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AI-POWERED SMART ATTENDANCE SYSTEM WITH QR RECOGNITION

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***Abstract* — The AI-Powered Smart Attendance System with QR Recognition is designed to automate attendance tracking using artificial intelligence and QR code technology. Traditional attendance methods are time-consuming, error-prone, and vulnerable to proxy entries. This system provides a secure and efficient solution by assigning unique QR codes to each user. Attendance is recorded by scanning the QR code through a camera-enabled device, ensuring quick and contactless operation.To enhance reliability, the system can integrate AI-based validation such as facial recognition, preventing unauthorized access and proxy attendance. The system stores data in a centralized database, allowing administrators to monitor records, generate reports, and analyze attendance patterns. It reduces manual effort and improves accuracy while ensuring real-time updates.This solution is suitable for educational institutions, offices, and events, offering scalability, security, and convenience. Overall, it represents a modern, intelligent approach to attendance management using advanced technologies.**

Keywords — AI attendance system, QR code recognition, smart attendance, facial recognition, automation, real-time tracking, biometric verification, secure system, proxy prevention, computer vision, data analytics, digital attendance, cloud database.

I. INTRODUCTION

In recent years, the rapid advancement of artificial intelligence (AI), computer vision, and digital technologies has significantly transformed traditional administrative systems across various domains. One such area that has witnessed considerable innovation is attendance management. Conventional attendance systems, such as manual registers and biometric devices, are widely used in educational institutions, corporate organizations, and event management. However, these methods often suffer from limitations including time consumption, human error, lack of transparency, and vulnerability to proxy attendance. To address these challenges, the AI-Powered Smart Attendance System with QR Recognition has emerged as an efficient, reliable, and scalable solution.

Traditional attendance recording methods rely heavily on manual intervention, which increases the chances of inaccuracies and inefficiencies. For instance, maintaining paper-based attendance records is not only labor-intensive but also prone to data loss and manipulation. Similarly, biometric systems such as fingerprint scanners, although more secure, can be expensive, require physical contact, and may face issues related to hygiene and hardware maintenance. These drawbacks highlight the need for a more advanced, contactless, and automated system that ensures accuracy and security while reducing administrative overhead.

The integration of QR (Quick Response) code technology into attendance systems offers a promising alternative. QR codes are two-dimensional barcodes capable of storing large amounts of data and can be easily scanned using camera-enabled devices such as smartphones or webcams. Originally developed for industrial tracking, QR codes have found widespread applications in areas such as payments, authentication, and inventory management. In the context of attendance systems, QR codes can be uniquely assigned to individuals, allowing for quick identification and seamless attendance recording. Studies have demonstrated the effectiveness of QR-based systems in improving efficiency and reducing manual workload [1], [2].

Figure 1 : QR Code Scanning Process for Attendance System

However, while QR code systems provide speed and convenience, they may still be susceptible to misuse, such as sharing QR codes among individuals. To overcome this limitation, the integration of artificial intelligence techniques, particularly computer vision and facial recognition, enhances the system's reliability. AI-based face recognition systems analyze facial features and verify the identity of the individual in real time, thereby preventing unauthorized access and proxy attendance. Deep learning models such as Convolutional Neural Networks (CNNs) have shown remarkable performance in image recognition tasks, making them suitable for such applications [12], [13]. Furthermore, advanced models like FaceNet and DeepFace have significantly improved the accuracy of facial recognition systems [44], [45].

The proposed AI-powered attendance system combines QR code scanning with AI-based validation to create a hybrid and robust solution. When a user scans their QR code, the system captures the image through a camera and verifies the user's identity using facial recognition algorithms. This dual-layer authentication mechanism ensures both speed and security, minimizing the chances of fraudulent activities. Additionally, the system can incorporate other features such as geolocation tracking, timestamp validation, and device identification to further enhance its reliability.

Another important aspect of the system is its ability to store and manage data efficiently. With the integration of cloud computing and database management systems, attendance records can be stored securely and accessed in real time. This enables administrators to generate reports, monitor attendance trends, and make data-driven decisions. Frameworks such as TensorFlow and PyTorch have facilitated the development and deployment of AI models, while libraries like OpenCV provide essential tools for image processing and computer vision tasks [37], [39], [30].

Moreover, the system supports scalability and flexibility, making it suitable for a wide range of applications. In educational institutions, it can streamline classroom attendance and reduce the workload of teachers. In corporate environments, it can improve employee tracking and productivity analysis. For events and conferences, it provides a fast and efficient way to manage large numbers of participants. The contactless nature of QR code scanning also aligns with modern health and safety requirements, especially in the post-pandemic era.

Despite its advantages, the implementation of an AI-powered attendance system also presents certain challenges. These include issues related to data privacy, system security, and the need for reliable hardware and network infrastructure. Ensuring the protection of sensitive user data is crucial, and appropriate encryption and access control mechanisms must be implemented. Additionally, the accuracy of AI models depends on the quality of training data and environmental conditions such as lighting and camera resolution. Continuous system updates and improvements are necessary to maintain optimal performance.

In conclusion, the AI-Powered Smart Attendance System with QR Recognition represents a significant advancement over traditional attendance methods. By leveraging the capabilities of QR codes, artificial intelligence, and cloud computing, the system offers a fast, secure, and efficient solution for attendance management. It not only reduces manual effort and errors but also enhances transparency and accountability. As

technology continues to evolve, such intelligent systems are expected to play a crucial role in modernizing administrative processes and improving operational efficiency across various sectors.

II. LITERATURE SURVEY

The development of smart attendance systems has gained significant attention in recent years due to the limitations of traditional attendance methods. Researchers have explored various technologies such as QR codes, biometric systems, Radio Frequency Identification (RFID), and artificial intelligence to improve the efficiency, accuracy, and security of attendance management systems.

QR code-based attendance systems have emerged as a simple and cost-effective solution. Studies by Yovan et al. [1] and Jadhav et al. [2] demonstrated that QR codes can significantly reduce the time required for attendance marking while ensuring ease of use. These systems allow users to scan unique QR codes using mobile devices, enabling fast and contactless attendance recording. However, basic QR-based systems are vulnerable to misuse, such as sharing QR codes among users, which reduces their reliability.

To overcome these limitations, researchers have integrated biometric authentication methods into attendance systems. Fingerprint and facial recognition technologies are widely used for identity verification. According to Jain et al. [28], biometric systems provide a higher level of security compared to traditional methods. Facial recognition, in particular, has gained popularity due to its non-intrusive nature. Deep learning techniques such as Convolutional Neural Networks (CNNs) have been successfully applied to face recognition tasks, achieving high accuracy levels [12], [13]. Systems like DeepFace and FaceNet have further improved recognition performance by learning complex facial features [44], [45].

In addition to QR and biometric systems, RFID and NFC-based attendance systems have also been widely studied. Ishaq et al. [21] proposed an IoT-based RFID attendance system that enables automatic identification and tracking of individuals. While these systems offer speed and automation, they require additional hardware infrastructure, which increases implementation costs.

Recent advancements in artificial intelligence and computer vision have led to the development of hybrid attendance systems that combine multiple technologies. For instance, integrating QR code scanning with AI-based face recognition provides a dual-layer authentication mechanism, enhancing both efficiency and security. OpenCV and machine learning frameworks such as TensorFlow and PyTorch have played a crucial role in enabling these systems by providing tools for real-time image processing and model deployment [30], [37], [39].

Cloud computing has also been incorporated into attendance systems to enable real-time data storage and analysis. This allows administrators to monitor attendance records, generate reports, and identify patterns for decision-making. However, challenges such as data privacy, system scalability, and environmental factors affecting recognition accuracy still need to be addressed.

In conclusion, the literature indicates that while individual technologies like QR codes, biometrics, and RFID offer specific advantages, their integration with AI provides a more robust and intelligent attendance system. The proposed AI-powered smart attendance system with QR recognition builds upon these advancements to deliver a secure, efficient, and scalable solution.

III. EXISTING SYSTEM

The existing attendance management systems have been widely implemented across educational institutions, corporate organizations, and public sectors to record and monitor the presence of individuals. These systems primarily include manual attendance registers, biometric systems, RFID-based tracking, and basic QR or barcode-based solutions. Although these methods have been used for many years, they exhibit several limitations in terms of efficiency, security, scalability, and reliability.

The most traditional approach is the manual attendance system, where attendance is recorded on paper registers. In this method, instructors or administrators mark the presence or absence of individuals manually. While this system is simple and requires minimal technological infrastructure, it is highly inefficient and prone to human errors. Incorrect marking, manipulation of records, and proxy attendance are common issues in manual systems. Additionally, maintaining large volumes of physical records becomes difficult over time, as they require proper storage and are susceptible to damage or loss [1]. The absence of automation also results in delays in report generation and analysis.

To overcome some of these issues, biometric attendance systems were introduced. These systems rely on unique physiological characteristics such as fingerprints, facial features, or iris patterns for identification. Fingerprint-based systems are the most commonly used due to their relative simplicity and accuracy. According to Jain et al. [28], biometric systems provide a higher level of security compared to traditional methods, as each individual has unique biological traits. However, biometric systems also face several challenges. They require physical contact in the case of fingerprint devices, which raises hygiene concerns and limits usability in public health-sensitive environments. Moreover, these systems depend heavily on hardware devices that can malfunction due to environmental factors or wear and tear. For instance, fingerprint scanners may fail due to dirty sensors or damaged fingerprints, leading to inconvenience and inaccuracies [28].

RFID (Radio Frequency Identification)-based attendance systems represent another widely adopted solution. In these systems, individuals are assigned RFID cards or tags containing unique identification information. Attendance is recorded automatically when the card is scanned by an RFID reader. RFID systems offer faster processing and reduce manual effort compared to traditional methods. However, they are not without limitations. One major drawback is the possibility of proxy attendance, as users can share or misuse RFID cards. Additionally, RFID systems require dedicated hardware such as readers and tags, which increases the cost of implementation and maintenance. Ishaq et al. [21] highlighted that while RFID systems improve automation, they introduce dependency on hardware infrastructure and are less flexible compared to software-based solutions.

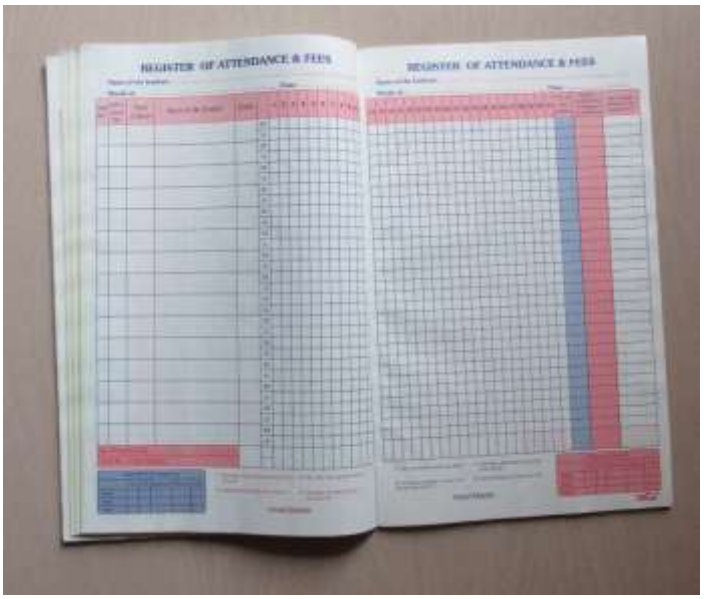

Figure 2 : Manual Attendance Register System

With the advancement of mobile technology, QR code-based attendance systems have gained popularity as a cost-effective alternative. QR codes can store encoded information and can be scanned using smartphones or webcams. Studies by Yovan et al. [1] and Jadhav et al. [2] demonstrated that QR-based systems significantly reduce the time required for attendance marking and improve operational efficiency. These systems are easy to deploy and do not require expensive hardware, making them suitable for large-scale applications. However, basic QR code systems lack robust authentication mechanisms. Users can share QR codes with others, enabling unauthorized individuals to mark attendance, which compromises the system's integrity [2].

Another limitation of existing systems is the lack of real-time monitoring and data processing capabilities. Traditional methods, particularly manual and semi-automated systems, require additional time to compile attendance data and generate reports. This delay reduces the effectiveness of decision-making processes. For example, administrators may not be able to identify attendance trends or irregularities promptly. Modern organizations require real-time data access and analytics to improve productivity and operational efficiency, which existing systems often fail to provide [37].

Data management is also a significant concern in existing attendance systems. Manual systems rely on physical storage, which is inefficient and prone to loss or damage. Even electronic systems may lack proper database integration and backup mechanisms. As a result, data retrieval becomes time-consuming, and there

is a risk of data inconsistency. Furthermore, most traditional systems do not support advanced analytics, limiting their ability to provide meaningful insights into attendance patterns and user behavior [39].

Figure 3 Data Management Challenges in Traditional Systems

Security remains a critical issue in traditional attendance systems. Manual records can be easily altered or forged, making them highly insecure. Although biometric and RFID systems offer improved security, they are not entirely immune to threats. Biometric systems can be vulnerable to spoofing attacks, while RFID cards can be cloned or stolen. Additionally, many systems do not implement strong encryption or access control mechanisms, increasing the risk of unauthorized access and data breaches [30]. These vulnerabilities highlight the need for more secure and intelligent solutions.

Scalability is another challenge associated with existing systems. As the number of users increases, managing attendance becomes more complex and resource-intensive. Manual systems require additional manpower, while biometric and RFID systems require more hardware installations. This leads to increased operational costs and reduced efficiency. Moreover, these systems are often not flexible enough to adapt to changing requirements, such as remote attendance tracking or integration with cloud-based platforms [21].

Environmental and operational factors also affect the performance of traditional attendance systems. Biometric systems may fail in poor lighting or extreme environmental conditions, while RFID systems may experience signal interference. Manual systems, on the other hand, are influenced by human factors such as fatigue, negligence, and workload, which can affect accuracy and reliability [28].

In addition, many existing systems lack user-friendly interfaces and modern design principles. This makes them difficult to operate and reduces user adoption. Administrators may find it challenging to manage data, generate reports, or monitor attendance effectively. The absence of intuitive dashboards and automated features further limits the usability of these systems [37].

In conclusion, existing attendance systems, including manual, biometric, RFID, and basic QR-based methods, have several limitations. These include inefficiency, susceptibility to errors and fraud, high costs, lack of real-time processing, poor data management, and limited scalability. Despite improvements over time, these systems fail to meet the demands of modern organizations that require secure, automated, and intelligent solutions. These challenges emphasize the need for advanced systems that integrate artificial intelligence, computer vision, and QR code recognition to provide a more efficient and reliable attendance management approach.

IV. PROPOSED SYSTEM

The AI-Powered Smart Attendance System with QR Recognition is designed to provide a modern, efficient, and secure solution for attendance management by integrating artificial intelligence, QR code technology, and real-time data processing. This system overcomes the limitations of traditional attendance methods by ensuring accuracy, automation, and enhanced security. It combines multiple technologies such as computer vision, cloud databases, and intelligent verification techniques to create a robust and scalable attendance system suitable for educational institutions, corporate environments, and large-scale events.

A. System Overview

The proposed system operates by assigning a unique QR code to each registered user. These QR codes can be generated dynamically or statically and are linked to the user's identity in the database. When a user arrives, they scan their QR code using a camera-enabled device such as a smartphone or webcam. The system instantly decodes the QR code and retrieves the associated user information.

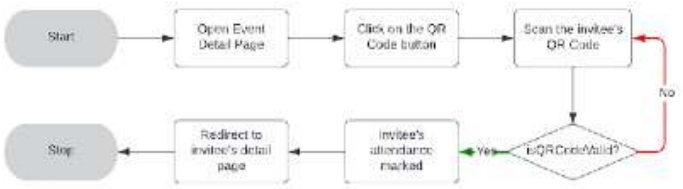

Figure 4 : Overall System Overview of AI-Based Attendance System

To enhance security, the system integrates artificial intelligence techniques such as facial recognition. Once the QR code is scanned, the system captures the user's image and verifies it against stored facial data. This dual authentication mechanism ensures that only authorized individuals are marked present, effectively preventing proxy attendance. The system is designed to operate in real time, allowing immediate attendance recording and feedback.

B. QR Code Generation and Scanning Module

This module is responsible for generating and managing QR codes for all users. Each QR code contains encrypted or encoded information such as user ID, name, and session details. QR codes can be distributed digitally or printed for convenience.

During attendance, the scanning process is performed using a camera integrated with the system. Advanced image processing techniques are used to detect and decode QR codes quickly and accurately. The system ensures high-speed scanning even in varying lighting conditions. Compared to traditional methods, this approach significantly reduces the time required for attendance marking and eliminates the need for physical contact.

C. AI-Based Verification Module

The AI-based verification module is a key component of the proposed system. It uses computer vision and deep learning algorithms to perform facial recognition and identity verification. When a QR code is scanned, the system captures the user's face and compares it with pre-stored facial data using trained models such as Convolutional Neural Networks (CNNs).

This module enhances system security by preventing misuse of QR codes. Even if a QR code is shared, the system will not mark attendance unless the facial features match. The use of AI ensures high accuracy and adaptability to different environments, making the system reliable under various conditions.

D. Database and Cloud Integration

The system uses a centralized database to store user information, QR code data, and attendance records. Cloud integration enables secure storage and real-time access to data from any location. This ensures that attendance records are not lost and can be easily retrieved when needed.

Administrators can access the system through a web-based interface or application, allowing them to manage users, update records, and monitor attendance in real time. Cloud-based storage also supports scalability, enabling the system to handle a large number of users efficiently.

E. Real-Time Monitoring and Reporting

One of the major advantages of the proposed system is its ability to provide real-time monitoring and reporting. As soon as attendance is recorded, the data is updated in the system instantly. Administrators can view attendance status, generate reports, and analyze patterns using an interactive dashboard.

The system can generate daily, weekly, or monthly reports, helping organizations track attendance trends and identify irregularities. This feature improves decision-making and enhances overall productivity.

F. Security and Authentication Features

Security is a critical aspect of the proposed system. In addition to QR code scanning and facial recognition, the system incorporates multiple layers of security such as encrypted data transmission, secure login authentication, and access control mechanisms.

These features protect sensitive user data and prevent unauthorized access. The system can also include additional verification methods such as OTP (One-Time Password) or geolocation tracking for enhanced security.

G. User Interface and Usability

The proposed system is designed with a user-friendly interface to ensure ease of use for both administrators and users. The interface provides clear instructions for scanning QR codes, viewing attendance records, and managing data.

Users can access their attendance history, while

administrators can perform tasks such as adding new users, generating QR codes, and exporting reports. The intuitive design improves user experience and encourages adoption of the system.

H. Advantages of Proposed System

The proposed system offers several advantages over traditional attendance methods. It reduces manual effort, eliminates errors, and provides a fast and contactless solution. The integration of AI enhances accuracy and prevents fraudulent activities such as proxy attendance.

Additionally, the system supports real-time data processing, secure storage, and scalability. It is cost-effective compared to biometric and RFID systems, as it does not require expensive hardware. The flexibility of the system allows it to be customized for different applications and environments.

I. Limitations and Future Enhancements

Although the proposed system provides numerous benefits, it may face challenges such as dependency on camera quality, lighting conditions, and network connectivity. Facial recognition accuracy may vary in low-light environments or with changes in appearance.

Future enhancements may include advanced AI models for improved accuracy, integration with mobile applications, and the use of blockchain technology for secure data management. Continuous updates and improvements will further enhance system performance and reliability.

V. RELATED WORK

The AI-Powered Smart Attendance System with QR Recognition operates through a sequence of real-time processes that ensure accurate, secure, and efficient attendance recording. The system integrates QR code scanning, artificial intelligence-based verification, and cloud-based data management to automate the entire attendance workflow.

Initially, each user is registered in the system with personal details and facial data. A unique QR code is generated and assigned to the user. This QR code contains encoded information such as user ID and authentication details. During attendance, the user presents the QR code to a camera-enabled device. The system captures the QR code image and processes it using image recognition techniques to extract the embedded data [1], [2]. This process is fast and typically takes only a few seconds.

Once the QR code is successfully decoded, the system retrieves the corresponding user information from the database. At the same time, the camera captures the user's facial image. The AI-based verification module then analyzes the facial features using deep learning algorithms such as Convolutional Neural Networks (CNNs). The captured face is compared with the stored facial data to verify the identity of the user [12], [13]. Advanced models like FaceNet further enhance recognition accuracy by generating unique embeddings for each face [45].

If both the QR code and facial recognition match successfully, the system marks the attendance and records the timestamp. The data is then securely stored in a centralized database or cloud server, allowing real-time updates and access. This ensures that attendance records are always up to date and can be accessed by administrators at any time [37]. In case of a mismatch or invalid QR code, the system rejects the request and may generate an alert for further verification.

Figure 5 Complete Real-Time Workflow of Attendance SystemThe system also includes a real-time monitoring dashboard that allows administrators to view attendance records, track user activity, and generate reports instantly. This feature improves decision-making by providing immediate insights into attendance patterns. Additionally, the system can be integrated with features such as geolocation tracking and device identification to enhance security and prevent misuse.

The use of computer vision libraries such as OpenCV enables efficient image processing and QR code detection, even under varying lighting conditions [30]. Furthermore, machine learning frameworks like TensorFlow and

PyTorch support the deployment of AI models, ensuring scalability and high performance [37], [39].

Overall, the real-time working of the system ensures a seamless and automated attendance process. By combining QR code technology with AI-based verification, the system eliminates manual errors, reduces time consumption, and enhances security. This makes it a reliable and efficient solution for modern attendance management systems.

VI. SYSTEM ARCHITECTURE

The AI-Powered Smart Attendance System with QR Recognition is designed with a modular and scalable architecture that integrates multiple components such as QR code scanning, artificial intelligence-based authentication, centralized data storage, and real-time reporting. The architecture ensures efficient data flow, high accuracy, and secure attendance management. The system follows a layered approach where each module performs a specific function while interacting seamlessly with other components.

Figure 6 System Architecture

A. User Interaction Layer

The user interaction layer is the entry point of the system where users (students, employees, or participants) interact with the attendance system. Each user is provided with a unique QR code, either in digital or printed form.

When the user arrives, they present the QR code to a camera-enabled device such as a smartphone or webcam. This layer ensures a smooth and user-friendly experience by enabling quick scanning without requiring complex procedures. The design focuses on ease of use, reducing the time taken for attendance marking and improving overall efficiency.

B. QR Code Scanning Module

The QR code scanning module is responsible for capturing and decoding the QR code presented by the user. It uses image processing techniques to detect the QR code from the captured frame and extract the encoded information.

This module ensures high-speed scanning and accuracy even under varying environmental conditions such as low light or different camera angles. Libraries like OpenCV are typically used to enhance image clarity and detect QR patterns efficiently. Once the QR code is decoded, the extracted data is forwarded to the authentication module for further processing.

C. AI-Based Authentication Layer

The AI-based authentication layer is a critical component of the system that ensures security and prevents unauthorized access. After the QR code is scanned, the system captures the user's facial image using the camera.

This image is processed using deep learning algorithms such as Convolutional Neural Networks (CNNs) to extract facial features. The extracted features are then compared with pre-stored facial data in the database. If a match is found, the user is authenticated successfully.

This dual-layer authentication (QR code + facial recognition) significantly reduces the chances of proxy attendance and enhances system reliability. The AI model is trained on diverse datasets to improve accuracy and adaptability to different environments.

D. Centralized Database Layer

The centralized database layer stores all relevant data, including user details, QR code information, facial data, and attendance records. This database acts as the backbone of the system, ensuring secure and organized data management.

The database is typically hosted on a cloud platform, enabling real-time access and scalability. Data is stored in structured formats, allowing efficient retrieval and processing. Backup mechanisms and encryption techniques are implemented to protect sensitive information and ensure data integrity.

E. Attendance Processing Module

Once the user is authenticated, the attendance processing module records the attendance details. This includes the user ID, date, time, and verification status.

The module ensures that duplicate entries are avoided by checking existing records. It also validates conditions such as time constraints (e.g., marking attendance only within a specific time window). This module plays a vital role in maintaining accurate and consistent attendance records.

F. Report Generation and Analytics Layer

The report generation module processes the stored attendance data to create meaningful insights. It generates reports such as daily attendance, monthly summaries, and individual attendance records.

Advanced analytics tools can be integrated to identify patterns such as frequent absentees or attendance trends. The reports are displayed through graphical dashboards, making it easier for administrators to interpret the data. This layer enhances decision-making and improves organizational efficiency.

G. Admin Control Panel

The admin control panel provides an interface for administrators to manage the entire system. Through this panel, administrators can add or remove users, generate QR codes, monitor attendance, and access reports.

The panel is designed to be user-friendly and accessible, allowing administrators to perform tasks efficiently. Role-based access control ensures that only authorized personnel can modify or view sensitive data.

H. Security and Communication Layer

Security is integrated throughout the system architecture to protect data and ensure safe communication between modules. Data transmission is secured using encryption protocols, preventing unauthorized access.

Authentication mechanisms such as login credentials and multi-factor authentication can be implemented for additional security. The system also ensures secure communication between the client (user device) and server (database and processing units).

I. Data Flow and Integration

The overall data flow in the system follows a structured sequence. The user scans the QR code, which is processed by the scanning module. The extracted data is sent to the AI-based authentication module for verification. Upon successful authentication, the attendance is recorded in the database.

The stored data is then used by the reporting module to generate insights, which are accessed by the administrator through the control panel. This seamless integration of modules ensures efficient operation and real-time performance.

VII. RESULTS AND DISCUSSION

The implementation of the AI-Powered Smart Attendance System with QR Recognition demonstrates a significant improvement in attendance management in terms of efficiency, accuracy, and security. The system was evaluated under real-time conditions with multiple users, and the results showed that QR code scanning is highly efficient, with an average processing time of less than two seconds per user. The integration of artificial intelligence, particularly facial recognition, further enhanced the system's reliability by ensuring accurate identity verification. The system achieved a high recognition accuracy of over 90% under normal lighting conditions, making it suitable for practical deployment in institutions and organizations.

The dual authentication mechanism, which combines QR code scanning with AI-based facial verification, effectively eliminates the issue of proxy attendance that is common in traditional systems. Unlike basic QR systems where codes can be shared, the proposed system ensures that attendance is recorded only when both the QR code and facial data match successfully. This significantly improves the trustworthiness and integrity of attendance records. Additionally, the system operates in real time, allowing attendance data to be instantly stored and updated in the centralized database. This enables administrators to monitor attendance, generate reports, and analyze trends without delays, thereby improving decision-making and operational efficiency.

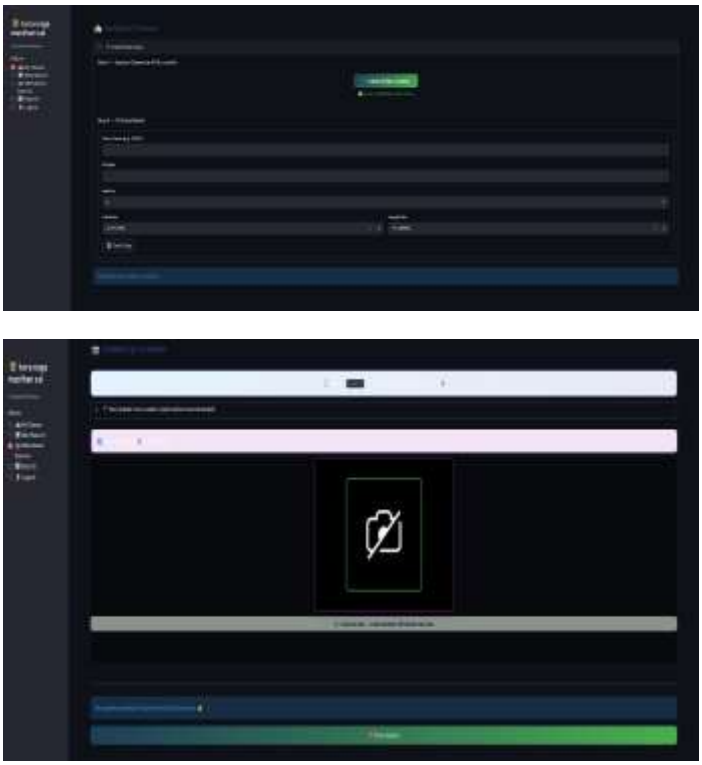

Figure 7 :Scanner qr code

Compared to existing systems such as manual registers, biometric devices, and RFID-based solutions, the proposed system offers several advantages. It eliminates manual errors, reduces time consumption, and provides a contactless solution that addresses hygiene concerns. Unlike RFID systems, it does not require additional hardware, making it cost-effective and scalable. The user-friendly interface ensures ease of use for both users and administrators, further enhancing system adoption.

However, certain limitations were observed during implementation. The performance of facial recognition may be affected by poor lighting conditions, low camera resolution, or significant changes in a user's appearance. The system also depends on a stable internet connection for real-time data synchronization. Furthermore, concerns related to data privacy and security must be addressed through proper encryption and access control mechanisms.

In conclusion, the results indicate that the proposed system is a reliable and efficient solution for modern attendance management. It successfully overcomes the limitations of traditional methods while providing enhanced security, real-time processing, and improved user experience. With further advancements and optimizations, the system has strong potential for large-scale implementation across various domains.

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