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# Development of an Employee Attendance System Using Face Recognition and QR-Code Technology

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***Abstract:*** ***The procedure of recording attendance at any organization, including polytechnics and other institutions, is crucial to demonstrating why a particular employee is exceptional. Traditional attendance management systems, which use attendance sheets and signatures, have shown to have some associated issues, including time wastage, impersonation, and attendance sheet misplacement, making the system wasteful and unproductive. Appraising Non-academic staff in Yaba College of Technology has been a great challenge due to the aforementioned problem confronting the management to properly monitored the attendance system put in place with the traditional methods. To solve these problems, the study developed a computerized attendance system that implements face recognition and QR-code was designed and implemented using python programming language, MySQL server database, Tkinter framework was used to build the interface and Open Camera Vision (OpenCV) library. The algorithms for face detection and recognition include Haar cascasde algorithm and Local Binary Pattern Histogram (LBPH) algorithm respectively. The system is equipped with the capability to send instant email attendance reports to the management on daily, weekly or monthly basis. The result findings shows that there was 98.8% detection and recognition rates and 0.12% errors encountered for both face and QR-code. The highest read time was also measured to be 210.30ms. The result finding from our test shows the efficiency and effectiveness of the attendance system and it is therefore recommended for use in Yaba College of Technology for attendance monitoring of Non-academic staff for onward appraisal by the HOD, Dean and the college management.***

***Keywords: Attendance, Impersonation, face recognition, QR-code, Employee***

## I. INTRODUCTION

Attendance taking is vital to management of an organization to keep track of who is present and absent in a particular location or event [1]. It is one of the important factors in many institutions and organizations that need to be followed by employees. The operation of any institution and organization is based on the contribution of employees either from the executive level or operational level. Employee attendance tracking is a common practice in almost all organizations. For an organization to present a valuable human-resource front it needs to maintain its performance standards in terms of attendance monitoring.

Every institution and organization put more importance on attendance management of staff in the organization to keep accurate record of employee. Yaba College of Technology is no exception in attendance monitoring of staff of the college, most especially the non-teaching which are expected to resume by 8:00am and close by 4:00pm on a daily basis. The present employee attendance framework system mandates that employees physically record their attendance on a sheet of paper each time they arrive at work and leave it. This method of recording attendance presented many difficulties for maintaining the attendance and was afterwards used for evaluation. These problems could include employees taking too long to find and sign their names in the attendance book and employees misplacing or avoiding the attendance book due to alleged improper activities.

The term "Automatic Identification and Data Capture" (AIDC) refers to a collection of technologies that enable direct data entry into a computer without the use of a keyboard. The time needed for data collection, identification, and labelling can be attributed to AIDC technologies [2]. The three main parts of almost all AIDC technologies are the data encoder, machine reader or scanner, and data decoder. Barcodes, radio frequency identification (RFID), magnetic stripes, optical character recognition, biometrics, and machine vision are important AIDC technologies. Two popular and commonly applied AIDC technologies are QR-codes and fingerprints [3]. The majority of products and materials now employ codes. The simplicity of use, low cost, and widespread application of barcode technology—in both goods and services—are its main advantages. To read data like numbers, letters, photos, and locations, optical scanners are used in QR-code technology. It could be a one-dimensional or two-dimensional code. Black rectangle bars known as barcodes are the one-dimensional code's commonly used version.

On the other hand, biometric recognition only implies "life measurement," but the phrase is connected to the use of quantifiable specific physiological and biological traits to identify an individual. Biometric characteristics are unique to an individual. It captures

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millions of faceprints within seconds, and provides intelligent million-scale data management. It offers more efficient, convenient, safe, reliable, and privacy-protecting authentication services to different employees in various institutions. Therefore, the use of a biometrics system provides a good approach against impersonation [4].

The research paper provides the use of a multifactor authentication system (Face Recognition and QR-code) for employees' attendance validation and verification.

The face recognition biometrics will help to resolve the problem of impersonation, while barcode system will enable easy report generation and proper record management.

The paper is organized as follows: In the first section, we introduce the attendance management system used in Yaba College of Technology and the present challenge. Section 2 study on the existing literatures and related works. Section 3 outlines the functions of this system briefly and describes the hardware and software design of this system. Section 4 presented result and discussion of the system and finally Section 5 contains conclusions.

## II. REVIEW OF ATTENDANCE SYSTEM

Employee attendance refers to their being at their assigned workplace during the necessary hours. Employee attendance in the retail industry refers to an employee reporting for and completing their assigned shift for the day. Among the various importance of employee attendance time theft should be considered. By keeping proper attendance records, you can prevent time theft, which occurs when employees are paid for hours they didn't actually work. Since hourly workers can fake their time clock figures, time theft is more prevalent among them.

That being said, time theft does occur among salaried workers. It is technically theft on your part when salaried staff browse the internet for personal reasons while at work.

Although time theft may not be a problem if productivity is constant, it may not be the case if your employees establish their own hours or are paid a flat wage regardless of how long their task takes.

In addition to attendance, absenteeism should also be taken into account. Monitoring employee attendance may indicate patterns of conduct, such as some employees who fail to report for duty [5]. Absenteeism is the term for this pattern of repeatedly skipping shifts, and it can have a significant effect on your income. Your crew may become overworked as a result of a recurring absentee, which will lower the quality of your services. Absenteeism can develop into time theft in an organization if absent employees are unintentionally still paid.

### *A. Employee Attendance in Yaba College of Technology*

The attendance system being used in Yaba College of Technology is Manual Recording for non-academic staff in different unit or department. A common manual approach will have an attendance form set at a specific place where each non-academic staff would sign in or out every day on a register.

Cheating usually occurs when some members of the non-academic staff mark the register on the days that they had not attended; or signing for others. Finding the evidence to support this cheating is just as difficult as spotting it when using manual approach. For both gathering initials and assessing attendance, a manual technique is likewise less effective. The register might easily be misplaced or result in data loss, which is another downside of paper-based attendance systems [6].

### *B. Employee Attendance System*

In the human resources division, the employee attendance system is a crucial procedure. For the dependability and success of the business, it is essential to monitor staff attendance [7]. Companies utilize a variety of techniques to monitor employee work hours, including biometric systems, timesheets, and old punch card systems. By documenting the clock-in and clock-out times of each employee each day, this procedure's primary goal is to maintain track of the employees' work hours. There are many different kinds of attendance management systems, but not all of them yield the same outcomes. A good attendance management system is required for the efficient operation of the human resources process. The biometric system of attendance of attendance has proving to be the most efficient and reliable to detect impersonation and track records of staff present in the organization within a period of time [8], [9]. This technique of identification is favoured for a number of reasons, including the requirement that the subject of the identification be physically present. The use of biometric identification eliminates the need to carry a token or memorize a password [10].

1) *Face Recognition and Barcode Technology:* Face recognition and QR-codes are two distinct technologies, but they can be used together for a variety of purposes. Face recognition technology uses algorithms and machine learning to analyze and recognize

human faces [11]. It can be used for a variety of applications, such as security and surveillance, access control and identification. On the hand, QR-codes are two dimensional barcodes that can store information such as websites URLs, text, email addresses, phone number and more [12]. They consist of black and white squares arranged on a grid, and can be read by a QR-code reader app or software. For example, a company might use face recognition technology to verify the identity of an employee or visitor, and then use a QR-code to grant them access to a specific area or to track their movement within a facility.

## III. RELATED WORKS

Many attempts have been made by researchers on the development of a computerized attendance system. The systems that were created were primarily focused on improving technical solutions that address issues and challenges in the recording, monitoring, positioning, and tracking of employees as opposed to traditional systems that required duplication of work and effort and increased demands on human resources. According to a literature assessment, biometrics are preferred over QR-Codes due to their affordability and scalability. Due to the vulnerability of QR-Code to impersonation, additional checks are made utilizing the smart phone's IMEI and GPS capabilities. To the best of our knowledge, none of the study examines and describes how the data is processed to identify potential impersonation within the system. These solutions are dependable, mature, accepted legally, acceptable, cost-effective, user-friendly, and secure. The table below shows the related work of the attendance system.

Table 1: Related Work of the attendance system

| Author(S) Name & Year | Research Topic | Technique(S) Used | Technology Limitation |
|---|---|---|---|
| [13] | Smart Attendance System Using QR-Code, Finger Print and Face Recognition | QR-code, Finger Print and Face Recognition | The system uses the IEEE 2413 Standard for an Architecture Framework for the Internet of Things (IoT), which is an Internet of Things (IoT)-based attendance system (Face recognition - Fingerprint - QR code). The system focuses on the student and employee attendance system but do not consider the report generation. |
| [14] | Online Attendance Monitoring System Using Face Detection and QR Code | Face Detector and QR-Code | The software takes attendance electronically via QR code or face detection. The system takes or captures all the face points like lips, chin, for this process basically we use the code for face detection. The system only consider attendance taken for student only, but not employee |
| [15] | Student Attendance Monitoring System using Face Recognition. | Face Recognition (Haar Cascade Classifier and Local Binary Pattern Histogram (LBPH)) | In computer vision, face identification is a challenging problem. The faults include poor lighting, awkward stance, scale inconsistency, poor image capture accuracy, and partially obscured faces. |
| [16] | Smart Attendance System Using QR-Code | QR-Code | The system developed focus on the use of QR-code for attendance taking in lectures by the lecturer to monitor and track record. Its limitation is that it can't track impersonation in lecture hall and could not detect student taking attendance for others. |
| [17] | Smart Attendance Management System using Face Recognition. | Face Recognition (Deep-learning and face detection) | The system sometimes fails to recognize students from distance, also processing limitation. |
| [18] | Smart Attendance System Applying QR Code. | QR Code | The method does not completely eliminate the risk of impersonation, but it does offer a simplified, low-cost embedded computer-based system solution to the management of attendance problem in poor countries. |

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## IV. METHODOLOGY

The proposed employee attendance system was developed to recognize each staff face and also to Capture the QR-code of their Identity Card issued by the college management. The QR-code is integrated with the staff Identity card as from of authentication with the face recognition. The system development is an automatic application which will be managed by a staff of CITM (Centre for Information and Technology Management) to monitoring the activities of the system at the backend. The system will help to eliminate the present challenges of the traditional method of taking attendance of non-academic staff in Yaba College of Technology. It will also assist the college management to generate report of attendance for staff during appraisal for evaluation on monthly basis.

The employee attendance system features will include employee registration, attendance monitoring for employee, easy retrieval of attendance record for employee, daily and monthly report of employee. The employee registration details are saved on the system database which is then use for taking attendance with the QR code on the Identity Card, the details in the database can also be used to monitor the employee present at the workplace and for how long the staff has worked. The attendance generated can be exported to our computer system and sent through the email sender in the attendance system to the management. The administrator is at the liberty of sending the daily attendance report or waiting till the end of the month to send the report.

### *A. System software Design Considerations*

A database (backend) and application program make up the software (Frontend). Data on the employees will be kept in the database, which will also produce reports according to the administrator's instructions. With the aid of the MySQL-connector package, the server can be easily integrated with the Python Tkinter framework environment and is scalable, allowing it to expand to meet a company's growing database demands. Dependable in the sense that it can spot a database's unfinished transactions and guard against data corruption in the case of a power outage. In the visual studio code environment, the application software is created using the Python Tkinter framework and the Opencv package. The block diagram of the system is shown in Fig 1 below.

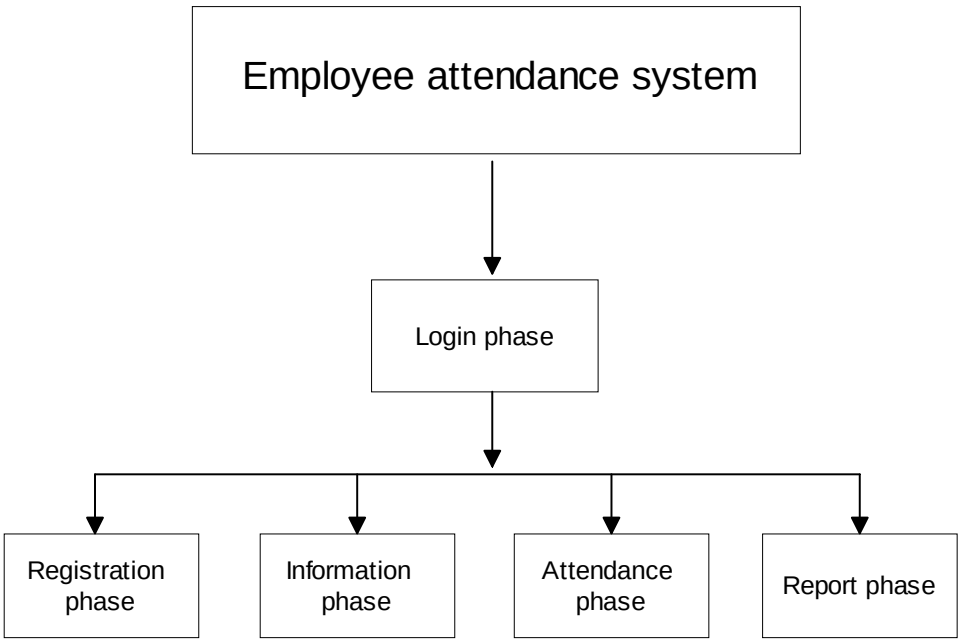



Fig 1: Block Diagram of the employee attendance system

In the attendance system, QR-code having unique characters are linked with employee ID. This implies every employee is given ID card containing QR-code exclusive to person. Passive QR-code were picked in light of the fact that they need not bother with a power source to function and they can be generated easily. At the point when an employee scans his/her ID card using the barcode reader (camera based), the QR-code on the ID card is caught by the barcode reader and sent to the application software which further shows the employees' details on a Liquid Crystal Display (LCD) screen. In addition, the system will need to scan each employee's face for authentication before entering the time of attendance into the database. The two phases of the attendance system are (i) the registration unit and (ii) the authentication unit. Figure 3.2 shows the block diagram of the system.

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1) *Registration Unit:* Registration with the Attendance System Desktop Application Software on the Administrator's computer, which will record each employee's personal information (employee ID, name, department, date of birth (DOB), age, marital status, address (permanent and present), Email, nationality, date of Employment (DOE), contact no, designation) to generate an ID card containing the employees name department and position along with a unique QR-code base on the employees' details. This will allow for the creation of reports and effective record keeping. In order to connect to the employee's QR-code information already put in the MySQL database, employees will also need to place their faces on a scanner (webcam) for biometric face capture.

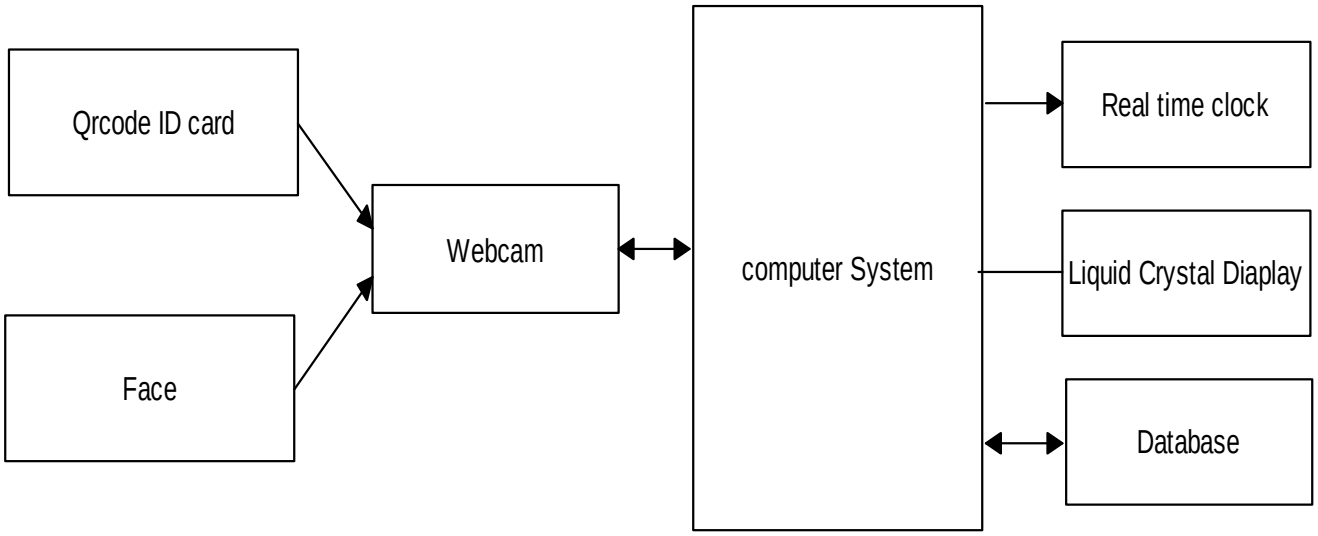



Fig 2: Block Diagram of Attendance System Hardware

2) *Authentication/Verification unit:* The employees must pass their ID cards close to the QR-code reader during authentication; the ***scanner*** reads the QR-code connected with the presenting employee and sends it to the application software, which then displays the employee's details on the screen. The system will furthermore proceed to scan the employees' face for verification and then record the time of attendance in the database. Fig 3 shows the sample of the Identity card that will be issued to each employee by the management of the college which will further by used for verification purpose after the recognition.

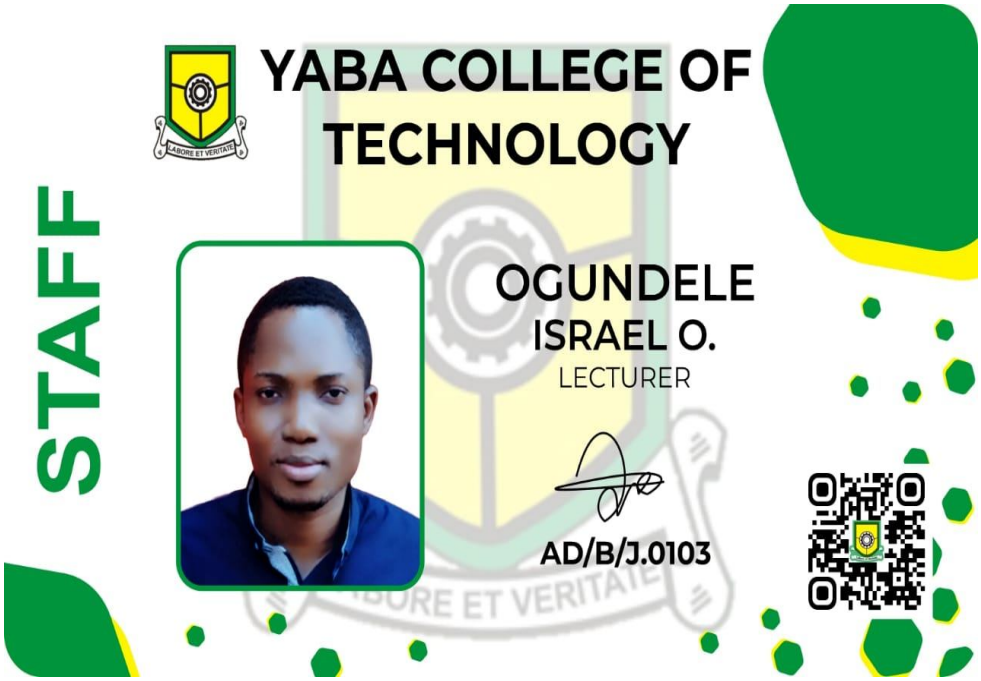



Fig 3: Identify card of the staff with QR-code

*B. Framework of the Employee Attendance System*

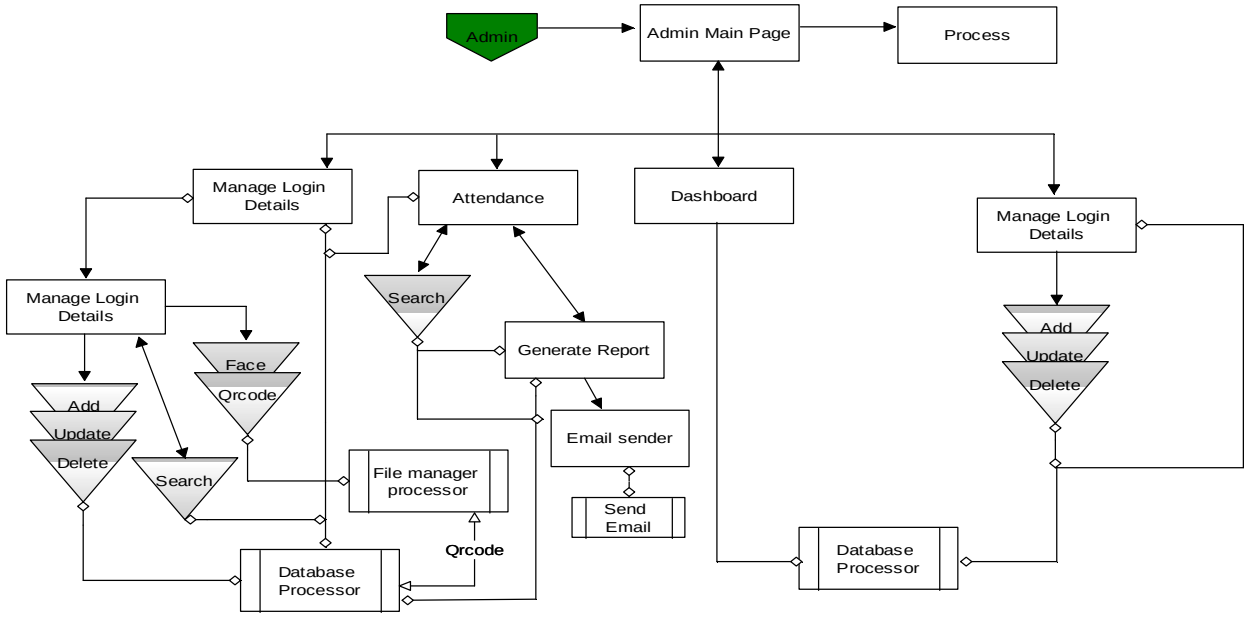



Fig 4: Model of the Employee Attendance System

The fig 4 above represents the conceptual framework of the Employee Attendance system Using face recognition and barcode technology; it visualizes the expected relationships between each module of the system. It shows the relationship and interactions among the dependent and independent modules of the Employee Attendance system.

*C. System Design*

The system design simply denotes set of interacting or interdependent pages forming an integrated framework. The design of the system is divided into three phases (Input, Output and Database design). These phases are interrelated to show the relationship between each module of the system. It is outlined in the following indexes.

1) *Input Design:* The design manages employee registration interface; it allows the admin to supply employees' registration information which are basically the employee's bio-data face sample capture. At this page the generation of employee's barcode also takes place along with training of each employee faces for recognition. This record can only be submitted successfully after all information matches the required data with this system design. This interface is an interactive page for the admin to navigate through the entire page. The supplied information is saved on the database on real-time. This page can only be accessed by users with valid login credentials. Fig 5 shows the design for the registration of the system for staff to input their details

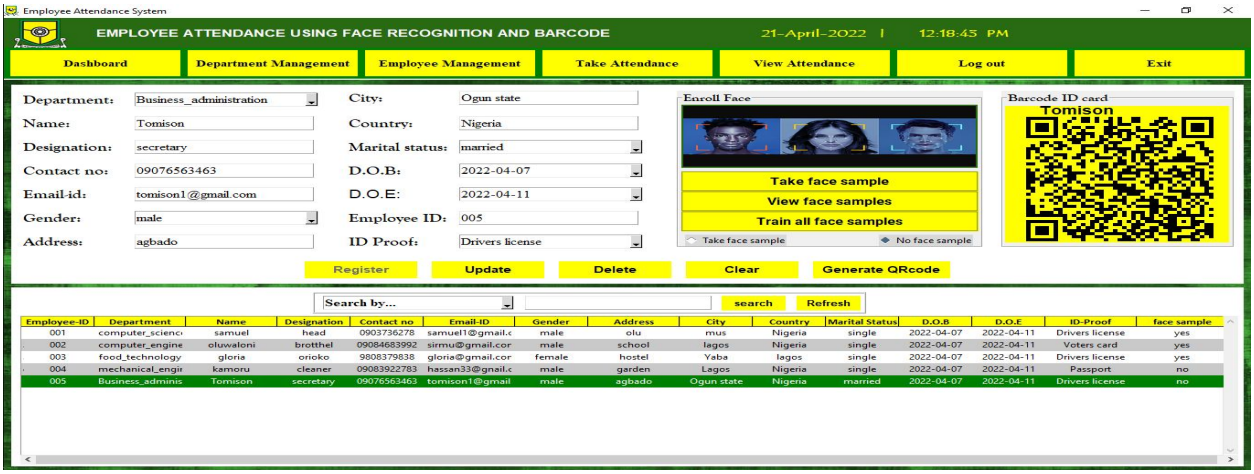



Fig 5: Employee Registration Information Snapshot

2) *Output Design:* This is the design that display the information of the saved in the database. It is the output design that will determine the input and method of processing. The interface can be accessed by both the employee and the admin to confirm the presence of an employee. The page also allows emails to be sent to any employee or management for further computation of the attendance report**.** Fig 6 shows the list of registered employee attendance.

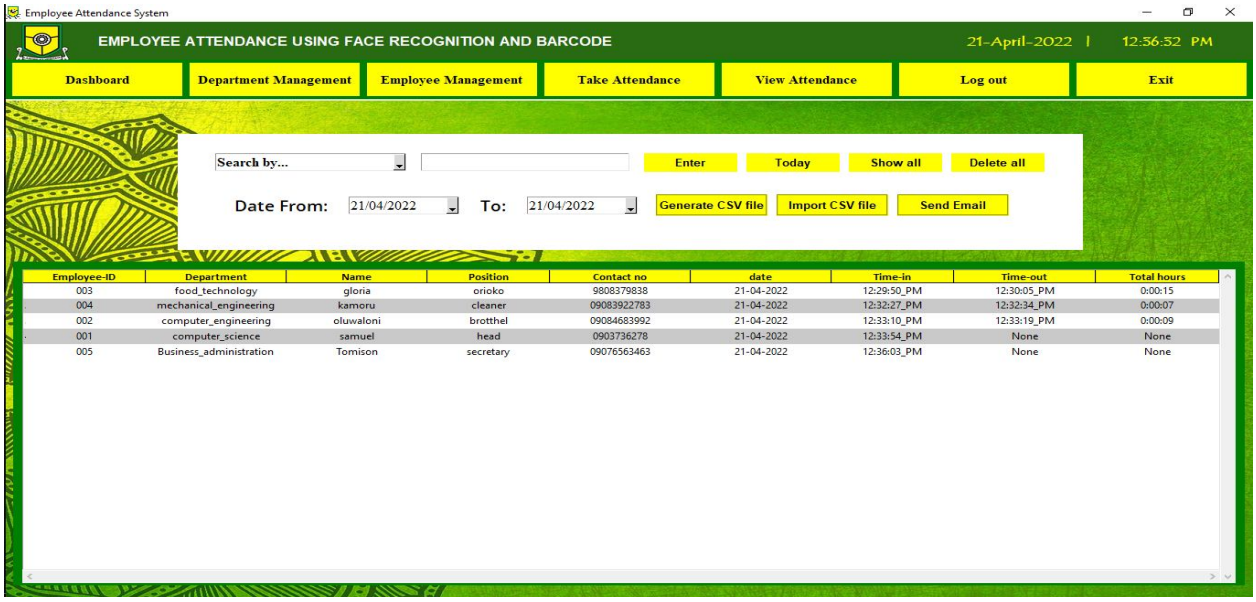



Fig 6: Employee Attendance report Snapshot

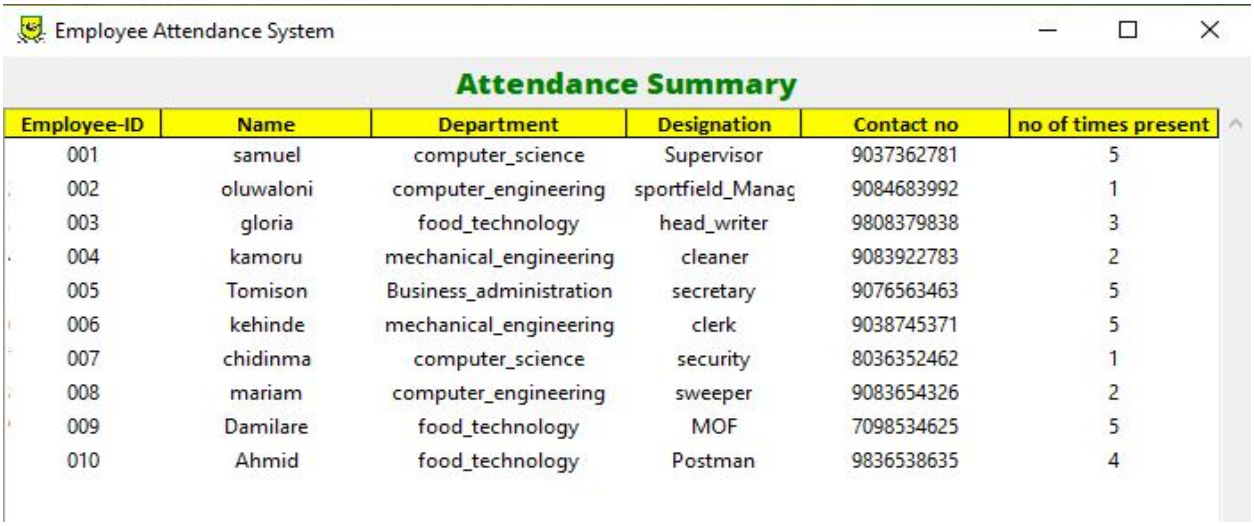



Fig 7: Employee Attendance summary Snapshot

3) *Database Design:* The database integrated with this system is MySQL. The data are manipulated and stored in database and then generated output data such as listing present employee and calculate total hour employees was present, giving status of department, how many barcode generated, daily, weekly and monthly attendance Report etc.

## V. RESULT AND DISCUSSION

The developed system was tested based on some metrics, such as the efficiency of the system on various factors or metrics, considering time taken per reading, the number of errors encountered, impersonation monitoring and attendance report generation. The details of thirty (30) employees were registered including their faces captured for testing purpose to generate the QR-code for training. The QR-code are then used to create the ID card that will be used by the employee to mark attendance and also for identification purposes.

The registered employees are then allowed to take attendance by clicking on the button. The command automatically turns on the computer webcam for the employee to scan the QR-code on the ID card first, after detection another window page opens showing the employee's data stored on the QR-code. The window also prompts the employee to scan face for verification. With the click of a button, the webcam is initiated again. During this process the Employee Attendance system checks for the similarity between the QR-code data and the face data. If all data conditions are meant and a similarity is found the employee's data is automatically registered on the attendance report with the employee clocked in time. The same process is carried out for the other entire registered employee. Clocking out after closing hour also involves same process of marking attendance.

The marking of attendance process is repeated daily. The report of the attendance is viewed by clicking the "View Attendance" button as shown in the implementation screenshot. The summary of the attendance is also shown, with this attendance summary, a descriptive analysis is done. This analysis is used at the end of every month to appraise each employee with regards to the number of times an employee was present. The system also allows the attendance reporting form of csv file to be sent via email sender built into the system for instant report submission to the management.

## VI. RESULT FINDING

The testing of the system was carried out to get the average accurate result of time-taken per reading and error encounters. The attendance was also reported to generate the attendance appraisal of each employee. The noticeable result during the testing showed that after several consecutive attendance marking using the QR-code and face recognition, there is 98.8% detection and recognition rates and 0.12% errors encountered during the implementation

The lowest average read time during the testing phase is 205.30ms while the highest is 210.30ms. by using the average read time of the entire attendance marking time, the overall average time of the attendance marking can be calculated using the formula

$$\text{Overall Average Read Time} = \frac{avg1+avg2+avg3+\cdots}{Total\ number\ of\ qrcode\ and\ face}$$

From the result obtained during the testing, it can be seen that face recognition and barcode technology-based attendance system designed is very efficient. The error encountered during the testing for each scanned QR-codes and faces is nil (0%), meaning that there was no error during the reading process. Error rates refer to the number of unsuccessful QR-code and face read by the Employee Attendance System. This is relatively low since it takes less than one-third fraction of a second to process data received thus making the Employee Attendance System an efficient one.

Using the formula: Monthly Appraisal = no of times present $\frac{no\ of\ times\ present}{no\ of\ working\ days}$ x 100 the monthly appraisal of each employee was gotten.

The no of times present can be easily found on the attendance summary generated from the Employee Attendance System. This can further be explained using the fig 8 and 9 respectively.

**EMPLOYEE ATTENDANCE SYSTEM USING FACE RECOGNITION AND BARCODE TECHNOLOGY**

**ATTENDANCE APPRAISAL FOR APRIL**

| Employee_ID | Name | Department | Position | Contact_no | Monthly Appraisal(100%) |
|---|---|---|---|---|---|
| 001 | samuel | computer_science | Supervisor | 9037362781 | 100% |
| 002 | oluwaloni | computer_engineering | sportfield_Manager | 9084683992 | 20% |
| 003 | gloria | food_technology | head_writer | 9808379838 | 60% |
| 004 | kamoru | mechanical_engineering | cleaner | 9083922783 | 40% |
| 005 | Tomison | Business_administration | secretary | 9076563463 | 100% |
| 006 | kehinde | mechanical_engineering | clerk | 9038745371 | 100% |
| 007 | chidinma | computer_science | security | 8036352462 | 20% |
| 008 | mariam | computer_engineering | sweeper | 9083654326 | 40% |
| 009 | Damilare | food_technology | MOF | 7098534625 | 100% |
| 010 | Ahmid | food_technology | Postman | 9836538635 | 80% |

Fig 8: Samples for Employee Attendance Appraisal for April

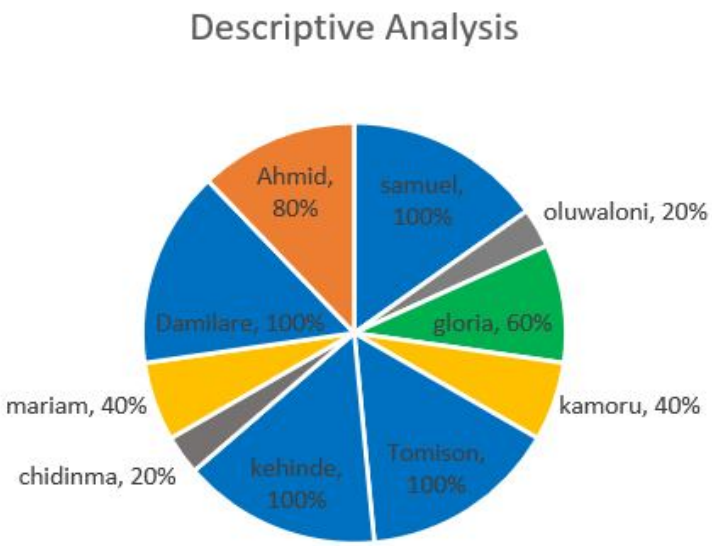



Fig 9: Descriptive Analysis of Employee Attendance Appraisal for April

From the descriptive analysis of the attendance report we can deduce that fig 9 illustrate april attendance appraisal for each employee in percentage. For this particular attendance twenty (20) working days in a month was considered with weekends as work-free days from these two graphical representations we can see that only four employees (006 - Kehinde, 005 - Tomison, 009 - Damilare, and 001 - Samuel) had a complete attendance based on the stipulated working days. Ahmid had a closer attendance appraisal of 80%. Indicating that he was absent for 4 days. Gloria (003) had an attendance appraisal of 60% indicating she was absent for 8 working days. Mariam (008) and Kamoru (004) has an attendance appraisal of 40% showing that they were both absent for 12 working days while Chidinma (007) and Oluwaloni (002) had the lowest attendance appraisal of 20% which denotes that they were absent for 16 working days.

We would realize that only four of the employees with the appraisal of 100% will be paid in full while the employees with the attendance appraisal of 80% and 60% will be paid in half, while the employees with the attendance appraisal of 40% and 20% will be put under consideration. The results gotten from the testing shows that there is an accurate monitoring and security through the use of the system. With the speed of recognition and descriptive analysis illustrated, we can confidently point out that the Employee Attendance System using face recognition and QR-code Technology can be considered as one of the effective tools for the improvement of employee productivity.

## VII. CONCLUSION

The development of an Employee Attendance System using Face Recognition and QR-code was developed to eliminate the numerous challenges being faced with the paper-based method in managing attendance and impersonation. The system's admin login screen appears before the login interface's login screen, which was created using the Python programming language and the XAMPP Server database.

The manual system was examined and analyzed during the fact-finding phase to clearly identify its shortcomings before the system was developed.

The employee attendance system result findings shows that attendance monitoring is more efficient and reliable in taking attendance in any organization or institution.

The system developed will not only allows the clock in and clock out of employees but enables instant sending of emails using the inbuilt email sender found in the system, also allows the attendance of each employee to be easily appraised based on the percentage of attendance gotten from the number of times present.

The Employee Attendance System is recommended for Yaba College of Technology, other institutions and organizations like the health facilities, industries, e-government (federal and non-federal) etc. the system can be extended to different working sectors where there is a need to record and to digitalize the attendance of employees in order to provide an efficient and reliable attendance management system.

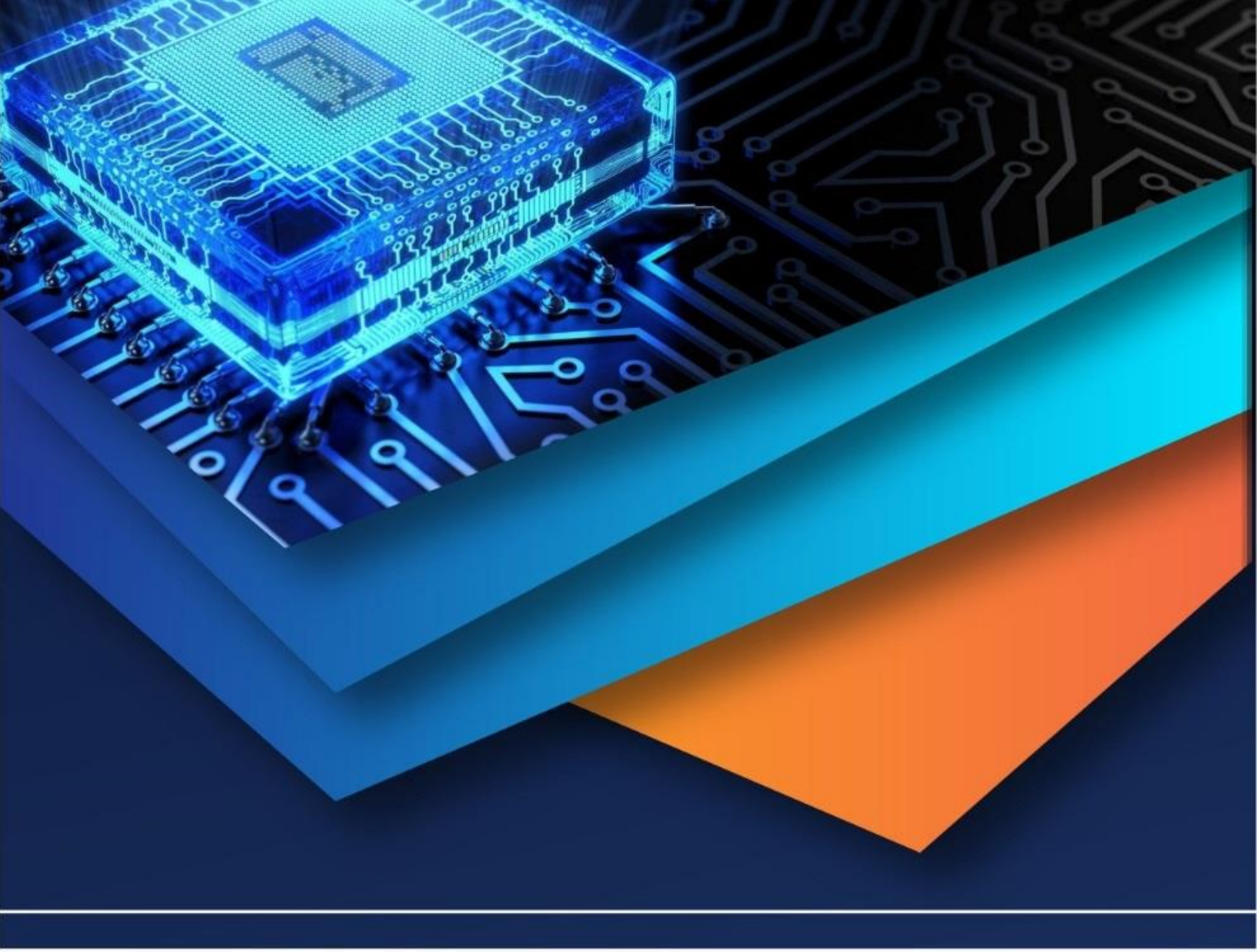
## VIII. ACKNOWLEDGMENT

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