Bar Code Scanning Based Attendance System

Jayashre K
Department of Computer Science and Engineering
Shiv Nadar University, Chennai
Chennai, India
jayashre22110169@snuchennai.edu.in

***Abstract*— The Barcode Scanning based Attendance System is a Python project for college students and professors. Using tkinter and pyzbar libraries, it scans barcode ID cards with a camera and retrieves details from an Excel sheet. This automated system updates attendance records in Excel, saving time and reducing errors. Specifically designed for Cyber Security students, it offers a user-friendly solution for efficient attendance management in educational institutions.**

Keywords*— *Barcode Scanning, Attendance System, Python, pyzbar, college, attendance records, Cyber Security.

I. INTRODUCTION

The Barcode Scanning based Attendance System is a Python project designed to streamline attendance management for college students and professors. By leveraging the tkinter and pyzbar libraries, this user-friendly system caters specifically to Cyber Security students and faculties. It utilizes a camera to scan the barcodes on their identity cards, extracting their information from an Excel sheet. This automated process eliminates the need for manual data entry and reduces errors. The system seamlessly updates the attendance records in Excel, ensuring accurate and up-to-date information. With its focus on efficiency, the system saves valuable time for both students and professors, allowing them to devote their energies to other tasks. By combining the power of technology and simplicity of use, the Barcode Scanning based Attendance System offers a reliable and convenient solution for managing attendance records in educational institutions.

II. LITERATURE REVIEW

The significance of student attendance in higher education institutions on academic performance has been emphasized in the findings of [1]. It has been observed that manual attendance recording methods employed in these institutions are not only time-consuming but also prone to inaccuracies. To address these challenges and ensure the integrity of attendance records, there is a clear need for the implementation of automated attendance systems. Such systems play a crucial role in deterring poor attendance and preventing cheating, thereby enhancing the overall effectiveness of academic assessments.

In paper [2], the authors discuss how traditional methods of authentication, such as passwords and PINs, are becoming less effective due to security compromises and the potential for theft or guessing. As a solution, biometrics have gained attention as reliable authentication systems. Biometrics employs measurable biological traits like fingerprints, facial appearance, voice patterns, and iris recognition to verify and authenticate individuals. These biometric features offer a higher level of security compared to traditional methods, making them an increasingly popular choice for authentication.

Paper [3] introduces a novel system that utilizes QR codes as an efficient method for attendance marking. Each student is assigned a unique QR code containing their credentials, ensuring the prevention of proxy attendance by disallowing code sharing. The system eliminates the need for manual logins or data entry, automatically detecting registered students and accurately recording their attendance. It focuses solely on attendance tracking and does not monitor the duration of students' presence in the class. This system brings substantial benefits to both students and teachers, saving time, reducing the requirement for extra classes, and improving attendance management. By harnessing the potential of QR codes, this innovative approach streamlines the attendance process, enhancing overall efficiency in educational settings.

According to paper [4], the QR Code Based Smart Attendance System offers several benefits such as improved security, easy maintenance, quick generation of attendance reports, and user-friendliness. The system relies on QR codes and face recognition technology to ensure accurate attendance monitoring. In comparison, traditional attendance systems like punch cards, logbooks, fingerprint systems, and RFID are limited and prone to providing inaccurate information. The smart attendance system mentioned in the paper incorporates various features, including face detection, dynamic QR codes, manual attendance marking, and the ability for teachers to rectify attendance records. Both students and teachers can access attendance records, allowing them to calculate the number of lectures attended or missed.

In paper [5], the authors discuss the significant benefits of leveraging technology, specifically face recognition, in enhancing attendance management efficiency. They emphasize the accuracy and effectiveness of face recognition-based biometric systems in preventing attendance fraud, such as proxies or forged signatures. The proposed system outlined in the paper eliminates the need for manual intervention from faculty members by automatically monitoring and recording attendance. By implementing this system, attendance marking accuracy can be improved, faculty members' time can be saved, and the occurrence of manual errors commonly associated with traditional attendance tracking methods can be eliminated.

The attendance management system proposed in paper [6] aims to revolutionize attendance recording in schools and colleges by providing an efficient and precise solution. The system utilizes handheld devices powered by AVR ATMEGA16 microcontrollers, incorporating essential components such as a Real Time Clock, EEPROM, keypad, LCD, and ZigBee module. By leveraging these devices, attendance records along with the corresponding date and time are securely stored in the EEPROM. The attendance data can then be effortlessly transmitted wirelessly to a local server, which runs on Raspberry Pi and functions as a web

server. Through ZigBee modules, seamless communication is established between the handheld devices and the server. The server hosts a user-friendly website that facilitates attendance record management, allowing students, teachers, administrators, and department heads to conveniently access and monitor attendance data. The system not only offers advantages such as affordability, compact size, energy efficiency, and user-friendliness, but it also holds potential for broader applications in education, industries, and healthcare. Overall, this embedded attendance system presents a comprehensive solution for accurate data collection and streamlined record-keeping processes.

In summary, paper [7] provides a comprehensive discussion on the diverse applications and security considerations associated with QR codes. The text emphasizes the advantages QR codes offer compared to traditional barcodes, such as their ability to store more data in a compact form, error-correction capabilities, and swift response time. The paper acknowledges the widespread utilization of QR codes across various sectors including online banking, attendance management, healthcare, and security applications. Furthermore, it introduces the concept of SQRC (Secured QR Code) as a means to securely transport data. The literature review section presents several instances of QR code implementation, encompassing student attendance systems, aiding visually impaired individuals, online banking authentication, and healthcare record management. Moreover, the paper explores the integration of cryptography and steganography with QR codes, thereby enhancing their security features. In essence, this paragraph effectively summarizes the primary points covered in the text.

In paper [8], the authors present an automated attendance system that combines face recognition and Radio Frequency Identification (RFID) technology. The system effectively detects authorized students by utilizing both face recognition and RFID, accurately tracking their entry and exit from the classroom. Notably, the system includes an energy-saving feature that activates room electronics only when individuals are present, achieved through the use of IR modules. The RFID system consists of a reader and a tag, where the tag is attached to the student and the reader identifies the correct object. The paper highlights the cost-effectiveness of this proposed system compared to previous RFID-based classroom systems. Moreover, the system offers the flexibility to log attendance information either using an SD card or by uploading it to the internet based on the client's requirements. Overall, the authors conclude that their proposed model successfully combines face recognition and RFID technology, providing an efficient and convenient alternative to manual attendance systems.

In Paper [9], an innovative automated attendance management system is introduced for professional gatherings, encompassing conferences, exhibitions, and training courses of various sizes. Leveraging RFID, mobile communication, and IT technologies, the system efficiently collects, records, and processes data pertaining to participants' activities, session attendance, and booth visits at the event. Real-time comprehensive reports are generated, highlighting attendance statistics, participant flow, preferred interests, and activities. This versatile system caters to diverse locations and timeframes, accommodating both small-to-medium seminars and workshops, as well as large-scale congresses and technical shows. The paper explores various attendance tracking techniques such as optical and laser scanning, infrared sensing, image processing, and RFID, emphasizing RFID-based systems as a cost-effective and efficient solution. The authors examine the characteristics of RFID tags and international protocol standards to support the selection of a suitable RFID solution. For wireless communication, WiFi is chosen due to its widespread availability, compatibility with existing devices, and internet connectivity, enabling seamless data transmission from RFID readers to a remote server. The system architecture is outlined, comprising RFID readers, a server application, and a wireless router for communication. The structure of the RFID reader device is explained, encompassing a microcontroller, RFID reader IC, on-board antenna, and WiFi transceiver module. The server's tasks encompass collecting and processing information, displaying real-time data, and storing it in an MS Excel database for further analysis. Overall, this paper presents an automated attendance management system that effectively tracks participants, generates insightful reports, and streamlines event organization and planning for professional gatherings, offering an efficient and cost-effective solution.

In their paper [10], the authors highlight the crucial role of RFID technology in attendance management within the corporate world, providing a productive and efficient solution. RFID, an acronym for radio frequency identification, employs wireless technology to transmit data from electronic tags to RFID readers for identification purposes. By integrating RFID tags into students' ID cards and installing RFID receivers in respective classes, the attendance process can be automated. Each ID card is assigned a unique ID (UID) that is linked to individual data stored in a database managed by microcontrollers like Arduino or Raspberry Pi. When a student enters the class with their ID card, the system detects the UID and automatically records their attendance. To mitigate proxy attendance, face recognition utilizing Face ID is utilized for verification, while attendance reports are generated in Excel Sheets format. This technology offers advantages such as minimizing direct contact, avoiding loss or damage to attendance forms, and surpassing other attendance systems like QR code or biometric-based solutions in terms of efficiency and convenience. Prior research and applications have explored the use of RFID in attendance systems, primarily utilizing passive RFID tags operating at a frequency of 13.56 MHz. The comprehensive system encompasses various components such as RFID readers, microcontrollers like NodeMCU, NodeMCU-ESP 32 CAM, and IoT technologies. Database management using PHP and SQL enables the storage and retrieval of attendance data, while face recognition for two-step authentication is facilitated through image processing, deep learning, and machine learning algorithms. This intelligent attendance system effectively addresses the challenges faced by educational institutions, offering a cost-effective and user-friendly solution for managing attendance efficiently. By reducing the time required for attendance taking and uploading, it optimizes class time utilization and enhances overall productivity. Additionally, the system can be further enhanced by incorporating PIR human detection sensors for improved power efficiency and integration with smart classroom systems. In conclusion, the RFID and Face ID-based attendance management system proposed in this paper [10] presents an attractive and practical solution for

schools and colleges, enhancing accuracy, reducing malpractice, and streamlining the attendance process.

III. Materials and Methods

A. Bar Code

Barcode technology has revolutionized data capture and identification processes in various industries. A barcode is a machine-readable representation of data in the form of parallel lines of varying thickness and spacing. Its purpose is to provide a unique identifier for items, enabling automatic data capture and retrieval. By using a barcode scanner, information encoded in the barcode can be quickly and accurately read and processed.

A barcode typically consists of several components. The start and stop characters indicate the beginning and end of the barcode, allowing scanners to identify the barcode boundaries. Data characters encode the actual information, which can be alphanumeric or numeric. A checksum digit is often included to ensure the accuracy of the barcode data and minimize errors. Quiet zones, which are blank areas before and after the barcode, are essential for scanning accuracy and reliable decoding.

Barcode scanners work based on the principle of light reflection and detection. When a barcode is scanned, a scanning device emits light, usually a laser or LED, onto the barcode. The light is reflected to a sensor, which detects the variations in light intensity caused by the alternating bars and spaces of the barcode. These variations are then translated into electrical signals, which are decoded to retrieve the encoded data.

Barcodes offer several advantages over manual data entry or other identification methods. They enable fast and accurate data capture, reducing errors and improving efficiency. Barcode scanning is non-intrusive and does not require direct contact with the item being scanned. Additionally, barcodes can store large amounts of information in a compact form, making them versatile for a wide range of applications.

However, barcode technology also has its limitations. Barcodes require line-of-sight scanning, meaning the barcode must be visible to the scanner for successful reading. Damaged or poorly printed barcodes may result in reading errors or failures. Moreover, barcodes have a limited capacity to store data compared to other technologies such as RFID (Radio Frequency Identification).

There are various types of barcodes available, each designed for specific applications.

EAN-13 (European Article Numbering-13) barcodes are widely used in retail environments and are associated with product identification and pricing. EAN-13 barcodes consist of 13 digits and are commonly found on consumer products worldwide. They encode product information such as the manufacturer's country code, company identifier, and item reference number.

The Universal Product Code (UPC) is widely used in North America for product identification in retail environments. UPC barcodes consist of 12 digits and are commonly found on consumer products such as groceries, electronics, and household items. They encode information such as the manufacturer's identification number and the product's item number. UPC barcodes enable quick and reliable product scanning at the point of sale, facilitating inventory management and pricing accuracy.

QR codes have gained significant popularity due to their ability to store large amounts of data, including text, URLs, and multimedia content. QR codes consist of black squares arranged on a white background in a square grid pattern. They can be scanned using smartphones or dedicated QR code scanners, allowing users to access information or perform specific actions. QR codes are commonly used for advertising, marketing campaigns, ticketing, and contactless payments.

Code 39 is a versatile barcode type that can encode both letters and numbers. It is frequently used in logistics, inventory management, and labeling applications. Code 39 barcodes can encode alphanumeric characters, including uppercase letters (A-Z), numbers (0-9), and several special characters. They are self-checking, meaning they include a built-in mechanism for error detection.

These are just a few examples of the diverse range of barcode types available. Each barcode type serves specific purposes and offers distinct advantages in terms of data capacity, versatility, and compatibility with existing systems. Choosing the appropriate barcode type depends on the specific requirements of the application and the industry in which it will be utilized.

B. Use of Code 39 in University Attendance Systems

In many educational institutions, including our university, Code 39 barcodes are widely adopted for attendance systems. Several reasons contribute to the prevalence of Code 39 in colleges and universities.

Fig.1: The figure displays a sample barcode utilized within our university.

Firstly, Code 39 barcodes offer compatibility with existing systems and infrastructure. Many universities already have barcode scanners and systems in place for various purposes, such as library management or access control. Leveraging the same technology for attendance tracking allows for easier integration and reduces the need for additional investments.

Furthermore, Code 39 is relatively easy to implement and cost-effective. It does not require complex encoding or specialized equipment, making it accessible to educational institutions with limited resources. The simplicity and ubiquity of Code 39 also facilitates training and adoption among staff and students.

C. The Proposed System

Our proposed system aims to revolutionize attendance management in educational institutions by leveraging barcode scanning and image processing techniques. This system provides an efficient and reliable solution for automating the tracking of student attendance, offering improved accuracy, and reducing the need for manual effort.

1) Module Import

To ensure the seamless functioning of our system, we import several essential modules, including pywin32, opencv, time, pyzbar, tkinter, datetime, and openpyxl. These modules serve different functionalities within our system, contributing to its smooth execution.

2) Excel File and Sheet Handling

Our system incorporates features that allow users to view attendance records, course and faculty information, and student records in a protected view. This functionality involves hiding sheets that are not currently in use and protecting the sheets with a password. Additionally, users can write a selected date to a specific cell in an Excel sheet for further convenience.

3) Bar Code Scanning

The core functionality of our system revolves around barcode scanning. We utilize the OpenCV library to continuously capture frames from a webcam and detect barcodes within those frames. When a new barcode is detected, it is added to the list of barcodes. We then employ the pyzbar library to decode the barcodes detected by the system.

4) User Authentication and Attendance Marking

In our system, we prioritize user authentication and accurate attendance marking. We have implemented the following functionalities:

User Attendance Verification: The system scans a barcode, reads data from an Excel sheet, and verifies the user's attendance by comparing their roll number with the data in the sheet.

Faculty Attendance Marking: Faculty members can mark students as "absent" or "present." The system verifies the registration numbers entered by the faculty against the last two digits of the registration number column. Once the verification process is completed, the system automatically records the attendance status of each student for the designated date selected by the faculty member.

5) Changing Attendance System

Our system also includes a feature that allows users to modify their attendance status. Users can change their attendance from "absent" to "present" or vice versa for a specific date and course.

6) Utlizing SVM for Barcode Classification

To classify the barcode information and determine student attendance status, we employ Support Vector Machine (SVM) algorithms. SVMs are well-suited for accurately classifying different types of barcodes. Preprocessing techniques are applied to barcode images using OpenCV to enhance classification accuracy.

7) Excel Database for Attendance Management

Our system relies on an Excel workbook as the database for storing various datasets. These datasets include student data, course data, and attendance data. The student data includes information such as names, roll numbers, and other relevant details. Course data comprises details about the courses being taught. Attendance data captures information about student attendance, including the date and attendance status.

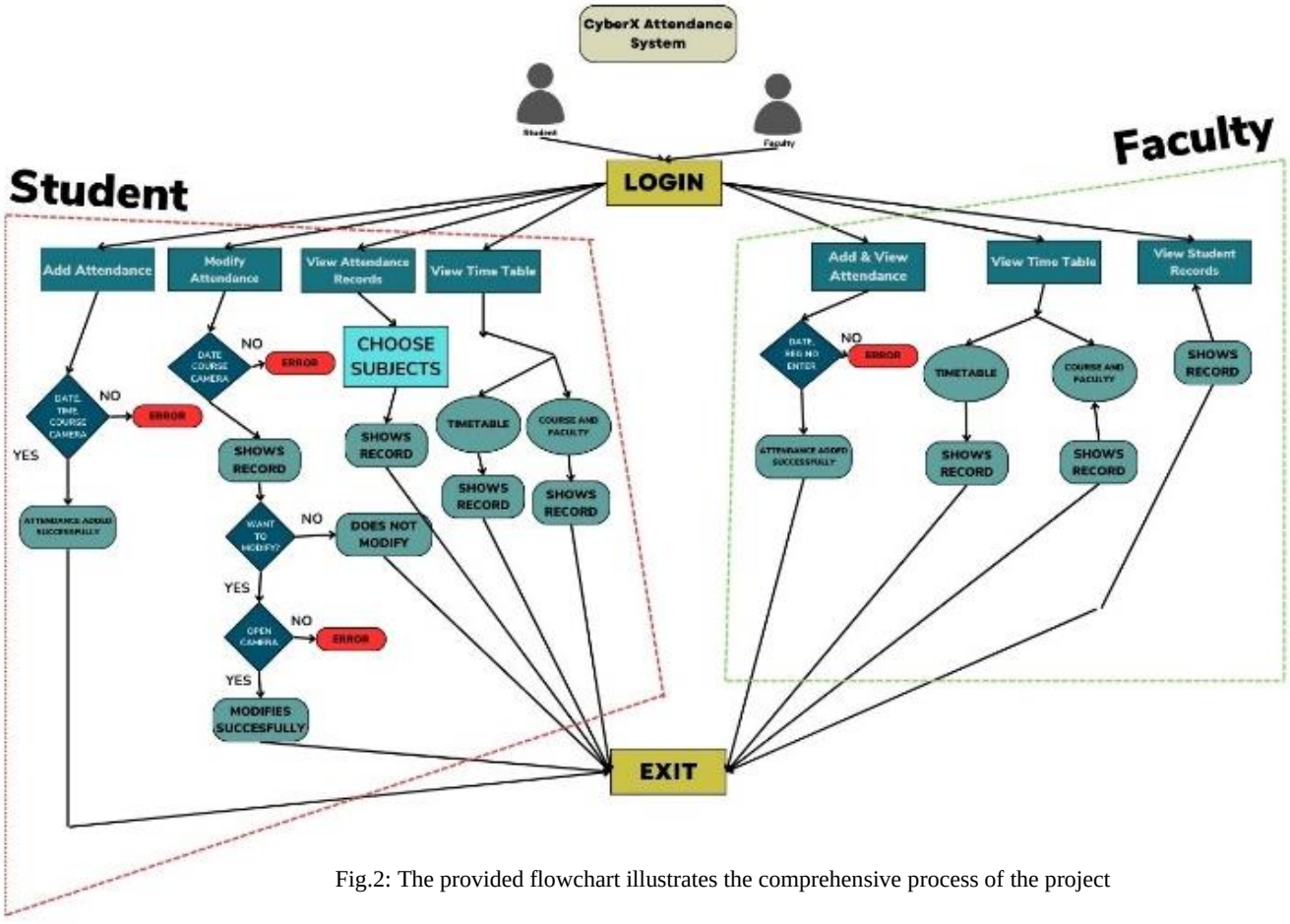

Fig.2: The provided flowchart illustrates the comprehensive process of the project

8) Image Processing Techniques

Image processing plays a vital role in our system, particularly in extracting and decoding barcode information. Image acquisition involves capturing an image of the barcode using a camera and applying techniques such as thresholding, smoothing, edge detection, and contour analysis. These techniques enhance barcode quality, remove noise, and extract barcode boundaries. Barcode decoding is performed using specialized software or libraries capable of recognizing and decoding different barcode types.

IV. RESULTS

The implemented system showcased promising results, effectively automating attendance management in educational institutions.

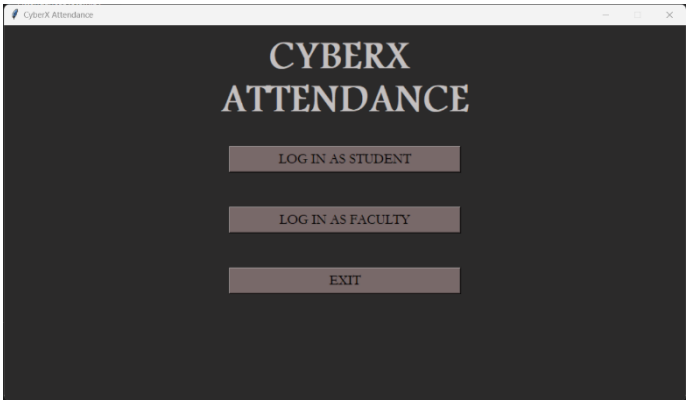

Fig.3(a): User-friendly mainframe of the Attendance App for efficient attendance management

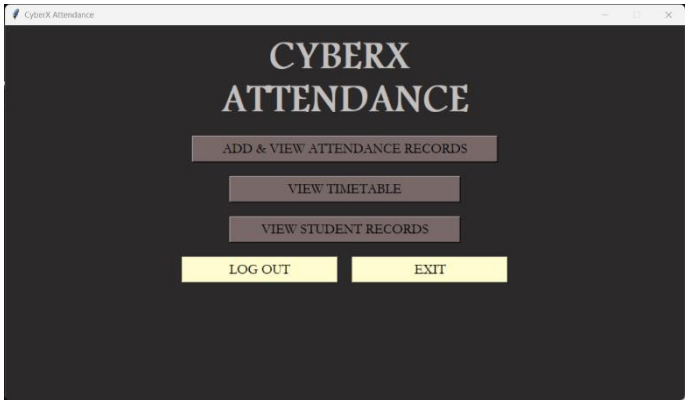

Fig.3 (b): Faculty Frame

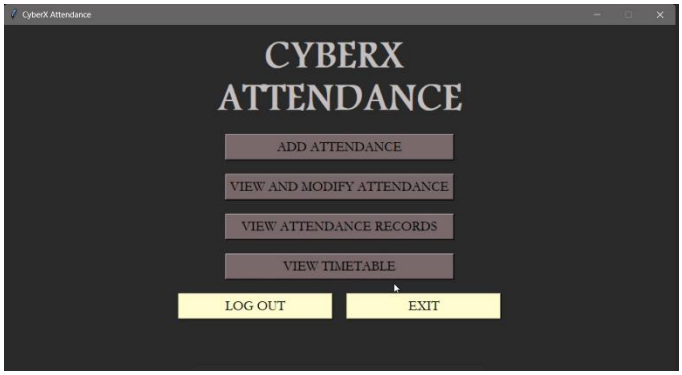

Fig.3 (c): Student Frame

Attendance tracking is a critical aspect of educational institutions, and traditional methods often involve manual processes that are time-consuming, prone to errors, and lack real-time feedback. Our system addressed these challenges by introducing a streamlined and automated approach to attendance management.

By harnessing the power of barcode scanning technology, we achieved significant improvements in accuracy and efficiency when tracking attendance. Figure 3 illustrates the system's real-time feedback mechanism, which played a pivotal role in providing prompt and precise attendance updates for both students and faculty members. Faculty members were able to closely monitor attendance records and promptly respond to the information provided, enhancing transparency, and fostering a more efficient attendance management system.

The user-friendly mainframe of our system, as depicted in Figure 3, greatly simplified the attendance management process. Its intuitive navigation and clear functionality empowered faculty members, administrative staff, and students to effortlessly interact with the system, ensuring seamless attendance monitoring and recording. This comprehensive solution transformed the way attendance is managed, optimizing accuracy, efficiency, and transparency across the entire educational institution.

The incorporation of barcode scanning technology, as illustrated in Figure 4, played a pivotal role in capturing attendance data and facilitating authentication and login processes for both students and faculty members. By scanning unique barcodes associated with everyone, the system accurately recorded their presence in real-time, ensuring accurate attendance tracking. Additionally, the captured barcode information was utilized for authentication purposes, allowing both students and faculty members to log in securely and access their personalized accounts within the system.

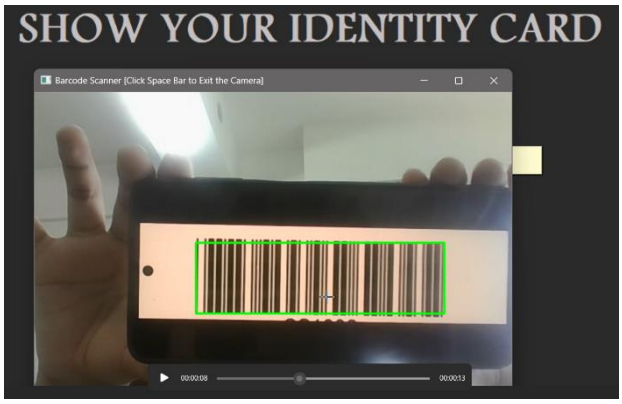

Fig.4: Barcode scanning process in action

The barcode scanning process served as a reliable means of verifying the identity of both students and faculty members. As students and faculty members scanned their respective barcodes, the system cross-referenced the captured information with the existing database to authenticate their identity and grant access to their respective accounts. This streamlined the login process for both students and faculty members, eliminating the need for traditional username-password combinations and simplifying their access to the system.

By incorporating barcode scanning for authentication, the system enhanced security and prevented unauthorized access to sensitive information. Faculty members also utilized the barcode scanning mechanism to log in securely and access their dedicated functionalities within the system. This ensured that only authorized faculty members could access the system and perform actions such as marking attendance, managing courses, and generating reports. The streamlined login process improved efficiency and eliminated the hassle of remembering and inputting login credentials.

Furthermore, the system provided faculty members with a convenient feature, as shown in Figure 5, to mark students as "present" or "absent" without the need for barcode scanning. Faculty members could accomplish this by entering the last two digits of the students' registration numbers directly into the system. This streamlined approach eliminated the necessity for scanning individual barcodes and allowed faculty members to efficiently update attendance records. By simplifying the process, the system reduced administrative burden and ensured accurate attendance tracking with real-time updates.

The system's real-time feedback mechanism, as showcased in Figures 5(a) and 5(b), proved invaluable in providing prompt and accurate attendance updates for both students and faculty members. Faculty members had the ability to view attendance records, as depicted in Figure 5(c), for the subjects they taught, enabling them to monitor attendance for specific classes or subjects and take necessary actions based on the information provided by the system. This feature enhanced transparency and accountability, fostering a more efficient attendance management system for educational institutions.

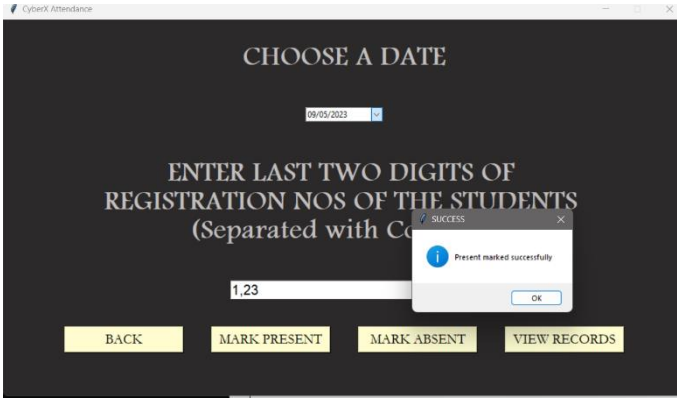

Fig.5 (a): Successful marking of student attendance by faculty

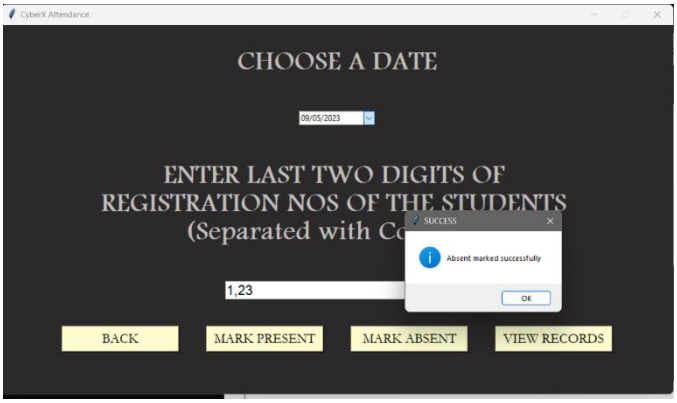

Fig.5 (b): Successful marking of student absence by faculty

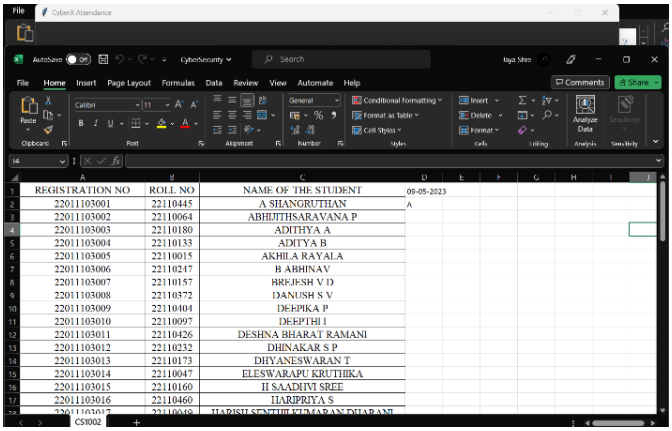

Fig.5 (c): Faculty and Student viewing attendance records

In addition to the functionalities available to faculty members, the system also allowed students to add their attendance by providing the course name, date, and session information. This feature empowered students to take an active role in managing their attendance. Once students input their attendance details through the interface (as shown in Figure 6), they can proceed to scan their barcodes to mark themselves as present, ensuring accurate and efficient attendance tracking.

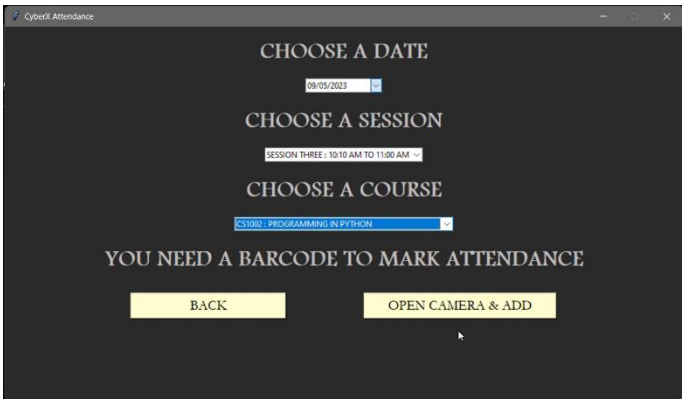

Fig.6 (a): Interface for Students to Add Attendance Details

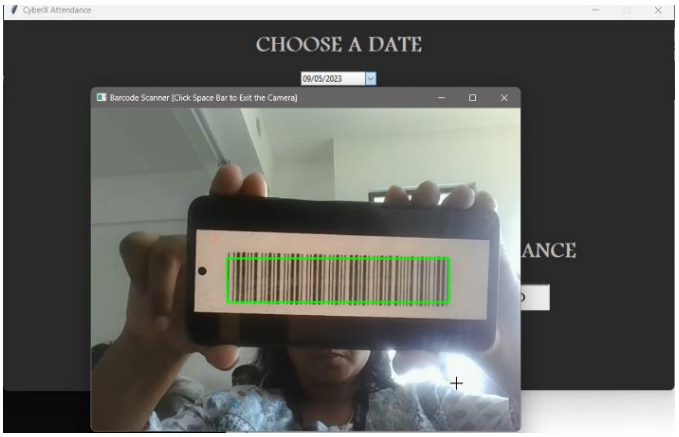

Fig.6 (b): Barcode Scanning for Student Attendance

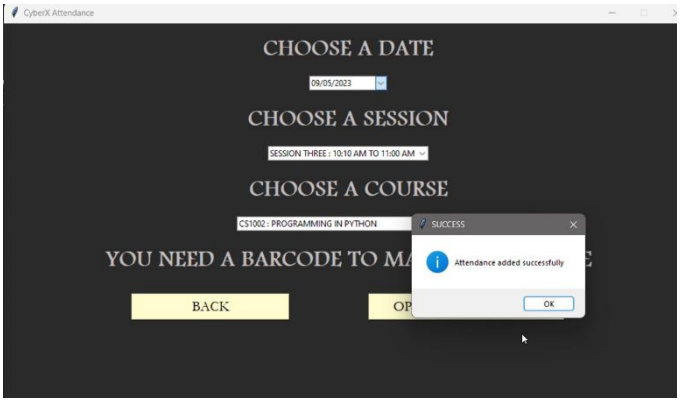

Fig.6 (c): Successful Student Attendance Addition

Moreover, the system offered the capability for students to modify their attendance records, subject to proper authentication from the respective faculty member responsible for the course. Students could request changes to their attendance by providing the course details and date. The system would validate the authentication of the faculty member before allowing modifications to be made. An output screenshot (Figure 7) showcases the interface where students can initiate the attendance modification process, ensuring accuracy and accountability in attendance management.

Fig.7 (a): Interface for Modifying Attendance Details

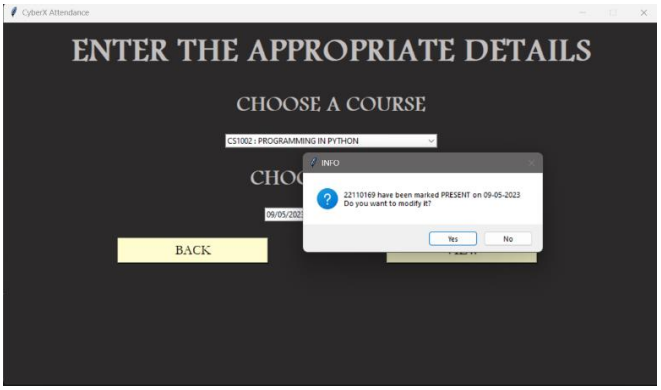

Fig.7 (b): Attendance Status Prompt for a Given Date

Fig.7 (c): Authentication Prompt for Changing Attendance Status

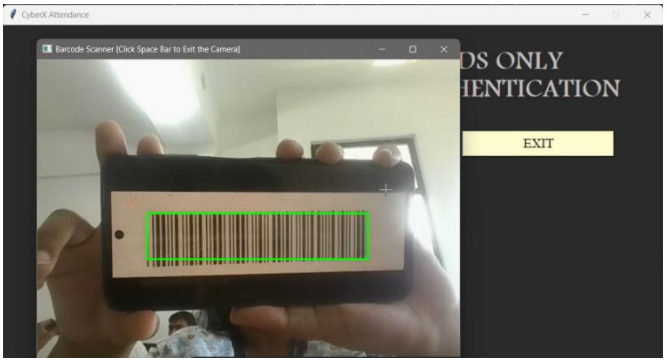

Fig.7 (d): Barcode Scanning for Authentication to Modify Attendance

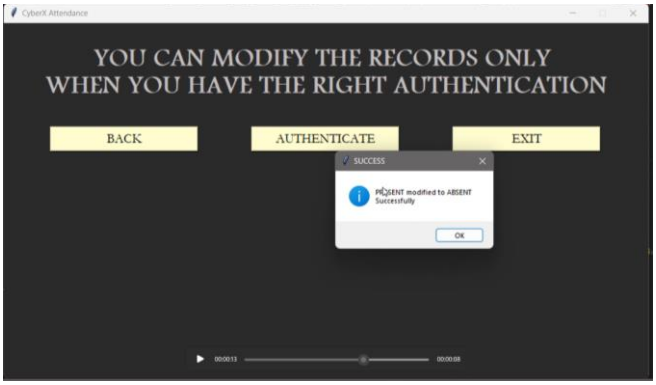

Fig.7 (e): Prompt Showing Successful Attendance Status Modification

Additionally, students had the ability to view their attendance records, like faculty members. By accessing the attendance records interface (Figure 5(c)), students could review their attendance history and monitor their overall attendance performance. This feature provided students with a comprehensive view of their attendance status and encouraged them to actively track their attendance progress throughout the semester.

V. Conclusion

The implemented Barcode Scanning based Attendance System has showcased promising results in automating attendance management in a college setting. By integrating barcode scanning technology, image processing techniques, and SVM-based classification, the system provides an efficient and reliable solution for accurate attendance tracking in real-time. The user-friendly interface facilitates easy navigation and interaction for both students and faculty members.

In the system, Python, OpenCV, and Excel are utilized to automate the attendance process, saving time and reducing errors. SVM Classifier is employed to recognize barcodes, and a dataset of barcode images is used to train the classifiers. Various image processing techniques are applied to enhance the quality of barcode images before classification.

This comprehensive system allows students to add their attendance by providing course details and verifying their presence through barcode scanning. It also enables them to request modifications to their attendance records with proper authentication from the respective faculty members responsible for the course. Faculty members have access to attendance records for the subjects they teach, allowing them to monitor attendance for specific classes or subjects.

The system's real-time feedback mechanism provides prompt and accurate attendance updates, enhancing transparency and accountability. By streamlining the attendance tracking process, improving accuracy, efficiency, transparency, and security, the Barcode Scanning based Attendance System revolutionizes attendance management in educational institutions.

In conclusion, the implemented system harnesses the power of barcode scanning, image processing, and SVM-based classification to automate attendance management effectively. It offers a comprehensive solution that improves accuracy, efficiency, transparency, and security, ultimately enhancing the overall educational experience for all stakeholders involved.

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