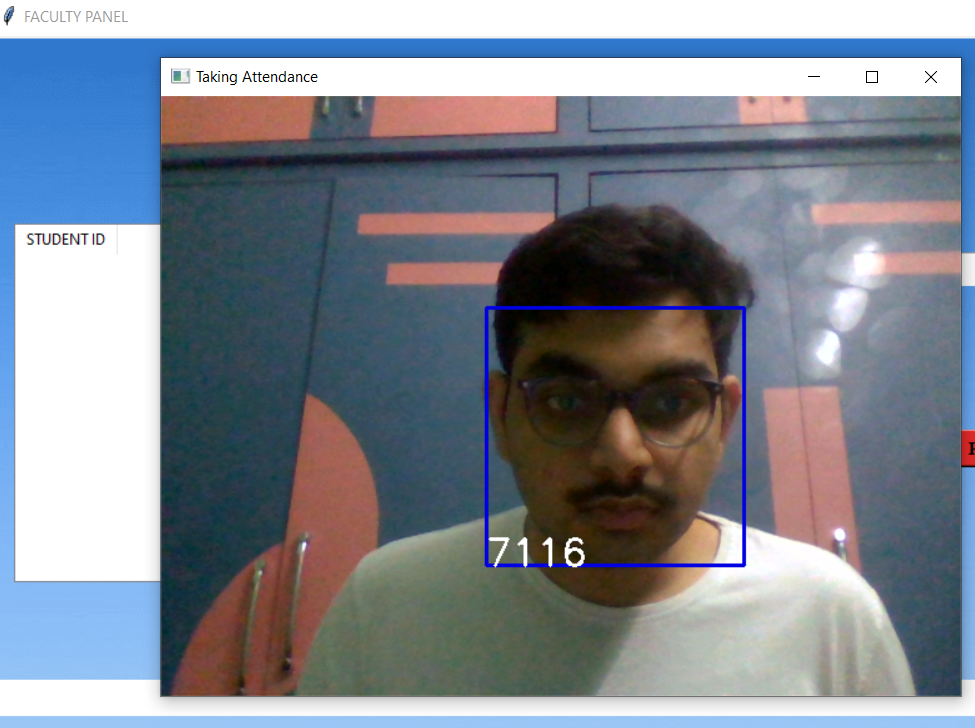
**2.5.2 Faculty panel**

Once logged into the system faculty will be directed to a panel as shown in the figure below.

****

**Figure Faculty Panel**

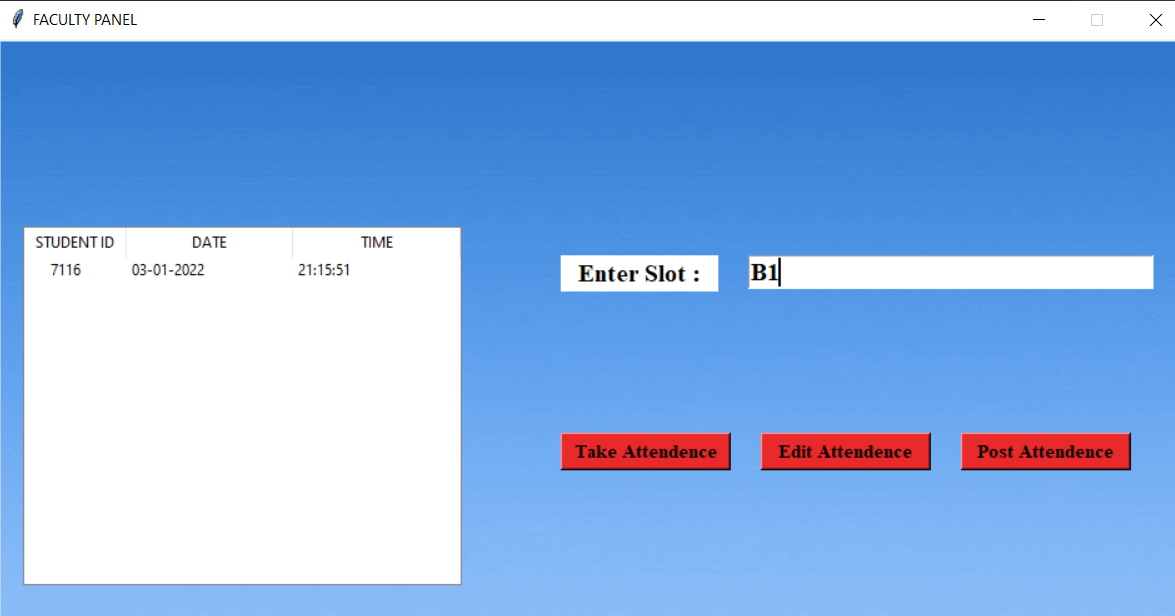
Faculty need to enter the slot code of the class he/she is wishing to proceed with attendance marking and select the option Take Attendance which switches the cameras on and detects the human face.



**Figure Attendance Tracking**

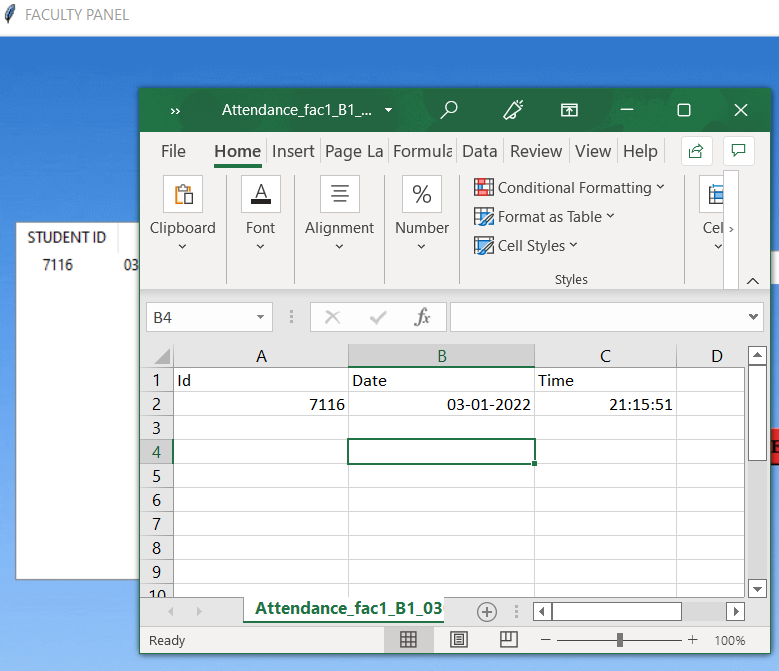
The ID of the student will be displayed at the right bottom of the blue square box if system could successfully recognize the person in the image. Faculty can use this option to check if the system is successful in recognition of student. And once the attendance marking is done faculty can close the camera by clicking ‘q’ key on the keyboard

Once faculty finishes the attendance tracking the marked attendance with data and time will be saved in the faculty local drive in the excel format and will also be displayed in the faculty panel as shown in the figure below



**Figure Marked Attendance View**

If there is any error to be rectified faculty can use Edit Attendance option which will open the excel sheet in which attendance was recorded. Faculty can manually correct any errors that occurred here. Faculty can also manually enter the class attendance in the excel sheet if automatic attendance does not work due to any error in the system.



**Figure Attendance Edit Option**

And once faculty verified the marked attendance, they can use Post Attendance option to post the recorded attendance to the SQL Database. Also, the recorded attendance is stored locally on the faculty system in the excel format which allows faculty to post data whenever they are connected to the server without any data loss.

**2.6 Web Portal**

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**NOTE:** Its **MANDATORY** for a student to attach all the PPT’s, Sample Materials, Specification Sheets, Programming Codes and a 5-10 minutes demo Video of the Project Digitally In CD . Stick the Compact Disk (CD) in the final page of the Thesis after binding it.