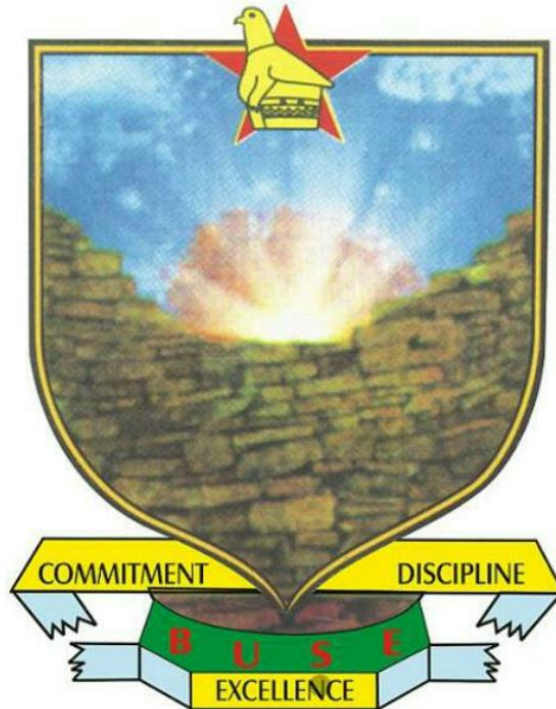


**BINDURA UNIVERSITY OF SCIENCE EDUCATION**

**FACULTY OF SCIENCE AND ENGINEERING**

**DEPARTMENT OF COMPUTER SCIENCE**



**SOFTWARE ENGINEERING LEVEL 2.2 PROJECT**

**SYSTEM DOCUMENTATION**

**TOPIC:**

**FACE RECOGNITION ATTENDANCE SYSTEM FOR EMPLOYEES**

**System files:** <https://github.com/kabukuanesu/Face-Recognition-Based-Attendance-System-For-Employees>

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## Table of Contents

<b>CHAPTER 1: PROBLEM IDENTIFICATION .....</b>	<b>5</b>
1.1 INTRODUCTION .....	5
1.2 BACKGROUND OF THE STUDY .....	6
1.3 STATEMENT OF THE PROBLEM.....	7
1.4 RESEARCH OBJECTIVES .....	8
1.5 RESEARCH QUESTIONS .....	8
1.6 SIGNIFICANCE OF THE STUDY .....	9
1.7 ASSUMPTIONS .....	10
1.8 LIMITATIONS.....	10
1.9 SCOPE OF THE RESEARCH .....	11
1.10 DEFINATION OF TERMS.....	12
1.10.1 BIOMETRICS .....	12
1.10.2 INTERFACE.....	12
1.10.3 SYSTEM.....	12
1.10.4 SOFTWARE .....	12
1.10.5 OPERATING SYSTEM.....	12
1.10.6 PROTOTYPE .....	13
1.10.7 FACE DETECTION .....	13
1.10.8 FACE RECOGNITION .....	13
1.10.9 DIFFERENCE BETWEEN FACE DETECTION AND FACE RECOGNITION .....	13
1.10.10 HAAR-CASCADE CLASSIFIER .....	13
1.10.11 SMART ATTENDANCE SYSTEM .....	13
1.10.12 NFC .....	13
1.10.13 RFID .....	13
1.10.14 OPEN-CV.....	13
1.10.15 NUMPY .....	13
<b>CHAPTER 2: LITARATURE REVIEW.....</b>	<b>14</b>
2.1 INTRODUCTION .....	14
2.2 THE CURRENT SYSTEM .....	14
2.3 LITERATURE SURVEY .....	15

2.3.1 DIGITALIZING THE OLD APPROACH.....	15
2.3.2 MACHINE LEARNING TECHNIQUES.....	16
2.3.3 AUTOMATED ATTENDANCE SYSTEM .....	16
2.3.4 EMPLOYEE ATTENDANCE SYSTEM .....	16
2.3.5 NFC TECHNOLOGY .....	17
2.4 EXISTING RECOGNITION SYSTEMS .....	17
2.4.1 FINGERPRINT BASED .....	17
2.4.2 RFID BASED .....	18
2.4.3 IRIS BASED.....	19
2.4.4 FACE BASED.....	19
2.4.5 GPS BASED .....	21
2.4.6 BARCODE BASED .....	21
2.4.7 ANDROID BASED .....	22
2.5 SOLUTIONS TO ADDRESS PROBLEMS.....	23
2.6 THE PROPOSED SYSTEM.....	24
2.7 EMPLOYEE ATTENDANCE SYSTEM .....	24
2.7.1 DIGITAL IMAGE PROCESSING.....	24
2.7.2 SYSTEM DESIGN .....	25
2.7.3 LIBRARIES DEVELOPMENT .....	25
2.7.4 SOFTWARE DEVELOPMENT .....	26
2.7.5 OVERVIEW.....	26
2.7.6 CONCLUSION.....	26
2.8 RESULTS AND DISCUSSIONS .....	26
2.8.1 CAPTURE VIDEO .....	27
2.8.2 SEPARATE AS FRAMES FROM THE VIDEO .....	27
2.8.3 FACE DETECTION.....	27
2.8.4 FACE RECOGNITION .....	27
2.8.5 POST-PROCESSING .....	28
2.8.6 FUTURE ENHANCEMENTS.....	28
2.8.7 CONCLUSION.....	28
<b>CHAPTER 3: RESEARCH METHODOLOGY .....</b>	<b>29</b>
3.1 INTRODUCTION .....	29

3.2 REQUIREMENTS ENGINEERING.....	29
3.2.1 ELICITATION .....	29
3.2.2 FUNCTIONAL REQUIREMENTS .....	29
3.2.3 NON FUNCTIONAL REQUIREMENTS .....	30
3.2.4 USER SOFTWARE REQUIREMENTS.....	30
3.3 SYSTEM REQUIREMENTS .....	30
3.3.1 INPUTS .....	30
3.3.2 PROCESSES .....	30
3.3.3 OUTPUTS.....	30
 <b>CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION .....</b>	<b>31</b>
4.1 INTRODUCTION .....	31
4.2 USER INTERFACE DESIGN .....	31
4.3 PROCESS DIAGRAMS .....	34
4.4 SYSTEM CODE.....	34
4.5 TESTING .....	39
4.5.1 UNIT TESTING.....	39
4.5.2 INTEGRATION TESTING .....	40
4.5.3 USER VALIDATION.....	40
 <b>CHAPTER 5: CONCLUSION AND RECOMMENDATIONS .....</b>	<b>41</b>
5.1 INTRODUCTION .....	41
5.2 CHALLENGES .....	41
5.3 RECOMMENDATIONS.....	41
5.4 CONCLUSION.....	42
 <b>REFERENCES.....</b>	<b>43</b>

# **CHAPTER 1: PROBLEM IDENTIFICATION**

## **1.1 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. 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 key-stroke 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. The face is the most important part of the human body because it uniquely identifies a person. Face recognition systems can be implemented by using facial characteristics as biometrics. The primary goal of this project is to build a face recognition-based attendance monitoring system for employees working in an organization in order to improve and upgrade the current attendance system to make it more efficient and effective than before. The employee should be in an area containing light so that the detection can be clearly made. It is on this very premise that I embark on this journey in an attempt to take full advantage of the tools that are at our disposal and further address the challenges that employers face in terms of employee attendance.

## **1.2 BACKGROUND OF THE STUDY**

Face recognition is crucial in daily life in order to identify family, friends or someone we are familiar with. We might not perceive that several steps have actually been taken in order to identify human faces. Human intelligence allows us to receive information and interpret the information in the recognition process. We receive information through the image projected into our eyes by the retina in the form of light. Light is a form of electromagnetic waves which are radiated from a source onto an object and projected to human vision. The analyzed information will be compared to other representations of objects or face that exist in our memory to recognize. In fact, it is a hard challenge to build an automated system to have the same capability as a human to recognize faces. However, we need large memory to recognize different faces, for example, in the Mining Sector, there are a lot of workers with different race and gender, it is impossible to remember every face of the individual without making mistakes. In order to overcome human limitations, computers with almost limitless memory, high processing speed and power are used in face recognition systems. The human face is a unique representation of individual identity. Thus, face recognition according to (Rouse,

2013) is defined as a biometric method in which identification of an individual is performed by comparing real-time capture image with stored images in the database of that person. Nowadays, face recognition system is prevalent due to its simplicity and awesome performance. For instance, airport protection systems and FBI use face recognition for criminal investigations by tracking suspects, missing children and drug activities as mentioned by (Silk, 2017). Apart from that, (Fussell, 2018) discussed that Facebook which is a popular social networking website implement face recognition to allow the users to tag their friends in the photo for entertainment purposes. Furthermore, Intel Company allows the users to use face recognition to get access to their online account as discussed by (Reichert, 2017). (deAgonia, 2017) said that, “Apple allows the users to unlock their mobile phone, iPhone X by using face recognition.” The work on face recognition began in 1960. Woody Bledsoe, Helen Chan Wolf and Charles Bisson had introduced a system which required the administrator to locate eyes, ears, nose and mouth from images. The distance and ratios between the located features and the common reference points are then calculated and compared. The studies are further enhanced by Goldstein, Harmon, and Lesk in 1970 by using other features such as hair colour and lip thickness to automate the recognition. In 1988, Kirby and Sirovich first suggested principle component analysis (PCA) to solve face recognition problem. Many studies on face recognition were then conducted continuously until today.

Manual Recording (Muster Roll) of In and out time of employees as well as maintaining the time sheets (in Microsoft Excel) are attendance systems that already exists in most of the institutions in Zimbabwe.

I discovered that:

- i. Personnel department spend a lot of time correcting errors due to employees recording their hours of work incorrectly in a time sheet and the information is incorrectly entered into a payroll software.
- ii. A lot of time is spent on attendance time sheets and employees have to queue to enter or exit.
- iii. Paperwork takes a lot of space.

### **1.3 STATEMENT OF THE PROBLEM**

Traditional employee attendance marking technique is often facing a lot of trouble. The face recognition employee attendance system emphasizes its simplicity by eliminating classical employee attendance marking technique such as calling employee names or checking respective identification cards. There are not only disturbing the working process but also causes distraction for managers who might have other important tasks to do. Apart from calling names, attendance sheet is passed around the work station during the work sessions. The work station especially the one with a large number of workers might find it difficult to have the attendance sheet being passed around the station. Thus, face recognition attendance system is proposed in order to replace the manual signing of the presence of employees which are burdensome and causes employees get distracted in order to sign for their attendance.

Furthermore, the face recognition based employee attendance system is able to overcome the problem of fraudulent approach and managers do not have to count the number of students several times to ensure the presence of the workers.

The paper proposed by (Zhao et al., 2013) has listed the difficulties of facial identification. One of the difficulties of facial identification is the identification between known and unknown images. In addition, paper proposed by (Pooja et al., 2020) found out that the training process for face recognition student attendance system is slow and time-consuming. In addition, the paper proposed by (Wagh et al., 2015) mentioned that different lighting and head poses are often the problems that could degrade the performance of face recognition based student attendance system. Hence, there is a need to develop a real time operating student employee system which means the identification process must be done within defined time constraints to prevent omission. The extracted features from facial images which represent the identity of the employees have to be consistent towards a change in background, illumination, pose and expression. High accuracy and fast computation time will be the evaluation points of the performance.

Employees record their hours of work incorrectly in a time sheet and the information is incorrectly entered into a payroll software. These errors often occur in the workplace where most of the employees are illiterate. Personnel department spend a lot of time correcting these errors. Unrecorded errors lead to incorrect employee payments and other payroll issues.

Manual time sheets and punched cards do not prevent time theft or punching by friends. With manual time recording, an employee use another punch card to register for his or her shift. This is called buddy punching and is a problem in large companies.

A lot of time is spent on attendance time sheets. Employees have to queue to enter or exit and human resources department spend time dealing with time on time ticket issues. This include correcting time entry errors and errors, and other problems that occur when using manual time recording systems.

Paperwork takes up a lot of space when the presence is marked in the records. For institutions with multiple offices, it is even more difficult to access documents from each office in different locations.

## **1.4 RESEARCH OBJECTIVES**

The objective of this project is to develop face recognition attendance system.

Expected achievements in order to fulfill the objectives are:

- i. To detect the face segment from the video frame.
- ii. To extract the useful features from the face detected.

- iii. To classify the features in order to recognize the face detected.
- iv. To record the attendance of the identified student.
- v. To deliver a system that uses face recognition to prevent signing in by a friend.
- vi. To deliver a system that automatically records hours of work correctly.
- vii. To provide an interface that allows employees to see their daily attendance time.
- viii. To deliver a system that allows the management to modify the pay per unit time and calculate the daily wage.
- ix. To deliver a system that is fast and spend less time in dealing with exit and entrance issues.
- x. To deliver a system based on the clear idea of what the users really want.
- xi. To provide a system that works on Windows Operating System which is a common OS to the target users.
- xii. To test the system on a small group of workers.
- xiii. Have enough memory space to store the database.
- xiv. Able to recognize the face of an individual accurately based on the face database.

## **1.5 RESEARCH QUESTIONS**

- i. What method is to be used in taking attendance?
- ii. How are the working hours going to be calculated?
- iii. How are the users going to have access to information on their daily attendance?
- iv. How is the daily wage going to be calculated?
- v. How is the system going to improve time resource as compared to currently existing systems?
- vi. What do the users want?
- vii. What Operating System am I going to use?
- viii. How do I test the system?

## **1.6 SIGNIFICANCE OF THE STUDY**

Employees record their hours of work incorrectly in a time sheet and the information is incorrectly entered into a payroll software therefore the study will deliver a system that automatically records hours of work correctly.

Manual time sheets and punched cards do not prevent time theft or punching by friends therefore the study will deliver a system that uses face recognition to prevent signing in by a friend.

Employees have to queue to enter or exit and human resources department spend time dealing with time on time ticket issues but the study will deliver a system that is fast and spend less time in dealing with exit and entrance issues.



Paperwork takes up a lot of space when the presence is marked in the records, so the study will deliver a system that do not use paper for storage of information but electronic storage devices.

For some institutions, the daily wages depend on the demand and workload of that particular day therefore the system will be able to calculate the daily wages depending on the payrate of that particular day.

Employees will be more punctual on attending duties. This is so because the attendance of an employee can only be taken personally where any absentees will be noticed by the system. This can not only train the employee to be punctual but as well as avoiding any immoral ethics such as signing the attendance of a friend.

The institution can save a lot of resources as enforcement are now done by means of technology rather than human supervision which will waste a lot of human resource for an insignificant process.

The application can operate on any device at any location which makes the attendance system to be portable and to be placed at any intended location. For example, the device can be placed at the entrance of the workstation to take the attendance.

It saves a lot of cost in the sense that it had eliminated the paperwork completely.

The system is also time effective because all calculations are all automated. In short, the project is developed to solve the existing issues in the old attendance system.

## **1.7 ASSUMPTIONS**

- i. Managers might participate in my survey in helping to identify problems faced when capturing attendance of employees.
- ii. Accountants might participate in my survey in helping to identify the challenges faced in calculating fair wages.
- iii. Employers might participate in my survey in helping to identify the challenges faced with employee attendance.
- iv. Employers might participate in my survey, helping to point out the problem faced with wages and working hours in respect to their attendance.
- v. Bindura University of Science Education might sponsor my project.

## **1.8 LIMITATIONS**

The system will improve efficiency and also bring convenience for all the operations at the university. However, the system also has limitations, these include:

- i. Unable to obtain a dataset of faces to train the model.
- ii. Unable to obtain an HD Camera.
- iii. Low response rate from managers and employers during the survey.
- iv. The system is unable to check-in and check-out a single person multiple times when going out for a break.
- v. The software cannot actually confirm the entrance of an individual. One can check-in and go back home at that moment and come back later to check-out.

## **1.9 SCOPE OF THE RESEARCH**

I am setting up to design a system comprising of a module that captures workers' faces and stores them in a file using computer vision face detection algorithms and face extraction techniques and do face recognition of the captured images (faces) in the file, marks the workers register and then stores the results in a database for future analysis. Although the project covers the boundary of developing an application to be used by managers, employers and staff from different institutions – ranging from government complexes, schools, mining sectors as well as retail shops and many other – I shall develop only a prototype as a proof of concept for the Faculty of Science Education and Engineering Complex General Workers. This is on the basis that if the system works for one group of workers at the Faculty, it can easily work for all the Faculties at the University because the problems I intend to address herein are universal to all groups of workers in different institutions.

The main intention of this project is to solve the issues encountered in the old attendance system while reproducing a brand new innovative smart system that can provide convenience to the institution. In this project, an application will be developed which is capable of recognising the identity of each individual and eventually record down the data into a database system. Apart from that, an excel sheet is created which shows the employees attendance.

The followings are the project scopes:

- a. The targeted groups of the attendance monitoring system are the employees and staff of an institution.
- b. The facial recognition process can only be done for 1 person at a time.
- c. An excel sheet is created which contains the employee attendance.

## **1.10 DEFINATION OF TERMS**

### **1.10.1 BIOMETRICS**

Biometrics is an emerging technology for automatic human identification and verification using unique biological traits.

### **1.10.2 INTERFACE**

An interface is a shared boundary across which two or more separate components of a computer system exchange information. The exchange can be between software, computer hardware, peripheral devices, humans, and combinations of these.

### **1.10.3 SYSTEM**

A system is a collection of elements related in a way that allows a common objective to be accomplished. In computer systems, these elements include hardware, software, people, facilities, and processes.

### **1.10.4 SOFTWARE**

Software is a set of instructions, data or programs used to operate computers and execute specific tasks.

### **1.10.5 OPERATING SYSTEM**

An operating system (OS) is the program that, after being initially loaded into the computer by a boot program, manages all of the other application programs in a computer.

### **1.10.6 PROTOTYPE**

A prototype is a rudimentary working model of a product or information system, usually built for demonstration purposes or as part of the development process.

### **1.10.7 FACE DETECTION**

Face Detection is the process of identifying and locating all the present faces in a single image or video regardless of their position, scale, orientation, age and expression. Furthermore, the detection should be irrespective of extraneous illumination conditions and the image and video content.

### **1.10.8 FACE RECOGNITION**

Face Recognition is a process of detecting faces by identifying facial features in a photo or video using machine learning algorithms. It first looks for an eye, and from there it identifies other facial features. It then compares these features to training data to confirm it has detected a face. Basically, it is a visual pattern recognition problem, where the face, represented as a three dimensional object that is subject to varying illumination, pose and other factors, needs to be identified based on acquired images. Face Recognition is therefore simply the task of identifying an already detected face as a known or unknown face and in more advanced cases telling exactly whose face it is.

### **1.10.9 DIFFERENCE BETWEEN FACE DETECTION AND FACE RECOGNITION**

Face detection answers the question, Where is the face? It identifies an object as a “face” and locates it in the input image. Face Recognition on the other hand answers the question who is this? Or whose face is it? It decides if the detected face is someone. It can therefore be seen that face detections output (the detected face) is the input to the face recognizer and the face Recognition’s output is the final decision i.e. face known or face unknown.

### **1.10.10 HAAR-CASCADE CLASSIFIER**

A Haar-Cascade classifier, is a machine learning object detection program that identifies objects in an image and video.

### **1.10.11 SMART ATTENDANCE SYSTEM**

A smart attendance system typically refers to a technology-driven system that allows organizations or educational institutions to manage and track attendance in a more efficient and automated way. This system uses various technologies such as biometric recognition, RFID, QR codes, or facial recognition to identify individuals and record their attendance.

### **1.10.12 NFC**

NFC stands for Near Field Communication, which is a technology that allows wireless communication between two devices that are in close proximity to each other, typically within a few centimeters. NFC uses radio waves to transmit data between devices, which can include smartphones, tablets, and other electronic devices.

#### **1.10.13      RFID**

RFID stands for Radio Frequency Identification, which is a technology that uses radio waves to identify and track objects or people. RFID systems typically consist of three parts: a tag, a reader, and a database.

#### **1.10.14      OPEN-CV**

OpenCV (Open Source Computer Vision) is a popular open-source computer vision and machine learning library that is written in C++ and has interfaces for Python, Java, and other programming languages. OpenCV provides a wide range of image processing and computer vision tools, including image and video capture, filtering, feature detection and matching, object detection and recognition, and more.

#### **1.10.15      NUMPY**

NumPy (short for Numerical Python) is a popular Python library that provides support for large, multi-dimensional arrays and matrices, as well as a wide range of mathematical functions to operate on them. NumPy is widely used in scientific computing, data analysis, and machine learning applications.

## **CHAPTER 2: LITARATURE REVIEW**

### **2.1 INTRODUCTION**

In this chapter, I will review relevent theory from emperical and theoetical literature related to facial recognition systems. The Journals to be used in this chapter are within the period 2014 upto the current date (2023).

Every institution that depends on people must account for its employees as a first step in the modern-day. As a result, creating and maintaining a suitable management system costs the different organizations a substantial sum of money. In many countries, government organizations and educational institutions keep track of attendance using paper-based methods. For example, to maintain track of each employee's attendance, it takes time to call out their name at the beginning of the day. False signs, names missing from spreadsheets, manually inputting data into systems, and the possibility of proxy attendance are further problems. Such techniques have a few problems that have grown over time. To track attendance, it is crucial to swap out these outdated practices for modern ones. As a result, a lot of work and research has been done in this area using current technologies. Especially, automatic recognition of a particular individual based on distinguishing characteristics such as QR code, ID and password, face recognition, fingerprint recognition is of interest to researcher. This chapter presents a literature overview of the recent works on automated and smart attendance tracking systems. Concerning technology, application domain, and key findings, this critical assessment has emphasized research in the body of literature.

### **2.2 THE CURRENT SYSTEM**

Traditional method of attendance marking is a tedious task in many organisations and institutions. (Smitha, Hegde & Afsin, 2020) stated that, “It is also an extra burden to the institutions who should mark attendance by manually calling the names of workers which might take about 5 minutes of entire session.” This is time consuming. There are some chances of proxy attendance. Therefore, many institutes started deploying many other techniques for recording attendance like use of Radio Frequency Identification (RFID), iris recognition, fingerprint recognition, and so on. However, these systems are queue based which might consume more time and are intrusive in nature.

(Abdalkarim & Ali, 2022) mentioned that in many countries, government organizations and educational institutions keep track of attendance using paper-based methods. For example, to maintain track of each employee's attendance, it takes time to call out their name at the beginning of the day. False signs, names missing from spreadsheets, manually

inputting data into systems, and the possibility of proxy attendance are further problems. Such techniques have a few problems that have grown over time. To track attendance, it is crucial to swap out these outdated practices for modern ones. As a result, a lot of work and research has been done in this area using current technologies. Especially, automatic recognition of a particular individual based on distinguishing characteristics such as QR code, ID and password, face recognition and fingerprint recognition.

(Abraham et al., 2020) stated, “Many organizations are using some automatic systems such as punch cards, RFID cards, fingerprint scanner and to some extent face recognition and the most traditional method of marking attendance is through roll calls.” The paper also proposed that most of the organizations have moved towards digital methods such as swipe or punch cards to get the job done. Both the methods got some drawbacks. Roll call method is time-consuming and prone to human errors. Mistakes such as marking the present person absent and vice versa can occur in this method. Digital methods such as swipe and punch cards can overcome the drawbacks in the previous mentioned method, but it also gives rise to new issues. Swipe cards are less time consuming but it doesn't check for the presence of the person while swiping the card, which may lead to another person marking proxy attendance of the absent person. Also, another concern is that if a person loses his or her swipe card, then he or she may have to wait sometime before getting a new card. Using biometric can help to overcome the issues existing in previous techniques.

## **2.3 LITERATURE SURVEY**

### **2.3.1 DIGITALIZING THE OLD APPROACH**

Traditional employee attendance involves all the roll-calling issues and takes a lot of time for employees and managers to conduct departmental sessions. The procedure is lengthy and takes many instructors' and employees' time. (Mendonca et al., 2020), reduced the length of the complete attendance verification by designing an online system. Substituting the conventional procedure, managers had to call each employee's name and note the attendance when the employee answered. It offers a more straightforward and quicker approach to monitoring attendance. Instructors will no longer require a paper sheet to mark employee attendance in their proposed system. They can construct attendance records by obtaining the necessary information from the database, making the entire procedure paperless. (Abdalkarim & Akgün, 2022) mentioned that another research used mobile devices in the attendance management system which were developed and put into practice. A mobile-based attendance management program for Android systems was developed using VB.NET and SQL Server. This project allows for the maintenance of employee attendance, calculating attendance grades, and creating a report. Five components make up the system: admin, registration, employee, SMS, and an

Android component. Employees can use the android part to send messages to the system informing managers of their absence. Employers can also get SMS notifications on attendance report.

### **2.3.2 ATTENDANCE AND FEEDBACK SYSTEM USING MACHINE LEARNING TECHNIQUES**

In the paper by (Nandhini, Duraimurugan & Chokkalingam, 2019), the idea of two technologies namely Employee Attendance and Feedback system has been implemented with a machine learning approach. This system automatically detects the employee performance and maintains the employee's records like attendance and their feedback on the salary and wages. Therefore the attendance of the employee can be made available by recognizing the face. On recognizing, the attendance details and details about the wages of the employee is obtained as feedback.

### **2.3.3 AUTOMATED ATTENDANCE SYSTEM USING FACE RECOGNITION**

(Nandhini, Duraimurugan & Chokkalingam, 2019) proposes that the system is based on face detection and recognition algorithms, which is used to automatically detects the employee face when he/she enters the room and the system is capable to mark the attendance by recognizing him/her. Viola-Jones Algorithm has been used for face detection which detect human face using cascade classifier and PCA algorithm for feature selection and SVM for classification. When it is compared to traditional attendance marking this system saves the time and also helps to monitor the employees.

### **2.3.4 EMPLOYEE ATTENDANCE SYSTEM USING IRIS DETECTION**

(Nandhini, Duraimurugan & Chokkalingam, 2019) proposed a system in which the employee is requested to stand in front of the camera to detect and recognize the iris, for the system to mark attendance for the employee. Some algorithms like Gray Scale Conversion, Six Segment Rectangular Filter, Skin Pixel Detection is being used to detect the iris. It helps in preventing the proxy issues and it maintains the attendance of the employee in an effective manner, but in one of the time-consuming process for a employee or a staff to wait until the completion of the previous members.



### **2.3.5 ATTENDANCE SYSTEM USING NFC TECHNOLOGY WITH EMBEDDED CAMERA ON MOBILE DEVICE**

According to (Bhise et al., 2015), the attendance system is improved by using NFC technology and mobile application. According to the research paper, each employee is given an NFC tag that has a unique ID during their recruitment into the institution. Attendance of each employee will then be taken by touching or moving these tags on the manager's mobile phone. The embedded camera on the phone will then capture the employee's face to send all the data to the institution server to do validation and verification. The advantages of this method is 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 could not 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 manager. Imagine if the manager 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 managers will not likely prefer their personal smart phones to be used in this way due to privacy matter. Hence, unique information about the employee like biometrics or face recognition, which is genuine for an employee should be used in replacement of the NFC tag. This will ensure attendance to be taken originally by the actual employee.

## **2.4 EXISTING RECOGNITION SYSTEMS**

### **2.4.1 FINGERPRINT BASED RECOGNITION SYSTEM**

In the Fingerprint based existing attendance system proposed by (Nandhini, Duraimurugan & Chokkalingam, 2019), a portable fingerprint device need to be configured with the employees fingerprint earlier. Later either during the working hours or before, the employee needs to record the fingerprint on the configured device to ensure their attendance for the day. The problem with this approach is that during the working time it may distract the attention of the employees.

Most of the research has demonstrated that fingerprint or hand gesture recognition is a highly suitable method for an attendance management system. The method of digitally comparing one or more unknown fingerprints to a collection of known and unknown fingerprints in the database is known as automated fingerprint recognition. A particular finger assumption device that is used as a component of a special finger impression attendance framework was described by (Mohamed & Raghu, 2015). The students may check their essence by placing their fingertips on

the device's sensor. But because fingerprint scanners can't always identify something the first time, this framework lacks viability. (Abdalkarim & Akgün, 2022) presented an attendance system employing smartphone GPS and fingerprint technologies. The method takes a lot of time since it makes use of fingerprint recognition.

(Yadav et al., 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 an employee'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 employees who are interested in knowing their attendance cannot easily or conveniently access the information. Therefore, to provide accessibility of the employee'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.

#### **2.4.2      RFID BASED RECOGNITION SYSTEM**

In the RFID based existing system mentioned by (Nandhini, Duraimurugan & Chokkalingam, 2019), the employee needs to carry a Radio Frequency Identity Card with them and place the ID on the card reader to record their presence for the day. The system is capable of connecting to radio station and record the attendance to the saved database. There are possibilities that fraudulent access may occur. Some of the employees may make use of other employees ID to ensure their presence when the particular employee is absent or they even try to misuse it sometimes.

(Abdalkarim & Akgün, 2022) refer to RFID as a more straightforward form of the NFC (Near field communication) technology that many Android devices utilize for digital payments. (Souza et al., 2015) explores numerous frameworks put up for board involvement using different improvements. The board is advised to use another form of participation specifically for ordinary level institutions in consideration of this discussion. The proposed model includes components for mobile applications and RFID. The RFID component is suggested for documenting student engagement in the database at the back end. The application portion is intended to give their families attendance information. When there is no electricity

or not many resources to send by the RFID component, the application part is used as a backup to track the attendance.

According to (Hussain et al., 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 is again used as a method of tracking the attendance of the employees. 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 genuine information that can uniquely identify an employee, thus, resulting in the inaccuracy of the collected attendance information.

#### **2.4.3 IRIS BASED RECOGNITION SYSTEM**

In the Iris based student attendance system proposed by (Nandhini, Duraimurugan & Chokkalingam, 2019), the student needs to stand in front of a camera, so that the camera will scan the Iris of the student. The scanned iris is matched with data of student stored in the database and the attendance on their presence needs be updated. This reduces the paper and pen workload of the faculty member of the institute. This also reduces the chances of proxies in the class, and helps in maintaining the student records safe. It is a wireless biometric technique that solves the problem of spurious attendance and the trouble of laying the corresponding network.

#### **2.4.4 FACE BASED RECOGNITION SYSTEM**

The Face Recognition-based Attendance Management System, was developed by (Smitha, 2016) to develop an organized attendance system using face recognition methods. Through facial ID, the system can record involvement. Through a camera, it finds faces and then recognizes them. The system is split into two parts: facial recognition and detection. Using the Local Binary Pattern Histogram (LBPH), the system will identify faces of workers in the live-streamed video from the and if the recognized face is found in the database, the system will mark their attendance.

Face recognition technology was also discussed by (Varadharajan et al., 2018) in their paper. They placed a camera inside a room, using this technique to take pictures. The attendance is registered as a present after faces are found and identified in the database. Managers are informed of a employee's disappearance if their attendance is noted as absent. The research by (Chandramouli et al., 2019), where they utilized NVIDIA's Jetson Nano, is one of many that tries to modernize how attendance is managed in a certain method and even the parameters for time management. The device is set in a room, where the names and photos of the

employees are held. Open CV is used to obtain the photos. The processor board would be NVIDIA Jetson Nano's Developer kit. A Haar classifier is used to identify faces once the extraction has been processed. They subsequently identified with the aid of the LBPH Algorithm. An Excel spreadsheet is generated and refreshed hourly with data from the appropriate department manager. (Ofualagba et al., 2019) suggested a system named Automated Attendance Management System Using Face Recognition that highlights the use of Cloud Computing (CC) technological concepts to boost the performance of face identification methods. The FACECUBE system, which is suggested here, uses facial recognition to take attendance. The system provides workers, instructors, and administrators with online features. However, putting this system together involves several steps, including purchasing new hardware and software. (Susanto et al., 2021) were attempted to perform a slightly different type of research concerning the detection of face recognition of users who are present in the application system via an Android device. They make a connection with face recognition detection and, after that, save it to the database that was used as information about the presence of users. The local binary pattern histogram (LBPH) classifier approach, which may be used as a strategy in the attendance system of employees to be more efficient and productive, is used to evaluate the facial recognition system. An open-source, generic application for assessing daily attendance using face recognition and making use of the Android system was proposed in the (Hava et al., 2022) study. Almost every institution may readily get it at no cost. With this suggested solution, Google Sheets are automatically created and available to the institution with no effort. The system involves facial identification and recognition algorithms to identify individual workers and record their participation. (Prangchumpol, 2020) mentions in his research that his performance still falls short when it comes to accurately identify employees' faces and that he is still unable to confirm or rectify the data when a mistake occurs. Therefore, he seeks to improve the efficiency of the face recognition-based attendant system and make the system's principles simple for employees to understand. This sort of validation aims to discover how to detect faces utilizing the Android Face Recognition with Deep Learning approach. The database is linked to the web server using cloud storage. (Alburaiki et al., 2018) developed a methodology that solved three key elements: First, using mobile phone cameras and automatically recognizing and analyzing faces. The second is a machine-learning based facial recognition API. Lastly, maps API. The outcome demonstrates that face recognition has attained high accuracy in identifying employees' faces even in unfavorable conditions. The system displayed practical examples of responses by marking the employee's attendance after identifying the employee's face and location, as well as the manager has the option to access a report of submitted attendance. A portable attendance system that could be accessed from any location at any time inspired (Abdalkarim & Akgün, 2022) study. Without carrying paper and PCs, the manager may simply verify attendance using an Android smartphone. The students' Android phones make it simple for them to

check their attendance information. Additionally, SMS technology is employed to ensure the safety of the employees and to notify families about their attendance. Face recognition is also used to establish a proper attendance record. A particular employee's face is detected and recorded as present in the database using the Android device's camera. When necessary, attendance reports could also be formed.

The research (Selvi, Chitrakala & 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 that attendance is marked on the server which is highly secure and no one can mark the attendance of another. 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.

#### **2.4.5      GPS-BASED ATTENDANCE SYSTEM**

(Abdalkarim & Akgün, 2022) mentioned that Global Positioning System, or GPS, enables us to determine a person's location and direction at any time, any place on Earth. In terms of knowing where humans are and how to go to other areas, people still need objects in the sky, but now satellites utilize them. In their work, (Kumar & Kumar, 2018) presented a creative location-based time and attendance monitoring system that was deployed on an Android mobile app. The use of smartphones helps to reduce the need for additional biometric scanning equipment. Components of the organization include a specific location, which may be located using GPS. The GPS on mobile phones determines each employee's place, and these locations are crucial for some time and attendance tracking.

#### **2.4.6      BARCODE / QR CODE BASED**

An associated barcode is a graphical way to represent data that machines regarding the item can read as mentioned by (Abdalkarim & Akgün, 2022). A quick Response

Code, sometimes known as a QR code, is comparable to a barcode. However, it holds data in both two perpendicular directions because of its two-dimensionality. As a result, a QR code may store several times more data than a barcode. Discussing a system for automating employee attendance was introduced by (Noor et al., 2009). Everyone in this system has a unique ID that is assigned a barcode that the mobile app can scan. Each user in this system has an individual ID with a barcode that the mobile app may scan. One of the drawbacks of this approach was that a single employee may trick it by using the IDs of the other employees in the arrangement. Another approach depends on gathering attendance and updating data in one area. The suggested method, which was built utilizing QR code technology and is based on research by (Sutar et al., 2011), is a smart attendance system that would speed the attendance process by creating and scanning QR codes. The system runs as an application on mobile devices and is built on QR Technology. Moreover, to assure employee attendance, Sunaryono et al. suggest "an Android-based attendance system using face recognition." (2010). The job information is encoded into a QR code and presented from the front of the employees. The employee is just required to use their phone to take a photo of their face and display a QR code. The picture will subsequently be transmitted to the server to manage the attendance.

#### **2.4.7      ANDROID-BASED AUTHORIZED ID AND PASSWORD**

(Hameed, 2017) developed and put into use an intelligent Android-based attendance system. The technology creates attendance data automatically and offers a quicker, more economical, and accessible solution for tracking online employee attendance. The three characteristics of the attendance system are the admin account, which can log in and change the database; the instructor account, which can mark workers as present; and the reporter which can verify attendance records and report all duties. The instructor will be ready to obtain attendance with ease using phones with Android OS which has been developed to save attendance both on the device and servers, as well as to Verify statistics and print a paper version according to (Islam et al., 2017) paper. Their system can record attendance, mark invaders' admission, calculate attendance percentages. The proposed system allows internet access at any time and from any location, which might greatly help instructors take care of their worker's attendance. An attendance management system was developed by (Kumbhar et al., 2016) to address issues with class attendance using Android devices. Both employees and managers must install APKs on their phones to access the system. They also received a unique ID and password. Employees must fill out the application with their information. The employee may register their attendance with only one click after the program is started by the instructor and is ready for use during attendance checking. Both weekly and monthly attendance records are available for managers.

## **2.5 SOLUTIONS TO ADDRESS PROBLEMS**

(Smitha et al., 2020) mentioned that, the purpose of this system is to build an attendance system which is based on face recognition techniques. Here face of an individual will be considered for marking attendance. Nowadays, face recognition is gaining more popularity and has been widely used. In this paper, we proposed a system which detects the faces of employees from an entrance camera and attendance will be marked if the detected face is found in the database. This new system will consume less time than compared to traditional methods.

(Wankhade et al., 2022) stated that, with the furtherance of technology, the frauds and malpractices related to it have been on the verge of happening, and technology has been a kind of savior in so many cases. Facial recognition can be considered as such a savior in terms of numerous malpractices and fraud activities. Not only in the field of fraud prevention or detection, but facial recognition and automated face detection tools and technologies play an important role in the attendance management systems.

(Abdalkarim & Ali, 2022) pointed out that, traditional employee attendance involves all the roll-calling issues and takes a lot of time for employees and managers to conduct departmental sessions. The procedure is lengthy and takes many instructors' and employees' time. This research reduced the length of the complete attendance verification by designing an online system. Substituting the conventional procedure, managers had to call each employee's name in board room and note the attendance when the employee answered. It offers a more straightforward and quicker approach to monitoring attendance. Instructors will no longer require a paper sheet to mark employee attendance in their proposed system. They can construct attendance records by obtaining the necessary information from the database, making the entire procedure paperless.

As said by (Abraham et al., 2020), roll call and swipe or punch cards have got some drawbacks. Roll call method is time-consuming and prone to human errors. Mistakes such as marking the present person absent and vice versa can occur in this method. Digital methods such as swipe and punch cards can overcome the drawbacks in the previous mentioned method, but it also gives rise to new issues. Swipe cards are less time consuming but it doesn't check for the presence of the person while swiping the card, which may lead to another person marking proxy attendance of the absent person. Also, another concern is that if a person loses his or her swipe card, then he or she may have to wait sometime before getting a new card. Therefore, using biometric can help to overcome the issues existing in previous techniques.

## **2.6 THE PROPOSED SYSTEM**

As discussed by (Abraham et al., 2020), the task of the proposed system is to capture the face of each employee and to store it in the database for their attendance. The face of the employee needs to be captured in such a manner that all the feature of the employees' face needs to be detected, even the seating and the posture of the employee need to be recognized. There is no need for the staff to manually take attendance because the system records a video and through further processing steps the face is being recognized and the attendance database is updated.

## **2.7 EMPLOYEE ATTENDANCE SYSTEM**

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

### **2.7.1 DIGITAL IMAGE PROCESSING**

(Kumar et al., 2021) mentioned that Digital Image Processing is the processing of images which are digital innature by a digital computer. Digital image processing techniques are motivated by three major applications mainly:

- Improvement of pictorial information for human perception.
- Image processing for autonomous machine application.
- Efficient storage and transmission.

Digital image processing involves the following basic tasks:

- Image Acquisition - An imaging sensor and the capability to digitize the signal produced by the sensor.
- Preprocessing – Enhances the image quality, filtering, contrast enhancement etc.
- Segmentation – Partitions an input image into constituent parts of objects.
- Description/feature Selection – extracts the description of image objects suitable for further computer processing.



- Recognition and Interpretation – Assigning a label to the object based on the information provided by its descriptor. Interpretation assigns meaning to a set of labelled objects.
- Knowledge Base – This helps for efficient processing as well as inter module cooperation.

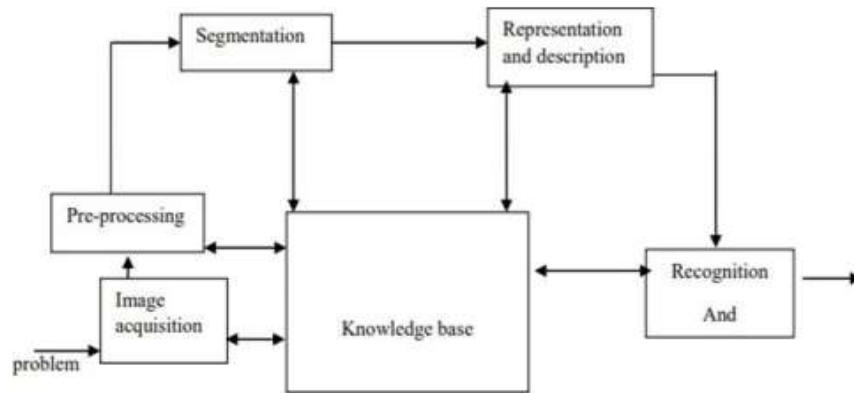


Figure 1: A diagram showing the steps in digital image processing.

### 2.7.2 SYSTEM DESIGN

As suggested by (Suresh et al., 2019), the design part of the attendance monitoring system is divided into two sections which consist of the hardware and the software part. Before the software 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.

### 2.7.3 LIBRARIES DEVELOPMENT

#### OpenCV

(Suresh et al., 2019) define OpenCV (Open source computer vision) as 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.

#### NumPy

As defined by (Suresh et al., 2019), 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. The numpy namespace includes all names under the numpy.core and numpy.lib namespaces as well. Thus, import numpy will also import the names from numpy.core and numpy.lib. This is the recommended way to use numpy.

#### **2.7.4 SOFTWARE DEVELOPMENT**

There are two major system flows in the software development section as shown below:

1. The creation of the face database.
2. The process of attendance taking.

Both processes above are mentioned by (Suresh et al.,2019) and are essential because they make up the backbone of the attendance management system. Their full functionality, specific requirements and also the methods/approach to accomplish such objectives will be discussed in the upcoming chapter.

#### **2.7.5 OVERVIEW**

The system proposed by (Suresh et al., 2019) is a software system which will mark attendance using facial recognition. In this project we used OpenCV module integrated with Python which will help the institution to make the attendance process easy and efficient. The system comprises of a computer and an HD Video Camera.

#### **2.7.6 CONCLUSION**

(Suresh et al., 2019) discussed that 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 but also eliminate 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 to store all the faces into the database storage. Fortunately, there is such existence of micro SD that can compensate with the volume of the data. At the end, the system will not only resolve troubles that exist in the old model but also provide convenience to the user to access the information collected.

### **2.8 RESULTS AND DISCUSSIONS**

According to (Nandhini, Duraimurugan & Chokkalingam, 2019), the main working principle of the project is that, the video captured data is converted into image to detect and

recognize it. Further the recognized image of the employee is provided with attendance, else the system marks the database as absent.

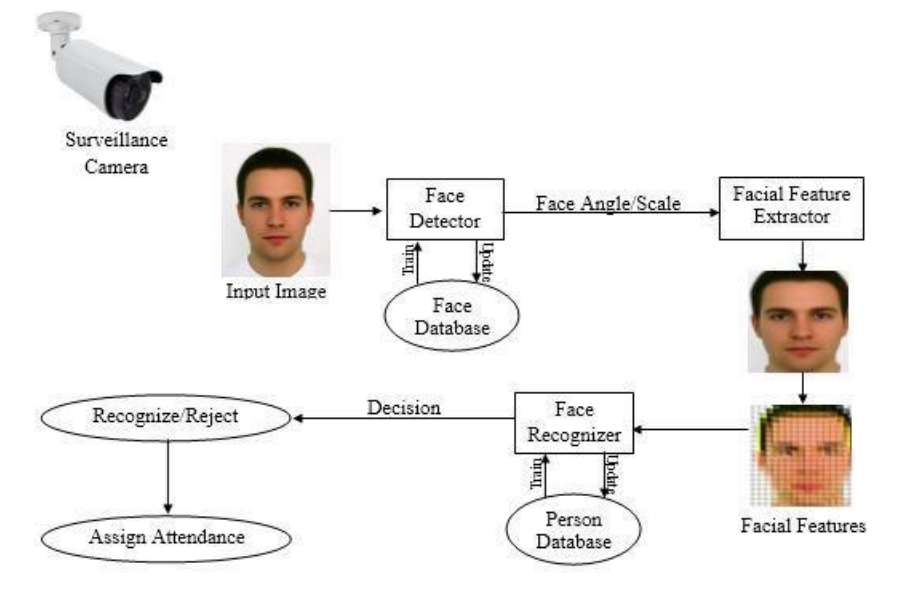


Figure 2: Image Processing

### 2.8.1 CAPTURE VIDEO

The Camera is fixed at a specific distance inside a room to capture videos of the frontal images of the entire employees.

### 2.8.2 SEPARATE AS FRAMES FROM THE VIDEO

The captured video needs to be converted into frames per second for easier detection and recognition of the employees' face to generate the attendance database.

### 2.8.3 FACE DETECTION

Face Detection is the process where the image, given as an input (picture) is searched to find any face, after finding the face the image processing cleans up the facial image for easier recognition of the face. CNN (Convolution Neural Network) algorithm can be implemented to detect the faces.

### 2.8.4 FACE RECOGNITION

After the completion of detecting and processing the face, it is compared to the faces present in the employees' database to update the attendance of the employees.

### **2.8.5      POST-PROCESSING**

The post-processing mechanism involves the process of updating the names of the employees into an excel sheet. The excel sheet can be maintained on a daily basis or weekly basis to record the employees' attendance. This attendance record can be used by staff to calculate employee wages.

### **2.8.6      FUTURE ENHANCEMENTS**

Sometimes the poor lighting condition of the room may affect image quality which indirectly degrades system performance, this can be overcome in the latter stage by improving the quality of the video or by using some algorithm.

### **2.8.7      CONCLUSION**

Thus, the aim of this document is to capture the video of the employees, convert it into frames, relate it with the database to ensure their presence or absence, mark attendance to the particular employee to maintain the record. The Automated Attendance System helps in increasing the accuracy and speed ultimately achieve the high-precision real-time attendance to meet the need for automatic workplace evaluation.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 INTRODUCTION**

In this chapter we shall fully elaborate on the set of all requirements that are to be imposed on the design and verification of the application. Both the functional and non-functional requirements will be briefed herein.

### **3.2 REQUIREMENTS ENGINEERING**

#### **3.2.1 ELICITATION**

In order to get data and facts to be able to come up with the scope management plan, the following techniques were applied:

##### **1. QUESTIONNAIRES**

I distributed questionnaires to a number of staff members working at different school campuses as well as government and non governmental institutions to gather precise information on service provision in the general workers section.

##### **2. INTERVIEWS**

I carried out a number of in-person interviews with the managing staff at all levels, from management all the way to the workers.

##### **3. OBSERVATION**

Moving from one organisation to another made it relatively easy for me to be able to get first-hand experience of the former system and gather an understanding of what exactly is required.

#### **3.2.2 FUNCTIONAL REQUIREMENTS**

- i. Register a new staff member, that is, the manager.
- ii. Allow Login to registered users.
- iii. Register new workers.
- iv. Allow to take workers' attendance.
- v. Show attendance of that particular day.
- vi. Provide the users with workers daily wages.
- vii. It should give the admin, the ability to see the number of workers in the database.

### **3.2.3      NON FUNCTIONAL REQUIREMENTS**

- i. Intuitive, attractive, and functional user interface design.
- ii. Secure user information architecture.
- iii. Efficiency and throughput.
- iv. Fast.
- v. Functional.

### **3.2.4      USER SOFTWARE REQUIREMENTS**

The final application will run on windows devices with a web browser.

## **3.3 SYSTEM REQUIREMENTS**

### **3.3.1      INPUTS**

The system shall require user input through forms and press gestures. Below is a generic list of some of the input to be collected.

- i. Workers details (images, names, ids, time in, time out).
- ii. Administrator inputs. (name, gender, roll, phone number, email, password).

### **3.3.2      PROCESSES**

- i. Login details validation.
- ii. Capturing user data.
- iii. Updating user data in the database
- iv. Face verification when taking attendance.
- v. Wage calculation.

### **3.3.3      OUTPUTS**

- i. View of that particular day attendance.
- ii. View of the total number of workers in the database.
- iii. View of a form to select wage rate.
- iv. View of workers' wages.

# CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

## 4.1 INTRODUCTION

The systems design phase focuses on the development of the objectives of the proposed system and it outlines how the proposed system is going to be developed, configured, and deployed.

## 4.2 USER INTERFACE DESIGN SNAPSHOTS

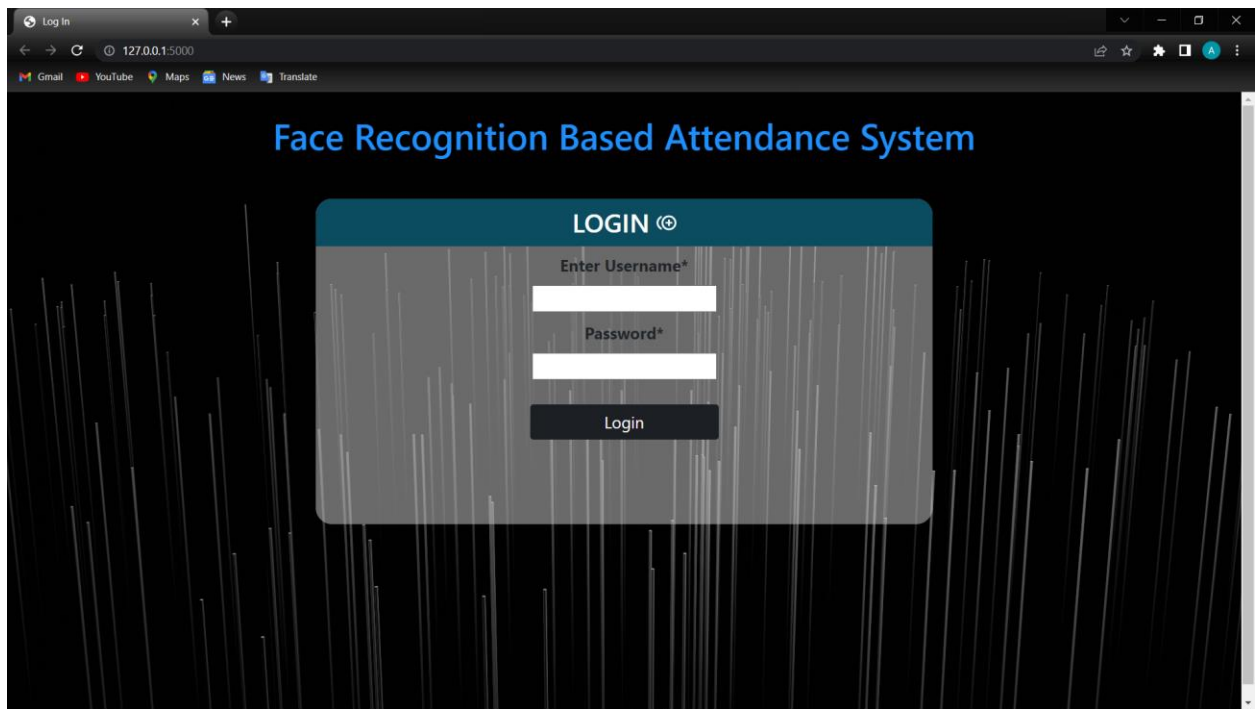


Figure 3: Login Design

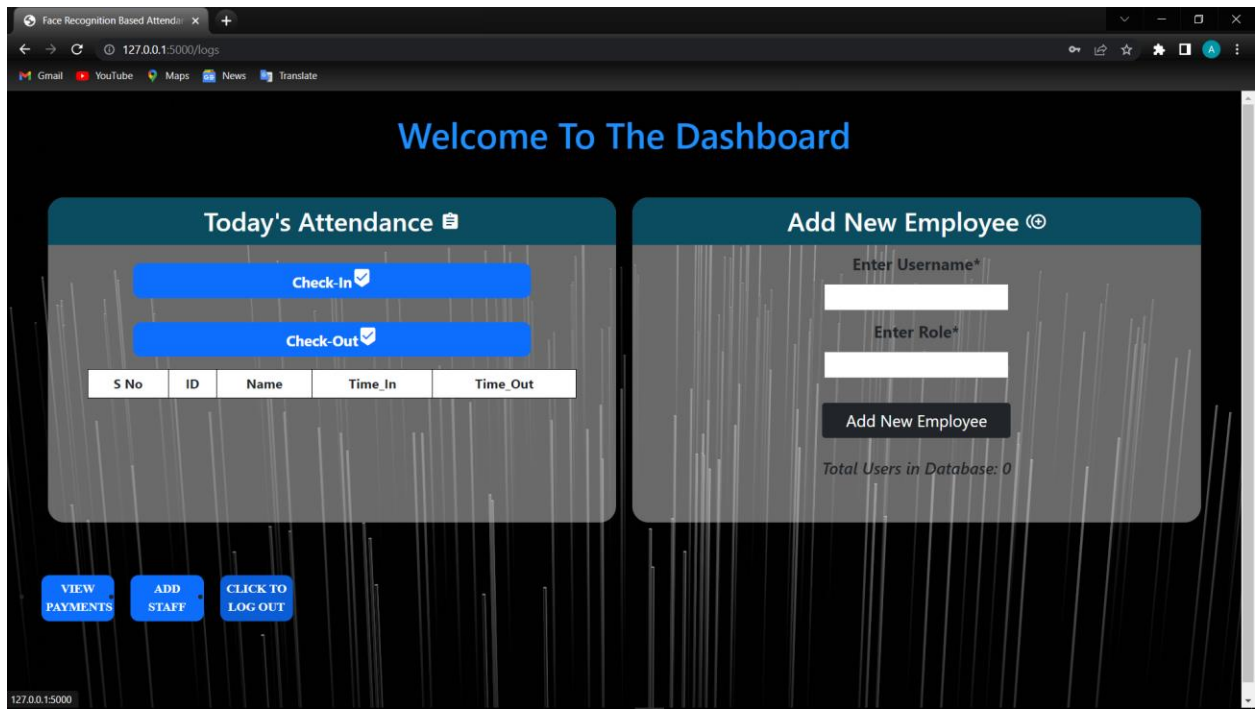


Figure 4: Dashboard

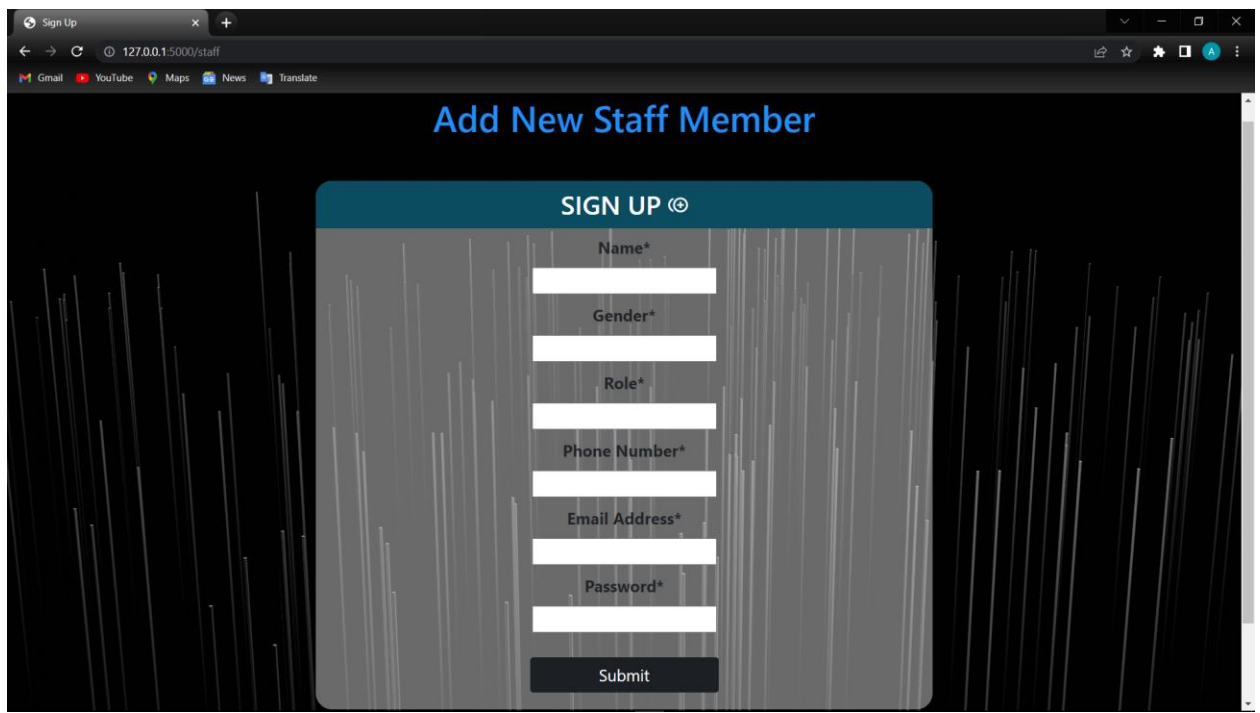


Figure 5: Signup



Figure 6: Adding new user

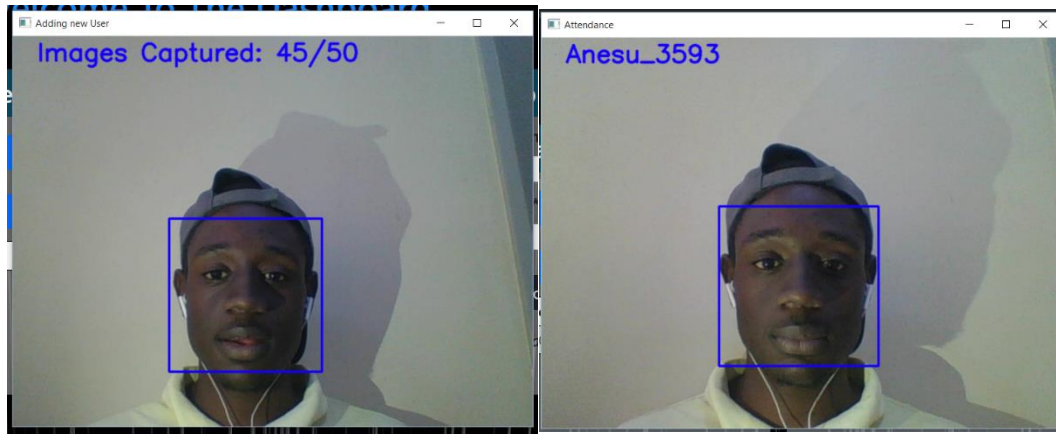


Figure 7: Taking Attendance

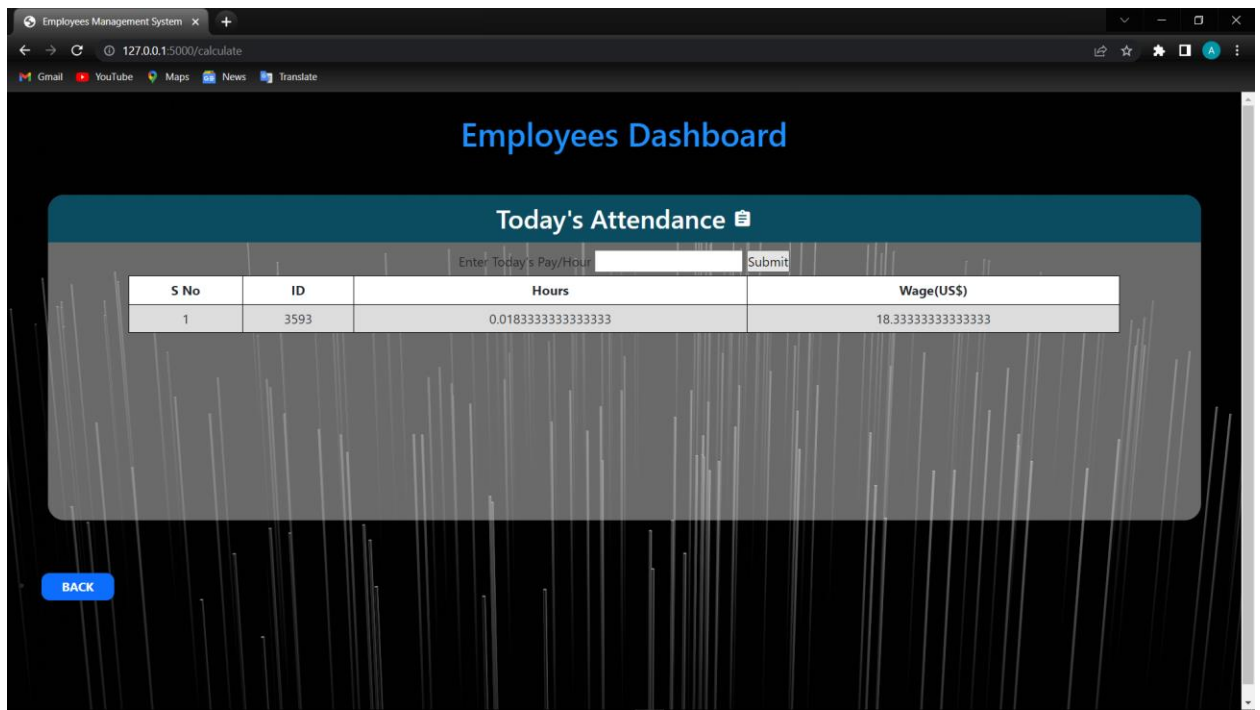


Figure 8: Payments list

## 4.3 PROCESS DIAGRAM

### 4.3.1 PROCESS FLOW CHART

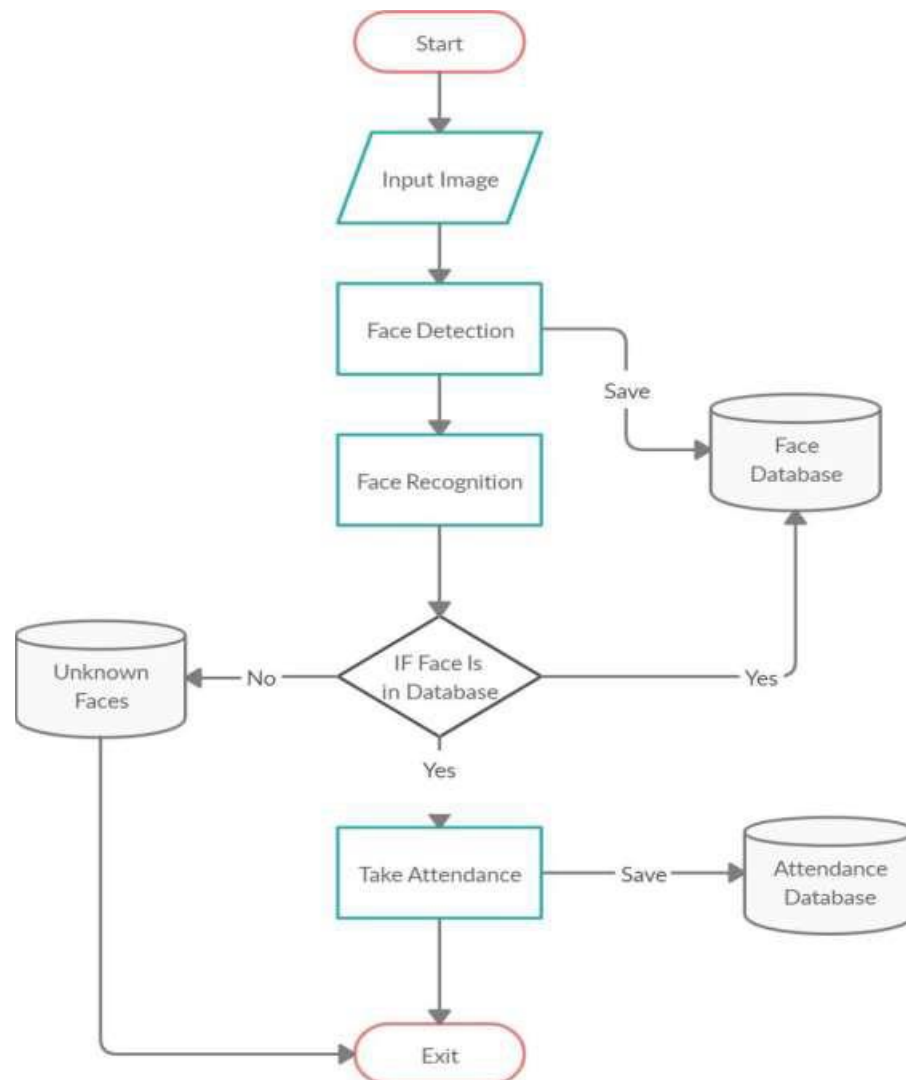


Figure 9: The process of taking attendance

## 4.4 SYSTEM CODE

I developed the application using the PYTHON programming language and the PyCharm IDE for the backend. For the front end design I used HTML and Bootstrap CSS. Below are the main code snippets with a brief explanation of the functionalities. Most of the application code will be delivered through the system files where further analysis can be done.

```

# Initializing VideoCapture object to access WebCam
face_detector = cv2.CascadeClassifier('static/haarcascade_frontalface_default.xml')
cap = cv2.VideoCapture(0)

# If these directories don't exist, create them
if not os.path.isdir('Attendance'):
    os.makedirs('Attendance')
if not os.path.isdir('static/faces'):
    os.makedirs('static/faces')
if not os.path.isdir('Database'):
    os.makedirs('Database')
if f'Attendance-{datetime.now().strftime("%Y-%m-%d")}.csv' not in os.listdir('Attendance'):
    with open(f'Attendance/Attendance-{datetime.now().strftime("%Y-%m-%d")}.csv', 'w') as f:
        f.write('ID,Name,Time_In,Time_Out')
if f'Payments-{datetime.now().strftime("%Y-%m-%d")}.csv' not in os.listdir('Attendance'):
    with open(f'Attendance/Payments-{datetime.now().strftime("%Y-%m-%d")}.csv', 'w') as f:
        f.write('ID,Hours,Wage')
if 'Database.csv' not in os.listdir('Database'):
    with open('Database/Database.csv', 'w') as f:
        f.write('Name,Gender,Role,Cell,Email>Password')

```

The above code snippet will initialize the VideoCapture. A VideoCapture is a python object used to access the WebCam. An Index number is passed to the object which will determine the WebCam you want to access suppose your machine is connected to multiple Web Cameras. For the following lines of code, they will check if the necessary files, database and folders are present otherwise they are created.

```

# This function will run when we click on Check-In Button
@app.route('/start', methods=['GET'])
def start():
    if 'face_recognition_model.pkl' not in os.listdir('static'):
        return render_template('home.html', totalreg=totalreg(), datetoday2=datetoday2(),
                               mess='There is no trained model in the static folder. Please add a new face to continue.')

    cap = cv2.VideoCapture(0)
    ret = True
    while ret:
        ret, frame = cap.read()
        if extract_faces(frame) != ():
            (x, y, w, h) = extract_faces(frame)[0]
            cv2.rectangle(frame, (x, y), (x + w, y + h), (255, 0, 20), 2)
            face = cv2.resize(frame[y:y + h, x:x + w], (50, 50))
            identified_person = identify_face(face.reshape(1, -1))[0]
            add_attendance(identified_person)
            cv2.putText(frame, f'{identified_person}', (30, 30), cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 0, 20), 2,
                        cv2.LINE_AA)
            cv2.imshow('Attendance', frame)
            if cv2.waitKey(1) & 0xFF == ord('q'):
                break
    cap.release()
    cv2.destroyAllWindows()
    id, name, time_in, time_out, l = extract_attendance()
    return render_template('home.html', id=id, name=name, time_in=time_in, time_out=time_out, l=l, totalreg=totalreg(),
                           datetoday2=datetoday2())

```

The above code snippet shows a start() function. This function will run when we click on the Checkin button to take attendance. The function initializes the VideoCapture and extract a face from the image. It uses a trained model named 'face\_recognition\_model.pkl' to compare the captured image with the ones currently present in the face database. If a match is found, it returns the name of the recognised face preceding the ID. The exact time the face was recognised is captured as 'time\_in' in the attendance database and the camera is closed by hitting 'q'. The function will finally display the details on the user interface.

```

# This function will run when we click on Check-Out Button
@app.route('/end', methods=['GET'])
def end():
    if 'face_recognition_model.pkl' not in os.listdir('static'):
        return render_template('home.html', totalreg=totalreg(), datetoday2=datetoday2(),
                               mess='There is no trained model in the static folder. Please add a new face to continue.')

    cap = cv2.VideoCapture(0)
    ret = True
    while ret:
        ret, frame = cap.read()
        if extract_faces(frame) != ():
            (x, y, w, h) = extract_faces(frame)[0]
            cv2.rectangle(frame, (x, y), (x + w, y + h), (255, 0, 20), 2)
            face = cv2.resize(frame[y:y + h, x:x + w], (50, 50))
            identified_person = identify_face(face.reshape(1, -1))[0]
            checkout_attendance(identified_person)
            cv2.putText(frame, f'{identified_person}', (30, 30), cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 0, 20), 2,
                        cv2.LINE_AA)
            cv2.imshow('Attendance', frame)
            if cv2.waitKey(1) & 0xFF == ord('q'):
                break
    cap.release()
    cv2.destroyAllWindows()
    id, name, time_in, time_out, l = extract_attendance()
    return render_template('home.html', id=id, name=name, time_in=time_in, time_out=time_out, l=l, totalreg=totalreg(),
                           datetoday2=datetoday2())

```

The above code snippet is the `end()` function. The function works the same as the `start()` function except that when it recognizes a face, it updates the row with the same ID as the recognized face and prints the 'time\_out' along that row.

```

def add():
    newusername = request.form['newusername']
    newuserid = create_next_id()
    userimagefolder = 'static/faces/' + newusername + '_' + str(newuserid)
    if not os.path.isdir(userimagefolder):
        os.makedirs(userimagefolder)
    cap = cv2.VideoCapture(0)
    i, j = 0, 0
    while 1:
        _, frame = cap.read()
        faces = extract_faces(frame)
        for (x, y, w, h) in faces:
            cv2.rectangle(frame, (x, y), (x + w, y + h), (255, 0, 20), 2)
            cv2.putText(frame, f'Images Captured: {i}/50', (30, 30), cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 0, 20), 2,
                        cv2.LINE_AA)
            if j % 10 == 0:
                name = newusername + '_' + str(i) + '.jpg'
                cv2.imwrite(userimagefolder + '/' + name, frame[y:y + h, x:x + w])
                i += 1
            j += 1
        if j == 500:
            break
        cv2.imshow('Adding new User', frame)
        if cv2.waitKey(1) & 0xFF == ord('q'):
            break
    cap.release()
    cv2.destroyAllWindows()
    print('Training Model')
    train_model()
    id, name, time_in, time_out, l = extract_attendance()
    return render_template('home.html', id=id, name=name, time_in=time_in, time_out=time_out, l=l, totalreg=totalreg(),
                          datetoday2=datetoday2())

```

The above code snippet shows the add() function. The function will run when we add a new worker. It captures 50 images, a name and an autogenerated user ID and the images are stored in a folder labelled with the worker's name and ID.

```

# This function will run when we click on Submit Button
@app.route('/calculate', methods=['GET', 'POST'])
def calculate():
    money = int(request.form['money'])

    id, name, time_in, time_out, l = extract_attendance()
    df = pd.read_csv(f'Attendance/Attendance-{datetime.now().strftime("%Y-%m-%d")}.csv', error_bad_lines=False)
    for i in range(l):
        id = df['ID'][i]
        time_in = df['Time_In'][i]
        time_out = df['Time_Out'][i]
        time_in = get_sec(time_in)
        time_out = get_sec(time_out)
        hours = (time_out - time_in) / 3600
        wage = hours * money
        with open(f'Attendance/Payments-{datetime.now().strftime("%Y-%m-%d")}.csv', 'a') as f:
            f.write(f'\n{id},{hours},{wage}')

    id, hours, wage, l = extract_payments()
    return render_template('admin.html', id=id, hours=hours, wage=wage, l=l, totalreg=totalreg(),
                           datetoday2=datetime.now().strftime("%Y-%m-%d"))

```

The above code snippet shows the calculate() function. The function will run when we calculate employees' wages. It accepts a wage rate from the interface and calculate the daily wage for each worker for that particular day. The data is saved in a file named, 'payments' and then displayed on the UI.

## 4.5 TESTING

### 4.5.1 UNIT TESTING

As described above, the application architecture consists of a few base classes that drive most of the application functionality. It is these classes that we focused on during our unit test as we tested the various objects at different application levels and modules that are created from these base custom classes.

During the testing of these base modules, we fed different allowable input to the modules and we monitored the output. All the modules were working properly as

expected from uploading data to the database and then retrieving the data into all our user interfaces. Needless to say, the unit test was indeed a successful one.

#### **4.5.2 INTEGRATION TESTING**

I carried out further testing with all the components combined. Again, it was a successful integration test as I observed that all the modules were responding as expected to the actions performed in another activity if they have to. For example, the dashboard interface was updated in almost an instance every time a new attendance was added to the database.

#### **4.5.3 USER VALIDATION**

The application was then tested with some real users. I installed the application on a number of managers' computers where I ran a virtual employee workstation that simulated the institution's work station. I would act as the admin, adding staff members, employees and taking attendance. All was going well, all features working well, except I had a few suggested features that could further improve my application system. These will be talked about in Chapter Five.



## **CHAPTER 5: CONCLUSION AND RECOMMENDATIONS**

### **5.1 INTRODUCTION**

The application's development was a journey I take much pride in. Herein, I shall brief my experiences and any further ideas to improve the application.

### **5.2 CHALLENGES**

- i. Time constraints was a difficulty to deal with. It proved almost impossible to stay on schedule. I discovered that this was mostly due to a lack of experience on my end.
- ii. Technical challenges in software and hardware also proved challenging. Several times, I had to depend on my previous iterations of the system, thanks to version control. I was depending on one computer which was hardly capable to keep up with the resource-thirsty PyCharm IDE.
- iii. Hardware also proved to be a challenge as the WebCam I used was capturing poor quality images which made it hard for my model to recognize the faces.

### **5.3 RECOMMENDATIONS**

To run the system more efficiently and without any delays or interruptions, it is recommended that one use a consistent and uninterruptible internet supply. It is known that for any meaningful computer-based system to be integrated into any organization, proper training and orientation have to be given both to the staff and the employees. The staff should also be highlighted the need and advantages of the system and how it will equally assist them in their various field of work. They should also be informed of the cost of maintaining this new system so that they will handle it with all carefulness.

To further improve the application, I recommend some machine learning integration to help monitor the attendance and help improve the employee's face recognition. More so, as this is just a prototype, the application should further be developed to cater to all organisations. It would be amazing during the maintenance to then introduce some sort of payment gateway in the application. Every working day will then be accompanied by payment.

## **5.4 CONCLUSION**

The development of the Face Recognition Attendance System For Employees application had objectives and this was accomplished hence the requirements were met. Conclusively, this research project was a success. The development of the application involved many phases. The first phase started with a detailed study of the problems and prospects of the current system at the Human Resource and Accounts Sector. These problems, information needs, and activities were documented and later used as the basis for system design, which immediately followed the design phase. The design phase was concerned primarily with the specification of the system elements in a manner that best met the organization's needs. During this phase, strict adherence was made to proven software engineering principles and practices. To implement this design, an application was then developed using the PyCharm. It is hoped that the effective implementation of this software product would eliminate many problems discovered during systems investigation.

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**System files:** <https://github.com/kabukuanesu/Face-Recognition-Based-Attendance-System-For-Employees>