

Bar Code Based Attendance System

Jayashre
Student
Department of Computer Science and
Engineering
Shiv Nadar University
Chennai, India
jaya2004kra@gmail.com

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, SVM, barcode classification, attendance records, authentication.

I. INTRODUCTION

The Barcode Scanning based Attendance System is a Python project aimed at streamlining attendance management for college Cyber Security students and faculty members. Leveraging tkinter and pyzbar libraries, this system eliminates manual data entry, reducing errors, and saving time. It uses barcode scanning technology to track attendance accurately, with real-time updates for transparency. The user-friendly interface simplifies interaction, and security is enhanced through barcode-based authentication.

The primary contributions of this paper are as follows:

- **Automated Attendance Management:** Introduces automated attendance tracking, saving time and reducing errors.
- **Barcode Scanning Technology:** Efficiently tracks attendance using unique barcodes.
- **Real-time Feedback Mechanism:** Provides prompt attendance updates for transparency.
- **User-friendly Interface:** Simplifies interaction for both students and faculty.
- **Security Enhancement:** Ensures system access only for authorized individuals.

This paper follows a concise structure, starting with a literature review in Section 2, which explores existing research. Section 3 outlines the material and methods used in our Barcode Scanning based Attendance System. Finally, Section 4 presents the results of implementing the system, offering insights into its effectiveness. This organized format allows readers to efficiently grasp the research's scope and outcomes.

II. LITERATURE REVIEW

Student attendance is pivotal in higher education [1]. Manual recording is error-prone and time-consuming. Automated systems enhance record integrity, discourage poor attendance, and improve assessment effectiveness. Traditional methods (passwords and PINs) are criticized for security flaws [2]. Biometrics, using traits like fingerprints and facial recognition, offer secure user verification, gaining popularity for authentication.

Khang & Tee et al. [3] introduces an innovative QR code-based attendance system that prevents proxy attendance with unique QR codes for each student. It automates attendance, detects registered students, and eliminates manual logins and data entry. While it focuses on attendance tracking, it doesn't monitor class duration, offering time savings and improving attendance management in education via QR codes.

The QR Code-Based Smart Attendance System, as discussed in [4], offers numerous advantages, including enhanced security, easy maintenance, rapid report generation, and user-friendliness. Combining QR codes and face recognition technology, it outperforms traditional methods like punch cards, logbooks, fingerprints, and RFID. This comprehensive system encompasses face detection, dynamic QR codes, manual marking, and enables both teachers and students to access and compute attendance records. In parallel, Rashmi et al. [5] underscore the merits of face recognition technology in attendance management, emphasizing its accuracy and efficiency in fraud prevention, automating attendance monitoring, and saving faculty time while eliminating manual errors.

Sangu et al. [6] introduces an efficient attendance system for educational institutions. It employs handheld devices with AVR ATMEGA16 microcontrollers, including Real Time Clock, EEPROM, keypad, LCD, and ZigBee module. Attendance data with timestamps is securely stored in EEPROM and wirelessly transmitted to a Raspberry Pi web server via ZigBee. A user-friendly website hosted on the server simplifies attendance management for various stakeholders. This cost-effective and compact system has versatile applications, including education, industries, and healthcare, ensuring accurate and streamlined record-keeping.

Saurabh & Komal et al. [7] extensively discusses QR codes, emphasizing their superiority over traditional

barcodes in terms of data capacity, error correction, and speed. It explores QR code applications across sectors such as banking, attendance management, healthcare, and security. The paper introduces SQRC (Secured QR Code) for enhanced data security, briefly touching on cryptography and steganography integration. This succinctly summarizes the paper's key points.

Shailendra et al. [8], introduces an automated attendance system that combines face recognition and RFID technology for accurate classroom tracking. The system conserves energy through IR modules, activating room electronics only when individuals are present. It includes an RFID reader and student-attached tags for identification, offering cost-effective advantages over previous RFID systems. Attendance can be logged via SD card or online upload, providing an efficient alternative to manual tracking.

Shubham et al. [9] introduces an automated attendance management system for professional events like

Victor & Mfundo et al. [10], emphasizes RFID's role in attendance management. RFID tags in student ID cards, along with RFID receivers in classrooms, automate attendance. Each card has a unique ID (UID) managed by microcontrollers like Arduino or Raspberry Pi. The system records attendance upon detecting the UID using Face ID verification, generating Excel reports. RFID offers contactless operation, protection against card loss or damage, and superior efficiency compared to QR codes or biometrics. The system optimizes class time and productivity, with potential enhancements like PIR human detection sensors for further efficiency and smart classroom integration. In conclusion, [10] presents a practical, efficient solution for schools and colleges, enhancing accuracy and efficiency.

III. MATERIALS AND METHODS

A. Bar Code

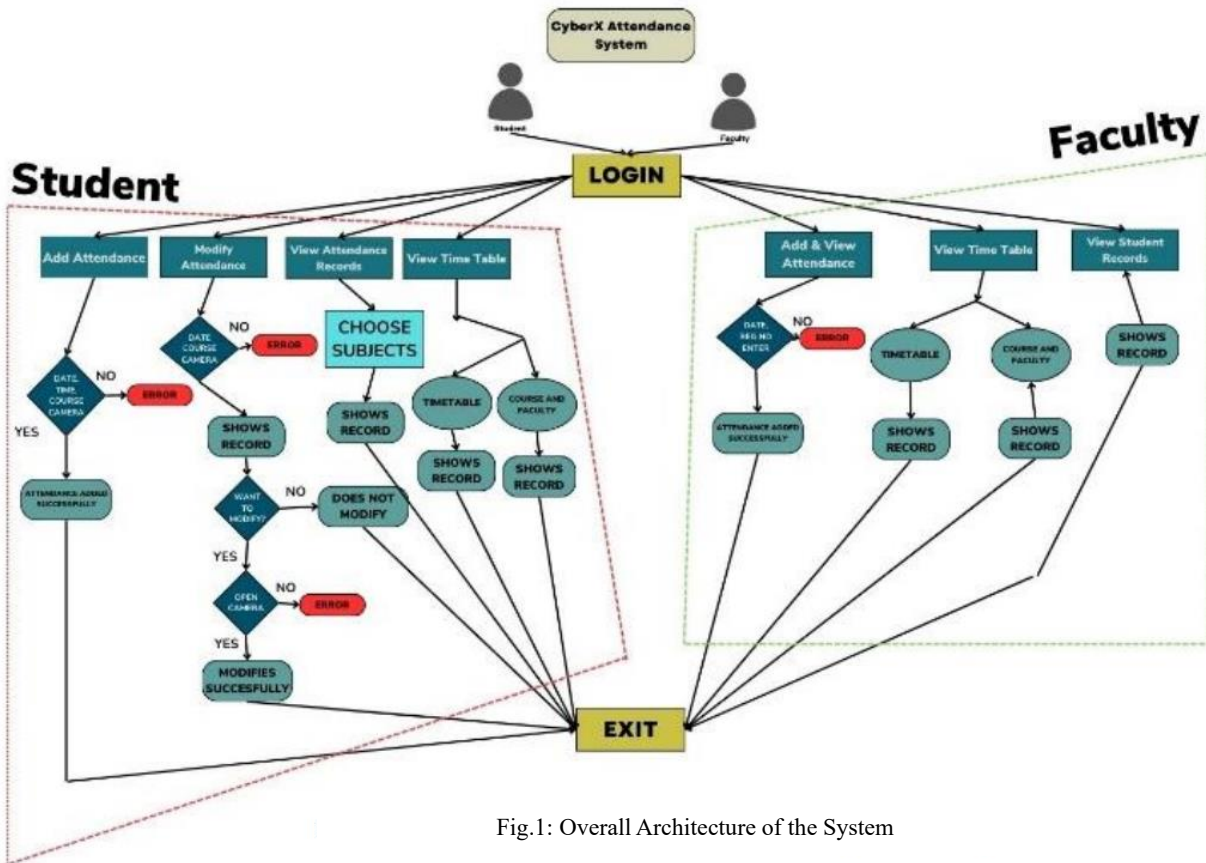


Fig.1: Overall Architecture of the System

conferences and exhibitions. This system utilizes RFID, mobile communication, and IT technologies to efficiently collect, record, and process participant data, including session attendance and booth visits in real-time. It generates comprehensive reports adaptable to various event sizes, emphasizing RFID's cost-effectiveness. The system architecture includes RFID readers, a server application, and a wireless router, enabling data transmission and real-time reporting. In essence, the paper presents an automated and cost-effective attendance management solution for professional gatherings.

Barcodes revolutionize data capture and identification across industries as machine-readable representations of information, featuring parallel lines with varying thickness and spacing for unique item identification. These codes include start and stop characters for boundaries, data characters for actual information encoding, and a checksum digit for data accuracy. Crucially, quiet zones, blank areas before and after the barcode, ensure accurate scanning. Barcode scanners employ light reflection and detection, using lasers or LEDs to emit light onto the barcode, which is then reflected and

detected by a sensor to translate variations in light intensity into electrical signals for data retrieval. Barcodes enable swift, error-reduced data capture and compact data storage but require line-of-sight scanning and may encounter issues with damaged or poorly printed barcodes, as well as having limited data capacity.

Various barcode types cater to specific applications: EAN-13 barcodes are vital in global retail, encoding 13 digits for product identification and pricing, including manufacturer details. In North America, the 12-digit Universal Product Code (UPC) is the standard for retail, facilitating point-of-sale scanning and inventory management. QR codes, known for their data storage capacity, consist of black squares on a white grid and are readable by smartphones, serving diverse purposes from advertising to contactless payments. Lastly, the versatile Code 39 Barcode encodes alphanumeric characters, finding use in logistics, inventory, and labeling, with self-checking capabilities for error detection.

The barcode landscape offers a variety of types, each with unique strengths in data capacity, versatility, and compatibility. Choosing the right barcode type hinges on specific application requirements and industry contexts.

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, as shown in Fig.2.



Fig. 2: The figure displays a sample barcode utilized within our university.

Firstly, Code 39 barcodes offer compatibility with existing university systems and infrastructure, like those used for library management or access control. This compatibility streamlines integration and minimizes the need for extra investments. Furthermore, Code 39 is cost-effective and straightforward to implement. It doesn't demand intricate encoding or specialized equipment, making it accessible to institutions with limited resources. Its simplicity also eases training and adoption among staff and students.

C. The Proposed System

Our proposed system, shown in Fig 1, 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) Utilizing 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.

8) Image Processing Techniques

Image processing is crucial in our system, especially for barcode extraction and decoding. It begins with image acquisition, where a camera captures the barcode image. Techniques like thresholding, smoothing, edge detection, and contour analysis are applied to improve barcode quality, eliminate noise, and define barcode boundaries. Barcode decoding relies on specialized software or libraries capable of recognizing and decoding various barcode types.

IV. RESULTS

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

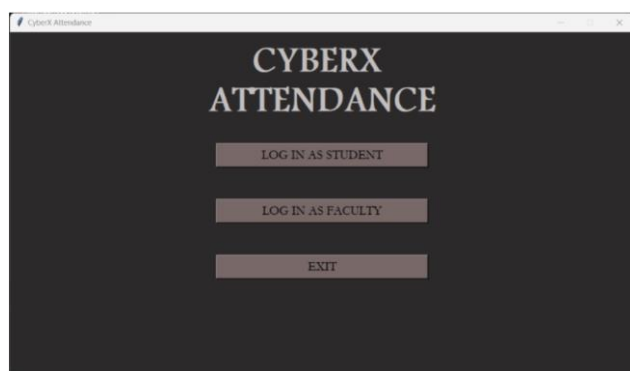


Fig.3(a): User-friendly mainframe of the Attendance App for efficient attendance management

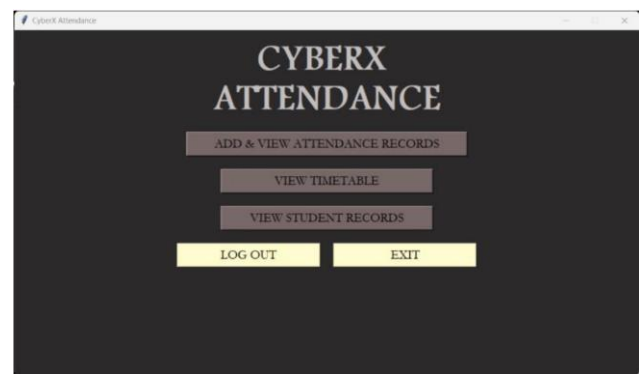


Fig.3 (b): Faculty Frame



Fig.3 (c): Student Frame

Attendance tracking in educational institutions has long been burdened by manual, time-consuming processes prone to errors and lacking real-time feedback. Our system, however, revolutionized this approach by seamlessly automating attendance management. Leveraging barcode scanning technology, we achieved remarkable gains in accuracy and efficiency. Figure 3 illustrates our system's real-time feedback mechanism, a key element in delivering prompt and precise attendance updates to students and faculty members alike. This real-time visibility empowered faculty members to closely monitor attendance, fostering transparency and significantly improving the overall efficiency of the attendance management system.

The user-friendly mainframe, depicted in Figure 3(a), (b), (c), simplified attendance management, enabling easy interaction for faculty, administrative staff, and students. This intuitive system optimized accuracy, efficiency, and transparency institution wide. The integration of barcode scanning technology, illustrated in Figure 4, played a pivotal role in capturing attendance data and facilitating secure authentication and login processes. Scanning unique barcodes ensured real-time attendance recording and secure access to personalized accounts for both students and faculty.

The barcode scanning process served as a reliable means of verifying the identity of both students and faculty members, streamlining their login process, and eliminating the need for traditional username and password combinations. This authentication method enhanced security by preventing unauthorized access to sensitive

information. Faculty members also used barcode scanning to securely access dedicated functionalities, ensuring that only authorized individuals could perform actions like marking attendance and managing courses. This streamlined approach improved efficiency and eliminated login-related hassles.

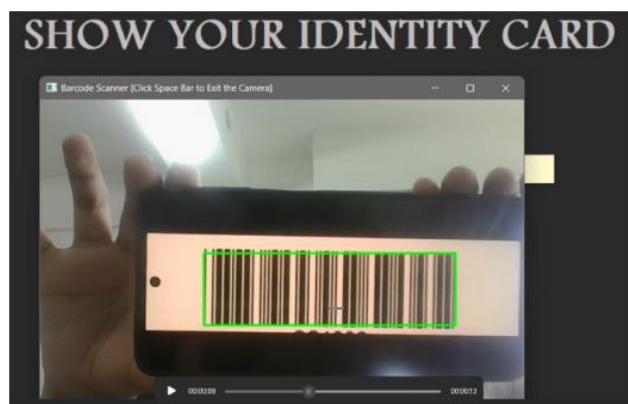


Fig.4: Barcode scanning process in action

The system also offered faculty members the convenience of marking students as "present" or "absent" directly by entering the last two digits of students' registration numbers, as shown in Figure 5. This streamlined approach eliminated the need for individual barcode scanning, reducing administrative burden, and ensuring accurate attendance records with real-time updates. The system's real-time feedback mechanism, demonstrated in Figures 5(a) and 5(b), provided prompt and precise attendance updates for both students and faculty members. Faculty members could access attendance records, for the subjects they taught, enhancing transparency, accountability, and overall efficiency in educational institutions' attendance management.

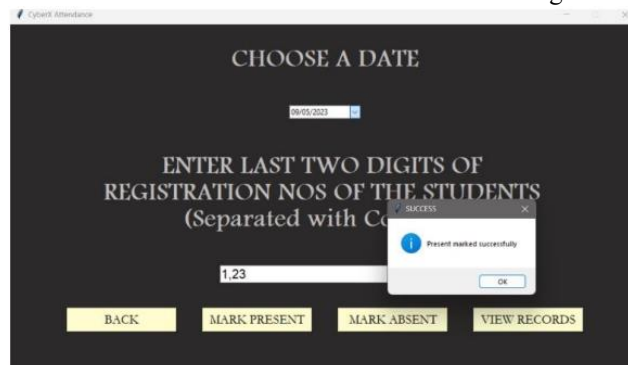


Fig.5 (b): Successful marking of student absence by faculty

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.

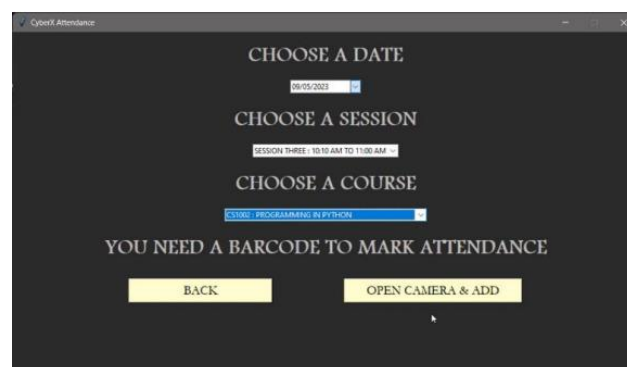


Fig.6: Interface for Students to Add Attendance Details

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: Authentication Prompt for Changing Attendance Status

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 Barcode Scanning Attendance System revolutionizes college attendance management through seamless integration of barcode scanning, image processing, and SVM-based classification. This user-friendly solution utilizes Python, OpenCV, and Excel to automate processes, reducing errors and saving time. The SVM Classifier accurately recognizes barcodes, while image processing enhances image quality. Students log attendance with barcode authentication, and faculty can monitor attendance in real-time with enhanced transparency and security, transforming educational institution attendance management for improved accuracy, efficiency, and accountability.

In conclusion, while the Barcode Scanning Attendance System presents a significant advancement in attendance management, it is essential to acknowledge its limitations. One notable limitation is the potential for unauthorized individuals to mark attendance using someone else's identity card with a barcode, posing a forgery risk. To address this concern, a promising future scope for the project involves the development of an Android app exclusively for students. This app will employ face and fingerprint recognition technology, linking these biometric features with the individual's unique barcode at the time of registration. Only when a match is confirmed between the faceprints, fingerprints, and the corresponding barcode, will the person be able to mark attendance, significantly enhancing security and authenticity. Additionally, as part of future expansion, a web app is also in development, promising further flexibility and accessibility in attendance management for educational institutions. These innovative enhancements aim to fortify

the system's security and provide more comprehensive attendance management solutions in the evolving landscape of educational technology.

VI. REFERENCES

- [1] H K Nguyen, M T Chew, "RFID-Based Attendance Management System", in *2017, IEEE*.
- [2] K Saranya, R S Reminaa, S Subhitsha, "Modern Applications of QR-Code for Security", in *2016 2nd IEEE International Conference on Engineering and Technology (ICETECH)*
- [3] Khang Jie Liew, Tee Hean Tan, "QR Code -Based Student Attendance System", in *2021 2nd Asia Conference on Computers and Communications (ACCC)*
- [4] Md. Sajid Akbar, Pronob Sarker, Ahmad Tamim Mansoor, Abu Musa AI Ashray, Jia Uddin, "Face Recognition and RFID Verified Attendance System", in *2018, IEEE*.
- [5] Rashmi A, S Brindha, Srinithin S B, Gnanasudharsan A, "Smart Attendance System using RFID and Face ID", in *2022 International Conference in Communication, Computing and Internet of Things (IC3IoT), 2022, IEEE*
- [6] Sangu Venkata Sai Harsith Reddy, Gadhiraaju Reddy Sekhar Raju, Nookala Jayanth, Malla Charan Sai, Biswajeet Pandey, Geetha G, Hardik Gohel, "Design of QR Based Smart Student Attendance System", in *2023 IEEE 2nd International Conference on AI in Cybersecurity (ICAC)*
- [7] Saurabh Singh Rajawat, Komal Saxen, "Face Recognition based Attendance System", in *2022 1st IEEE International Conference on Industrial Electronics: Developments & Applications (ICIDeA)*
- [8] Shailendra, Manjot Singh, Md. Alam Khan, Vikram Singh, Avinash Patil, Sushma Wadar, "Attendance Management System", in *2015 IEEE Sponsored 2nd International Conference on Electronics and Communications System (ICECS)*
- [9] Shubham Mishra, Chandan Kumar, Ahmad Ali, Jeevan Bala, "Online Attendance Monitoring System Using QR Code (OAMS)", in *2021 2nd International Conference on Intelligent Engineering and Management (ICIEM)*
- [10] Victor Oluwatobiloba ADENIJI, Mfundo Shakes SCOTT, Nomnga PHUMZILE, "Development of an Online Biometric-enabled Class Attendance Register System", in *IST-Africa 2016 Conference Proceedings*