A Project Report on

FACE RECOGNITION ATTENDANCE SYSTEM

BY

Mr. SAYYED SULEMAN RAHEMAN

Mr. SHIKALGAR TANVEER

Mr. VANJARE AKSHAY

GUIDE

Miss. ANKITA KANCHAN

MACHINE LEARNING DEPARTMENT

SYMBIOSIS SKILLS AND PROFESSIONAL UNIVERSITY,

KAWALE, PUNE

SYMBIOSIS SKILLS AND PROFESSIONAL UNIVERSITY, KAWALE, PUNE

CERTIFICATE

This is to certify that **Sayyed Suleman, Shikalgar Tanveer, Vanjare Akshay** has successfully completed project entitled "**Face Recognition Attendance System**" under my supervision, in fulfillment of CSR Course of Machine Learning of Symbiosis Skills and Professional University.

Date: 06/06/2021

Place: SSPU

Guide

(**Miss.Ankita Kanchan**)

Co-ordinator

(**Mr. Sumeet Bhagat**)

ACKNOWLEDGEMENT

We have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organization. I would like to extend my sincere thanks to all of them. I am highly indebted to Miss. Ankita Kanchan for her guidance and constant supervision as well as for providing necessary information regarding the project and also for her support in completing the project. I would like to express my gratitude towards my parents and member for their kind cooperation and encouragement which help me in completion of these project. I would like to express my special gratitude and thanks to Symbiosis Skills and Professional University for giving us such an opportunity. My thanks and appreciations also go to my colleagues in developing the project and people who have willingly helped me out with their abilities.

ABSTRACT

The main aim of this project is to build a face recognition-based attendance monitoring system for educational institution or for any other institutions where attendance monitoring is performed to enhance and upgrade the current attendance system into more efficient and effective as compared to before methods. The current old system has a lot of equivocal that caused incorrect and inefficient of attendance taking. Many problems arise when the authority is unable to enforce the regulation that present in the old system. The technology working behind will be the face recognition system. The human face is one of the natural attributes that can uniquely identify an individual. Therefore, it is used to trace identity as the possibilities for a face to duplicated is low. In this project, face databases will be created to pump data into the training algorithm. Then, during the attendance taking, faces will be compared against the database for identity. When an individual is identified, its attendance will be taken down automatically saving necessary information into SQL database. At the end of the day, the table in SQL containing attendance information regarding all individuals can be mailed to the respective faculty or can be stored online or within the system it through which it is connected.

Contents

INTRODUCTION

In today's networked world, the need to maintain the security of information or physical property is becoming both increasingly important and increasingly difficult. From time to time, we hear about the crimes of credit card fraud, computer break-ins by hackers, or security breaches in a company or government building.

In most of these crimes, the criminals were taking advantage of a fundamental flaw in the conventional access control systems: the systems do not grant access by "who we are", but by "what we have", such as ID cards, keys, passwords, PIN numbers, or mother's maiden name. None of these means are really define us. Recently, technology became available to allow verification of "true" individual identity. This technology is based in a field called "biometrics".

Biometric access control are automated methods of verifying or recognizing the identity of a living person on the basis of some physiological characteristics, such as fingerprints or facial features, or some aspects of the person's behavior, like his/her handwriting style or keystroke patterns. Since biometric systems identify a person by biological characteristics, they are difficult to forge. Face recognition is one of the few biometric methods that possess the merits of both high accuracy and low intrusiveness. It has the accuracy of a physiological approach without being intrusive. For this reason, since the early 70's (Kelly, 1970), face recognition has drawn the attention of researchers in fields from security, psychology, and image processing, to computer vision.

According to the previous attendance management system, **the accuracy of the data** collected is the biggest issue. This is because the attendance might not be recorded personally by the original person, in another word, the attendance of a particular person can be taken by a third party without the realization of the institution which violates the accuracy of the data. For example, student A is lazy to attend a particular class, so student B helped him/her to sign for the attendance which in fact student A didn’t attend the class, but the system overlooked this matter due to no enforcement practiced. Supposing the institution establish an enforcement, it might need to waste

a lot of human resource and time which in turn will not be practical at all. Thus, all the recorded attendance in the previous system is not reliable for analysis usage. The second problem of the previous system is where it is **too time consuming**. Assuming the time taken for a student to sign his/her attendance on a 3-4 paged name list is approximately 1 minute. In 1 hour, only approximately 60 students can sign their **attendance which is obviously inefficient and time consuming**. The third issue is with the **accessibility of those information by the authorized concerned party**. For an example, most of the parents are very concerned to track their child's actual whereabouts to ensure their kid really attend the classes in college/school. However, in the previous system, there are no ways for the parents to access such information. Therefore, evolution is needed to be done to the previous system to improve efficiency, data accuracy and provides accessibility to the information for those authorized party.

OBJECTIVE

In order to solve the drawbacks of the previous system stated in 1.1, the existing system will need to evolve. The proposed system will reduce the paperwork where attendance will no longer involve any manual recording. The new system will also reduce the total time needed to do attendance recording. The new system will acquire individual attendance by means of facial recognition to secure data accuracy of the attendance.

The following are objectives of the project:

▪ To develop a portable Smart Attendance System which is handy and self-powered.

▪ To ensure the speed of the attendance recording process is faster than the previous system which can go as fast as approximately 3 second for each student.

▪ Have enough memory space to store the database. ▪Able to recognize the face of an individual accurately based on the face database.

▪ Allow parents to track their child's attendance.

▪ Develop a database for the attendance management system.

▪ Provide a user-friendly interface for admins to access the attendance database and for non-admins (parents) to check their child's attendance by mailing the attendance.

▪ Allow new students or staff to store their faces in the database by using a GUI.

▪ Able to show an indication to the user whether the face- recognition process is successful or not.

LITERATURE REVIEW

Face recognition is one of the few biometric methods that possess the merits of both high accuracy and low intrusiveness. It has the accuracy of a physiological approach without being intrusive. Over past 30 years, many researchers have proposed different face recognition techniques, motivated by the increased number of real-world applications requiring the recognition of human faces. There are several problems that make automatic face recognition a very difficult task. However, the face image of a person inputs to the database that is usually acquired under different conditions. The important of automatic face recognition is much be cope with numerous variations of images of the same face due to changes in the following parameters such as

1. Pose
2. Illumination
3. Expression
4. Motion
5. Facial hair
6. Glasses
7. Background of image.

Face recognition technology is well advance that can apply for many commercial applications such as personal identification, security system, image- film processing, psychology, computer interaction, entertainment system, smart card, law enforcement, surveillance and so on. Face recognition can be done in both a still image and video sequence which has its origin in still-image face recognition. Different approaches of face recognition for still images can be categorized into three main groups such as

1. Holistic approach
2. Feature-based approach
3. Hybrid approach product

1. Holistic approach: -

   In holistic approach or global feature, the whole face region is taken into account as input data into face detection system. Examples of holistic methods are eigenfaces (most widely used method for face recognition), probabilistic eigenfaces, fisher faces, support vector machines, nearest feature lines (NFL) and independent-component analysis approaches. They are all based on principal component-analysis (PCA) techniques that can be used to simplify a dataset into lower dimension while retaining the characteristics of dataset.

2. Feature-based approach: -

   In feature-based approaches or local feature that is the features on face such as nose, and then eyes are segmented and then used as input data for structural classifier. Pure geometry, dynamic link architecture, and hidden Markov model methods belong to this category. One of the most successful of these systems is the Elastic Bunch Graph Matching (EBGM) system [40],[41], which is based on DLA. Wavelets, especially Gabor wavelets, play a building block role for facial representation in these graph matching methods. A typical local feature representation consists of wavelet coefficients for different scales and rotations based on fixed wavelet bases. These locally estimated wavelet coefficients are robust to illumination change, translation, distortion, rotation, and scaling. The grid is appropriately positioned over the image and is stored with each grid point's locally determined jet in figure 2(a), and serves to represent the pattern classes. Recognition of a new image takes place by transforming the image into the grid of jets, and matching all stored model graphs to the image. Conformation of the DLA is done by establishing and dynamically modifying links between vertices in the model domain.

3. Hybrid approach: -

   The idea of this method comes from how human vision system perceives both holistic and local feature. The key factors that influence the performance of hybrid approach includes how to determine which features should be combined and how to combine, so as to preserve their advantages and avert their disadvantages at the same time. These problems have close relationship with the multiple classifier system (MCS) and ensemble learning in the field of machine learning. Unfortunately, even in these fields, these problems remain unsolved. In spite of this, numerous efforts made in these fields

indeed provide us some insights into solving these problems, and these lessons can be used as guidelines in designing a hybrid face recognition system. hybrid approach that uses both holistic and local information for recognition may be an effective way to reduce the complexity of classifiers and improve their generalization capability.

There are also some other types through which we can build automated system for attendance and they are as follows-

1) Attendance System Using NFC Technology with Embedded Camera on Mobile Device

According to research journal "Attendance System Using NFC (Near Field Communication) Technology with Embedded Camera on Mobile Device" (Bhise, Khichi, Korde, Lokare, 2015). The attendance system is improved by using NFC technology and mobile application. According to the research paper, each student is given a NFC tag that has a unique ID during their enrolment into the college. Attendance of each class will then be taken by touching or moving these tags on the lecturer mobile phone. The embedded camera on the phone will then capture the student's face to send all the data to the college server to do validation and verification. The advantages of this method are where the NFC is simple to use, and the speed of connection establishment is very high. It indeed speeds up the attendance taking process a lot. However, this system couldn't automatically spot the violation when the NFC tag is not personally tagged by the original owner. Apart from that, the convenience of the system which uses the mobile phone as the NFC reader was actually an inconvenience to the lecturer. Imagine if the lecturer had forgotten to bring their mobile phones to work, what would be the backup procedure for the attendance to be recorded? Moreover, most of the lecturer will not likely to prefer their personal smart phones to be used in this way due to privacy matter. Hence, unique information about the student like biometrics or face recognition, which is guanine for a student should be used in replacement of the NFC tag. This will ensure attendance to be taken originally by the actual student.

2) Face Recognition Based Attendance Marking System

The second research journals "Face Recognition Based Attendance Marking System" (SenthamilSelvi, Chitrakala, Antony Jenitha, 2014) is based on the identification of face

recognition to solve the previous attendance system's issues. This system uses camera to capture the images of the employee to do face detection and recognition. The captured image is compared one by one with the face database to search for the worker's face where attendance will be marked when a result is found in the face database. The main advantage of this system is where attendance is marked on the server which is highly secure where no one can mark the attendance of other. Moreover, in this proposed system, the face detection algorithm is improved by using the skin classification technique to increase the accuracy of the detection process. Although more efforts are invested in the accuracy of the face detection algorithm, the system is yet not portable. This system requires a standalone computer which will need a constant power supply that makes it not portable. This type of system is only suitable for marking staff's attendance as they only need to report their presence once a day, unlike students which require to report their attendance at every class on a particular day, it will be inconvenient if the attendance marking system is not portable. Thus, to solve this issue, the whole attendance management system can be developed on an portable module so that it can be work just by executing the python program.

3) Fingerprint Based Attendance System Using Microcontroller and LabView

The third research journal "Fingerprint Based Attendance System Using Microcontroller and LabView" (Kumar Yadav, Singh, Pujari, Mishra, 2015) proposed a solution of using fingerprint to mark the attendance. This system is using 2 microcontrollers to deal with the fingerprint recognition process. Firstly, the fingerprint pattern will be obtained through a fingerprint sensor, then the information will be transmitted to microcontroller 1. Next microcontroller 1 will pass the information to microcontroller 2 to do the checking with the database that resides in it. After finding a student's match, the details are sent to the PC through serial communication to be displayed. This design is good as it accelerates development while maintaining design flexibility and simplifies testing. But again, this system is attached to a PC which make it not portable. Other than that, the database information cannot be accessible easily. Meaning that, for the parents whom are interested in knowing their child's attendance cannot easily or conveniently access the information. Therefore, to provide accessibility of the student's information to the legitimate concerned party, the information can be uploaded to a web server for easy access. While the authentication for the appropriate access can be enforced

through a login screen. 2.4 RFID based Student Attendance System According to the fourth research journal “RFID based Student Attendance System” (Hussain, Dugar, Deka, Hannan, 2014), the proposed solution is almost similar to the first research journal where RFID technology is used to improve the older attendance system. In this system, a tag and a reader are again used as a method of tracking the attendance of the students. The difference between the first journals with this is where attendance’s information can be accessed through a web portal. It provides more convenient for information retrieval. Again, this system is imperfect in the sense that, firstly, it is not portable, as the RFID reader can only work when it is connected to a PC. Secondly, the RFID tag is not a guanine information that can uniquely identify a student, thus, resulting in the inaccuracy of the collected attendance information.

In conclusion, a better attendance monitoring system should be developed based on its portability, accessibility and the accuracy of the collected attendance information.

Table 1. Factors affecting face detection

Background	Variation of background and environment around people in the image which affect the efficiency of face recognition.
Illumination	Illumination is the variation caused by various lighting environments which degrade the facial feature detection.
Pose	Pose variation means different angle of the acquired the facial image which cause distortion to recognition process, especially for Eigen face and Fisher face recognition method.
Expression	Different facial expressions are used to express feelings and emotions. The expression variation causes spatial relation change and the facial-feature shape change.
Occlusion	Occlusion means part of the human face is unobserved. This will diminish the performance of face recognition algorithms due to deficiency information.
Rotation, scaling and translation	Transformation of images which might cause distortion of the original information about the images.

Varsha Gupta and Dipesh Sharma (2014) studied Local Binary Pattern (LBP), Adaboost algorithm, local successive mean quantization transform (SMQT) Features, sparse network of winnows

(SNOW) Classifier Method and Neural Network-based face detection methods in addition to Viola-Jones algorithm.

Table 2. Advantages & Disadvantages of Face Detection Methods (Varsha Gupta and Dipesh Sharma, 2014)

Face Detection Method	Advantage	Disadvantage
Viola jones algorithm	1. High detection speed 2. High accuracy.	1. Long training time. 2. Limited head pose. 3. Not able to detect dark faces.
Local Binary pattern	1. Simple computation. 2. High tolerance against the monotonic illumination changes.	1. Only used for binary and grey images. 2. Overall performance is inaccurate compared to Viola-Jones algorithm.
AdaBoost algorithm (Part of Viola jones algorithm)	Need not to have any prior knowledge about face structure.	The result highly depends on the training data and affected by weak classifiers.
SMQT Features and SNOW Classifier Method	1. Capable to deal with lighting problem in object detection. 2. Efficient in computation.	The region contain very similar to grey value regions will be misidentified as face.
Neural-Network	High accuracy only if large size of image were trained.	1. Detection process is slow and computation is complex.

		2. Overall performance is weaker than Viola-Jones algorithm.

SYSTEM DESIGN

The design part can be developed, the hardware part is first completed to provide a platform for the software to work. Before the software part we need to install some libraries for effective working of the application. We install OpenCV and NumPy through Python.

Libraries Development

OpenCV

OpenCV (Open-source computer vision) is a library of programming functions mainly aimed at real-time computer vision. The OpenCV project was initially an Intel Research initiative to advance CPU-intensive applications, part of a series of projects including real-time raytracing and 3Ddisplay walls. The main contributors to the project included several optimization experts in Intel Russia, as well as Intel's Performance Library Team.

OpenCV's application areas include:

- 2D and 3D feature toolkits
- Egomotion estimation
- Facial recognition system
- Gesture recognition
- Human–computer interaction (HCI)
- Mobile robotics
- Motion understanding
- Object identification
- Segmentation and recognition
- Stereopsis stereo vision: depth perception from 2 cameras
- Structure from motion (SFM)

 Motion tracking

 Augmented reality

To support some of the above areas, OpenCV includes a statistical machine learning library that contains:

 Boosting

 Decision tree learning

 Gradient boosting trees

 Expectation-maximization algorithm

 k-nearest neighbour algorithm

 Naive Bayes classifier

 Artificial neural networks

 Random forest

 SVM

Programming Language:

There are bindings in Python, Java and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation.

Operating System Support:

All of the new developments and algorithms in OpenCV runs on the following desktop operating systems: Windows, Linux, macOS, FreeBSD, NetBSD, OpenBSD. OpenCV runs on the following mobile operating systems: Android, iOS, Maemo, BlackBerry 10. The user can get official releases from SourceForge or take the latest sources from GitHub. OpenCV uses CMake.

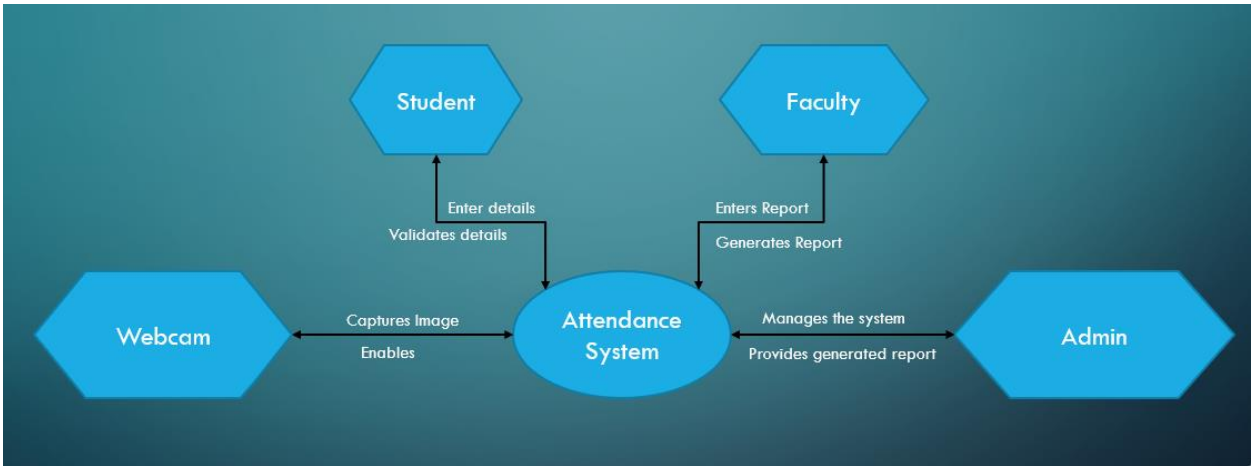
NumPy

NumPy is a package that defines a multi-dimensional array object and associated fast math functions that operate on it. It also provides simple routines for linear algebra and fft and sophisticated random-number generation. NumPy replaces both Numeric and Numarray.

Thus, import numpy will also import the names from numpy.core and numpy.lib. This is the recommended way to use numpy.

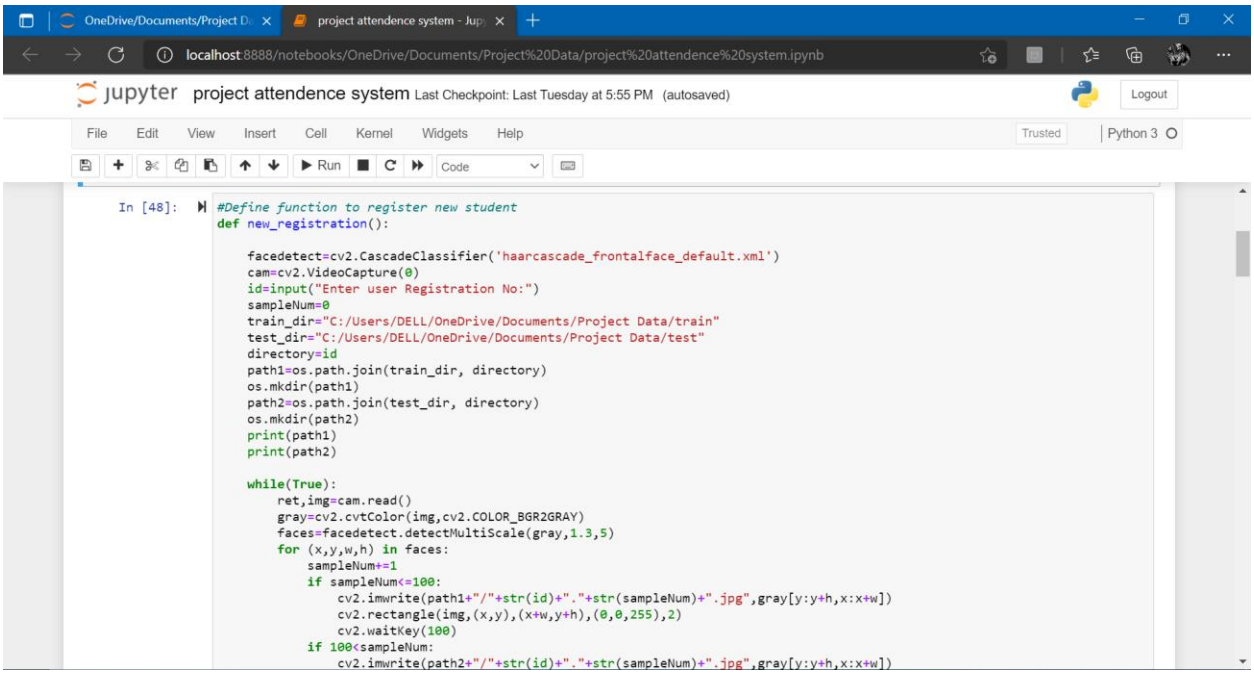
The face database is an important step to be done before any further process can be initiated. This is because the face database acts as a comparison factor during the recognition process which will be discussed in later section. In the process above, a csv file is created to aid the process of image labelling because there will be more than one portrait stored for each student, thus, in order to group their portraits under the name of the same person, labels are used to distinguish them. After that, those images will be inserted into a recognizer to do its training. Since the training process is very time consuming as the face database grew larger, the training is only done right after there is a batch of new addition of student's portraits to ensure the training is done as minimum as possible.

Below diagram shows the system design-



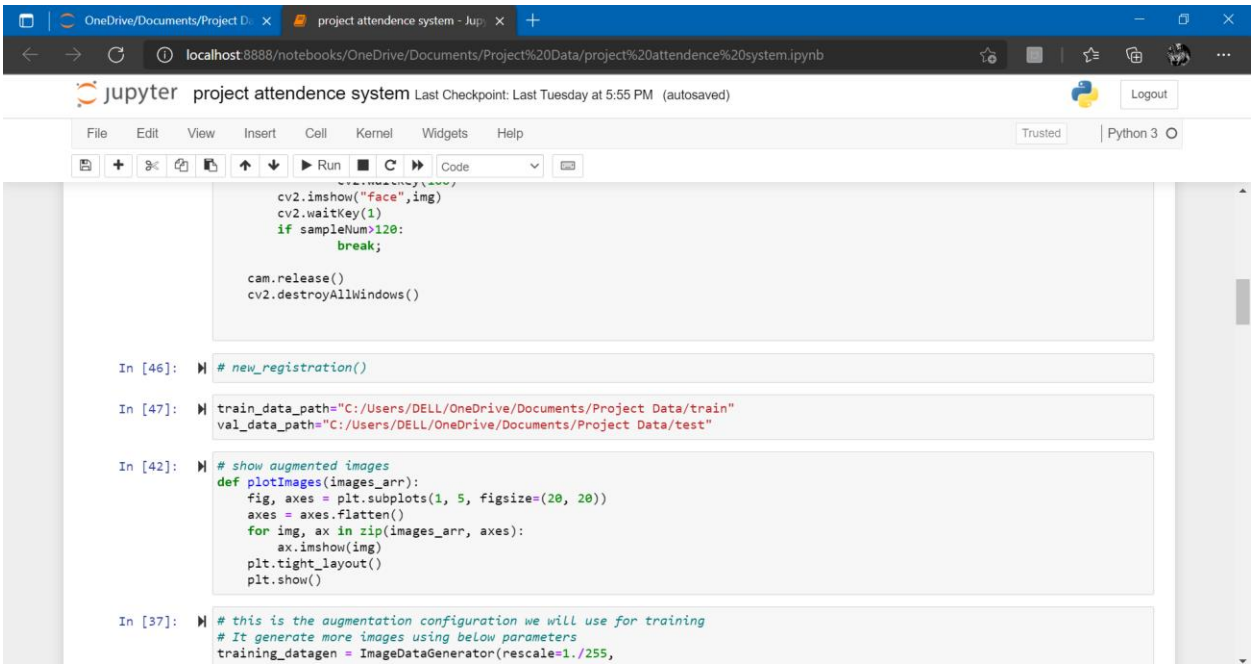
METHODOLOGY

Before the attendance management system can work, there are a set of data needed to be inputted into the system which essentially consist of the individual's basic information which is their ID and their faces. The first procedure of portrait acquisition can be done by using the Camera to capture the faces of the individual. In this process the system will first detect the presence of a face in the captured image, if there are no face detected, the system will prompt the user to capture their face again until it meets certain number of portraits which will be 10 required portraits in this project for each student. The decision of storing only 10 portrait per student is due to the consideration of the limited storage space in the raspberry pi because the total amount of students in the university is considered heavy. Then, the images will undergo several pre-processing procedures to obtain a grayscale image and cropped faces of equal sized images because those are the prerequisites of using the openCv. Both of the processes mentioned above can be represented in the diagram below.

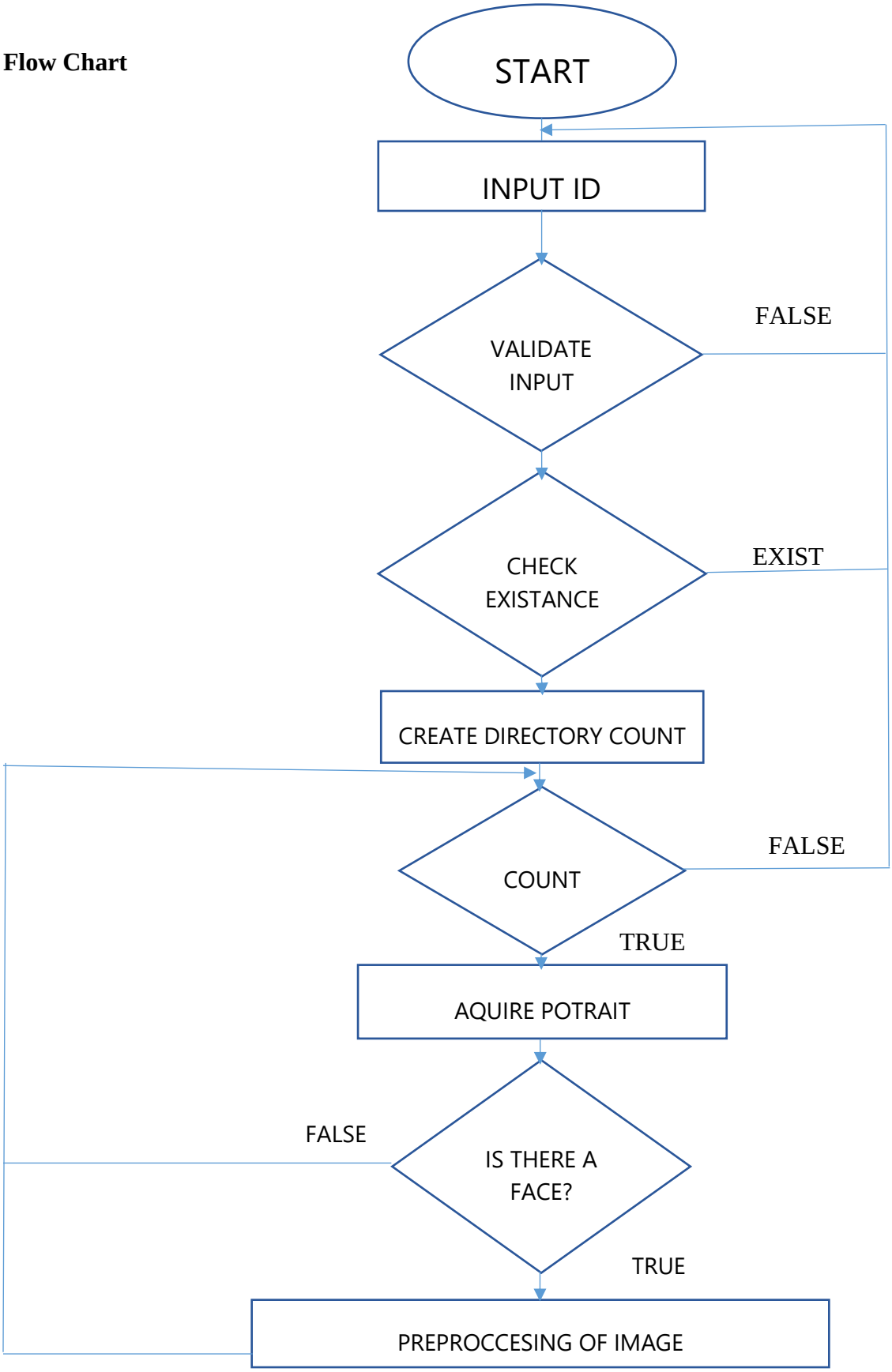


New Registration

After the images are being processed, they are stored into a file in a hierarchy manner. In this project, all the faces will be stored in a hierarchy manner under the „database" folder. When expanding through the database folder, there will consist of many sub-folders which each of them will represent an individual where a series of face portrait belonging to the same individual will be stored in that particular sub-folder. The sub-folders that represent each individual will be named upon the ID no. of that individual which is unique for every single individual in the institution. The whole process of image retrieval, pre-processing, storing mechanism is done by the script named **create_database.py**



Flow Chart


START
INPUT ID
VALIDATE INPUT
FALSE
CHECK EXISTANCE
EXIST
CREATE DIRECTORY COUNT
COUNT
FALSE
TRUE
AQUIRE POTRAIT
IS THERE A FACE?
FALSE
TRUE
PREPROCCESING OF IMAGE

OVERVIEW

In this project we used OpenCV module integrated with Python which will helps the institution to make the attendance process easy and efficient. The system comprises of Computer, HD Video Camera and Wi-Fi module or Internet.

Steps of Working:

- Initiate the [cv2.CascadeClassifier('haarcascade_frontalface_default.xml')] python script.

- Create a DATASET of the student by entering his ID Number/Name.

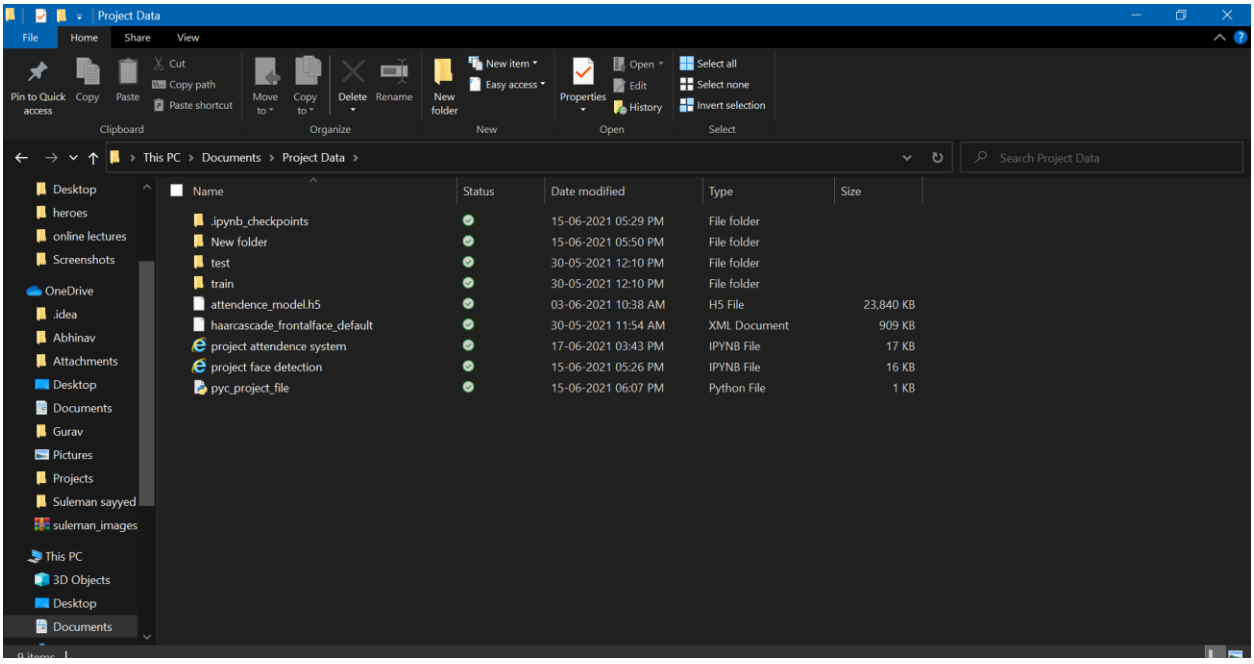
- Train the dataset, attendance_model.h5 file is created.

- A picture of the student is taken, and the OS python file is initiated.

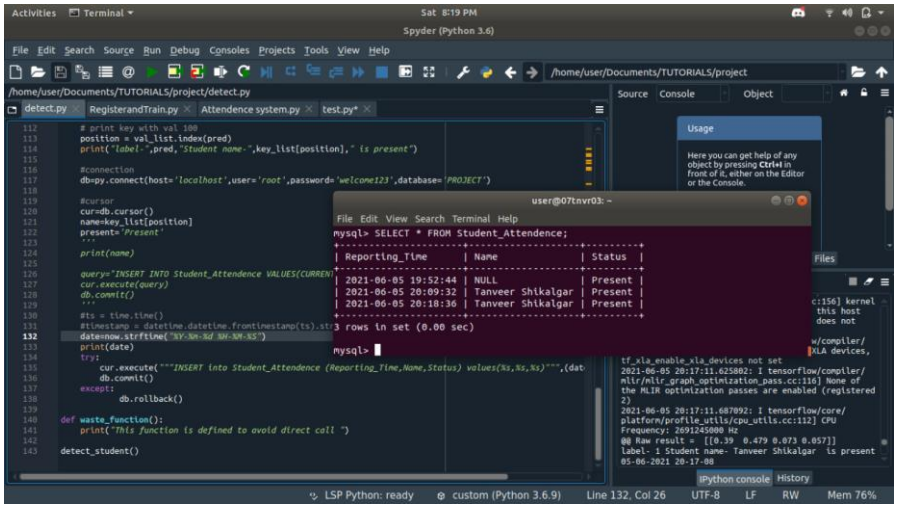
- Attendance is taken by cropping the faces in the picture and comparing with the faces in the database.

- If a face is matched, the responding name with PRESENT status is marked in SQL DBS with the current date and time.

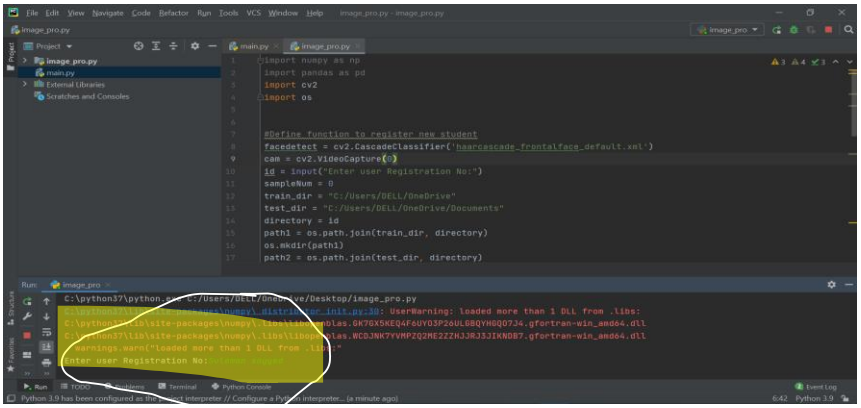
Result -

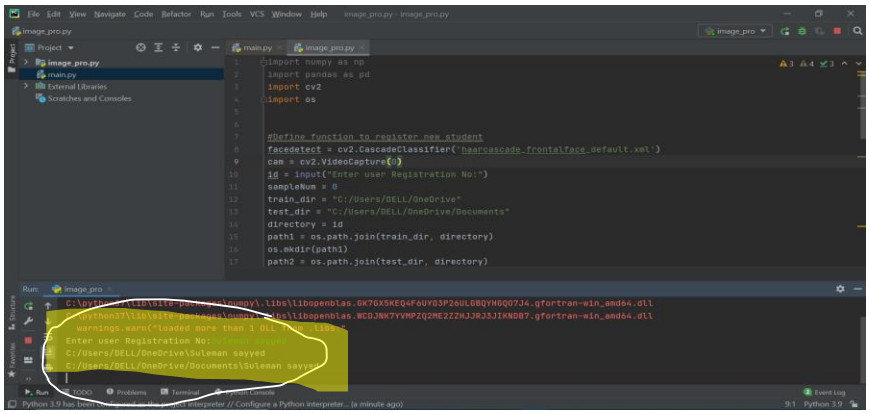


Final Attendance entry in SQL DBS –

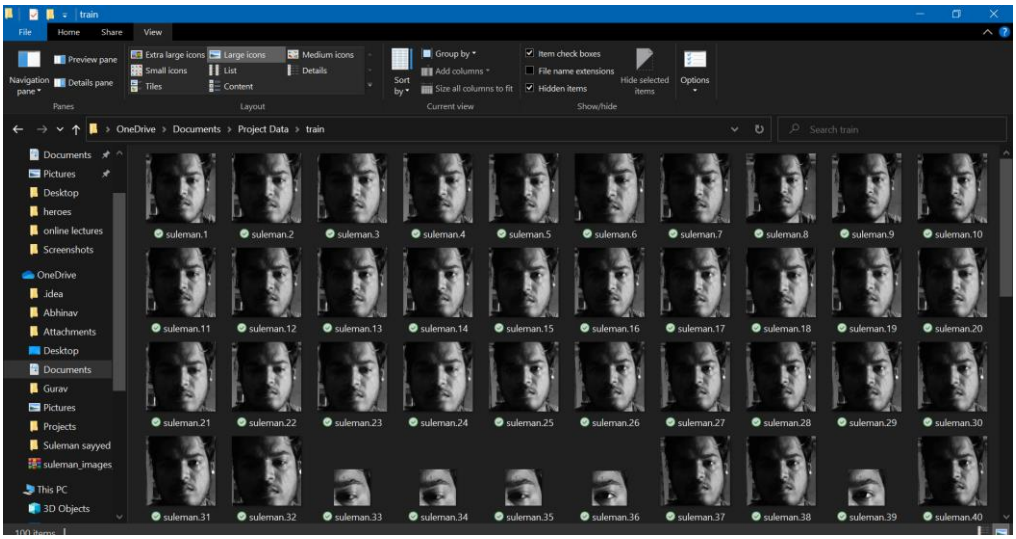


Dataset Capture-





Training dataset –



CONCLUSION

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage. In this project, the face database is successfully built.

Apart from that, the face recognizing system is also working well. At the end, the system not only resolve troubles that exist in the old model but also provide convenience to the user to access the information collected in SQL DBS which further can be shared or send.