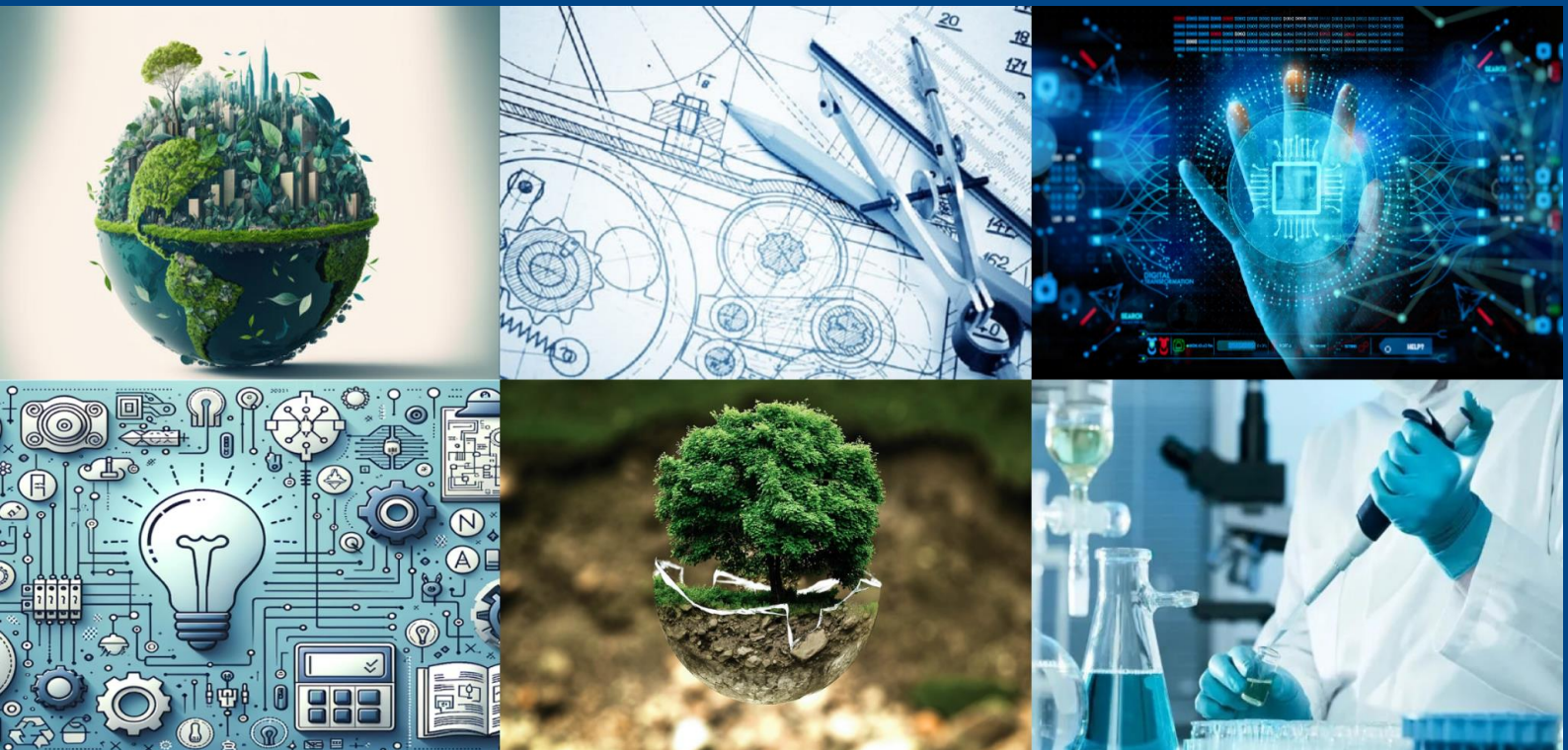




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Survey on Smart Attendance Tracking System

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ABSTRACT: Attendance management is a fundamental activity in educational institutions and organizations to monitor and record the presence of individuals. Traditional methods, such as manual entry or biometric systems, often suffer from drawbacks like proxy attendance, time consumption, and inefficiency. In recent years, smart attendance tracking systems have emerged, incorporating technologies such as QR codes, RFID, face recognition, GPS, and IoT. This paper presents a comprehensive survey of various smart attendance tracking methods, evaluating their effectiveness, limitations and suitability for different environments.

KEYWORDS: Attendance system, Smart tracking, Face recognition, RFID, QR code, IoT, GPS.

I. INTRODUCTION

Attendance monitoring is an essential administrative task in educational settings. However, manual methods such as roll calls or physical sign-ins are inefficient and vulnerable to manipulation. Attendance tracking is a crucial aspect of academic and organizational management, as it helps maintain discipline, monitor participation, and improve overall productivity. Traditional attendance systems such as manual registers or biometric scanners are often time-consuming, error-prone, and susceptible to manipulation. These modern systems utilize a range of technologies, including QR codes, RFID, face recognition, GPS, and IoT, offering automated, real-time, and contactless solutions. This survey aims to explore the various smart attendance tracking methods, analyze their strengths and limitations, and provide a comparative overview to help institutions choose the most suitable system for their needs. Traditionally, attendance has been recorded manually through paper-based registers or basic electronic logbooks. However, these conventional methods often suffer from various challenges such as time consumption, human error, proxy attendance, and difficulty in data storage and retrieval. The development of smart attendance tracking systems marks a significant shift, leveraging modern technologies like biometrics, QR codes, RFID, GPS, and IoT to overcome the limitations of traditional approaches.

II. LITERATURE REVIEW

[1] **Attendance monitoring system** that uses **mobile devices and photos** to check if students are present in class. It's meant to make the attendance process **faster, more accurate, and less manual**. They also describe the **technical setup**, like needing Wi-Fi, and how photo quality affects results. Finally, they talk about testing the system and confirming that it meets quality standards for real use in schools. [2] They explain the **development of a smartphone-based attendance system** using QR code scanning, aimed at reducing manual work and errors in student attendance tracking.[3]

He presents a **face recognition attendance system using Raspberry Pi**, where facial features are used to identify and mark student presence automatically.[4] They describe a **student attendance system using Raspberry Pi and face recognition**, focusing on real-time image processing to automate attendance.[5] They introduce a **smartphone app for tracking class attendance**, allowing students and teachers to monitor attendance digitally and reduce paperwork.[6] They explore **how academic staff are adapting to electronic attendance systems**, particularly in a college in Ibri, studying user acceptance and usage trends.[7] They explain the design of an **RFID-based attendance system**, where students use RFID cards to register attendance automatically when entering the class.[8] They describe a **wireless iris recognition attendance system**, focusing on using biometric iris scanning to ensure secure and accurate student attendance.[9]

They discuss **using a computer game reward mechanism** to restore student attention in classrooms, not attendance directly, but enhancing student engagement.[10]

They explain an **IoT-based smart resource management system** with a case study of an "intelligent chair," which tracks usage and can be applied in smart classrooms.



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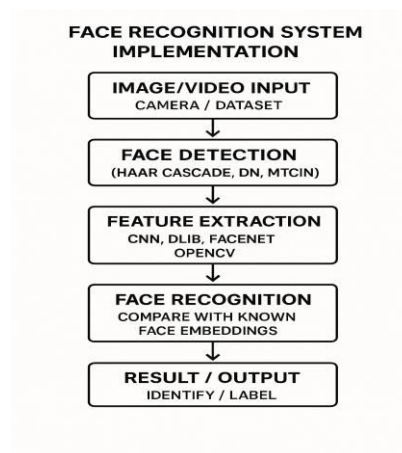
III. ATTENDANCE TRACKING METHODS

There are various methods used to track student attendance, ranging from traditional to advanced technologies. The most basic form is the manual roll call, where the teacher calls out names and records responses, or manual digital entry using spreadsheets or classroom software. While simple, these methods are time-consuming and prone to errors. More modern approaches include smartphone-based systems, such as QR code scanning where students scan a code to register their presence, or photo verification where students submit selfies to prove attendance. Some systems use GPS or geo-location to ensure students are physically present within the school premises when marking attendance. Biometric systems offer a higher level of security and automation, using technologies like face recognition, fingerprint scanning, and even iris recognition to identify students uniquely and record their attendance accurately. RFID and NFC-based systems are also popular, where students use cards or mobile phones to tap a reader and log their presence. Furthermore, IoT-based solutions such as smart chairs can automatically detect student presence without any manual action. In virtual learning environments, web-based platforms and learning management systems allow students to check in through online portals. Each method has its own benefits and limitations depending on the context, such as cost, privacy, accuracy, and ease of use.

3.1 Face Recognition

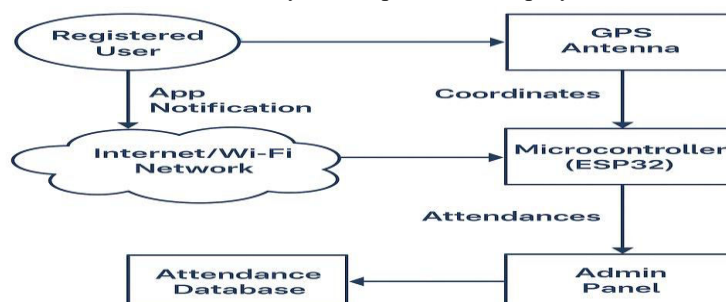
The process works by capturing digital images of faces and comparing them against a database of previously collected data. The captured image is then matched to the information stored within the system, which will either return a match location or not depending on whether the person is in the database or not. Three-dimensional face recognition technique uses 3D sensors to capture information about the shape of a face. This information is then used to identify distinctive features on the surface of a face, such as the contour of the eye sockets, nose, and chin it is described in fig 1.

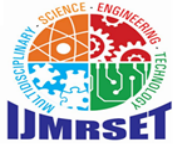
FIG 1: FACE RECOGNITION



3.2 GPS-based Attendance System

The Global Positioning System (GPS) works by using a network of satellites to determine the precise location of a device on Earth. The GPS system uses a process called trilateration, where distances to at least three satellites are measured to pinpoint a location. These measurements, along with the known positions of the satellites, allow the receiver to calculate its coordinates. GPS-based attendance system captures the employee location during clock-in and out.





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Usually, a tablet device will be placed at the entrance. The employees entering the workplace can mark their attendance using facial recognition technology or other biometric devices it is described in fig 2.

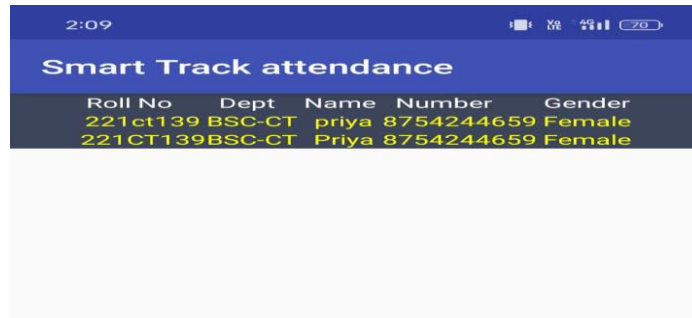


FIG :2 GPS BASED ATTENDANCE

3.3 Barcode / QR code Based

A QR code attendance system is a method of tracking attendance that utilizes QR (Quick Response) codes. This smart attendance system allows individuals to sign in or check-in by scanning a QR code with their smartphone or other mobile device. This affordable QR code-based attendance system enables lecturers to speed up the process of recording attendance, especially in a large classroom and would save them valuable teaching time. The proposed system provides better security than the traditional methods, including eliminating chances of students signing up for others who may not be present.

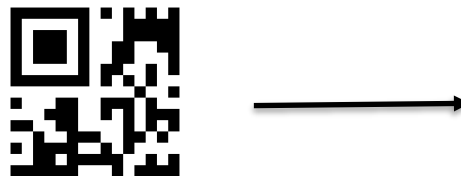
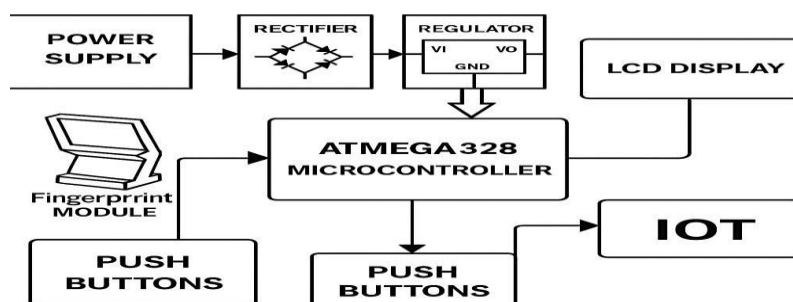


FIG :3 BAR CODE /QR BASED ATTENDANCE

3.4 IoT Based Attendance

A biometric attendance system records employee presence using unique physical traits like fingerprints recognition. These systems capture biometric data, analyze it, and compare it to stored templates to authenticate the individual. If a match is found, the attendance is recorded. The diagram shows an IoT-based biometric system using a fingerprint sensor captures user data for authentication. The power supply is regulated to run the system, and the fingerprint sensor captures user data for authentication. The microcontroller processes the input, displays messages on the LCD, and interacts with push buttons for control. Verified data is sent to the cloud via the IoT module, allowing for remote monitoring and smart access control. it is described in fig 4.

FIG 4: IOT BASED ATTENDANCE





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IV.DISCUSSION

The survey highlights that smart attendance tracking systems offer significant advantages over traditional methods in terms of automation, efficiency, and security. Among the technologies reviewed, face recognition systems stand out for their high level of accuracy and resistance to proxy attendance. However, they may face issues in poor lighting conditions and require high-quality hardware, which can increase implementation costs. QR code-based systems, on the other hand, are simple, low-cost, and widely used in educational institutions but are more vulnerable to misuse if the code is shared among students.

RFID-based systems provide a good balance between automation and accuracy, though they require proper hardware setup and may raise concerns about privacy. GPS-based systems are ideal for field-based or remote attendance tracking but may suffer from location inaccuracy and battery consumption issues. IoT-based solutions present an advanced level of integration and real-time monitoring, yet their complexity and cost may not be feasible for all institutions.

The findings suggest that no single technology offers a perfect solution. Instead, a hybrid approach—combining two or more technologies—could enhance reliability, reduce loopholes, and meet diverse institutional requirements. Moreover, factors such as infrastructure, budget, privacy concerns, and user acceptance play a crucial role in the successful implementation of any smart attendance tracking system.

The survey reveals that smart attendance tracking systems significantly outperform traditional methods in terms of accuracy, time efficiency, and user convenience. Each technology studied—RFID, QR code, face recognition, GPS, and IoT—demonstrates unique strengths and weaknesses. Face recognition systems achieved the highest accuracy and security ratings, making them suitable for environments where preventing proxy attendance is critical. QR code-based systems were the most cost-effective and easiest to implement, especially in institutions with limited resources. RFID systems offered a reliable and automated process but required additional hardware investment. GPS-based attendance proved effective for tracking mobile or remote users, though it was affected by location accuracy issues. IoT-enabled systems provided advanced functionality and real-time monitoring but required complex setup and maintenance.

Overall, the survey results indicate that smart attendance systems can drastically improve attendance monitoring when properly implemented. The choice of system should be based on the institution's objectives, budget, and technological readiness. Hybrid systems, combining the benefits of multiple technologies, were identified as the most promising solution for comprehensive and tamper-proof attendance tracking.

V. CONCLUSION AND FUTURE WORK

Smart attendance tracking systems represent a major step forward in automating and improving the accuracy of attendance management. This survey has reviewed various technologies such as RFID, QR codes, face recognition, GPS, and IoT, each offering distinct advantages depending on the use case. While traditional methods are still in use, they are gradually being replaced due to their limitations in efficiency and security. Among the modern approaches, face recognition and IoT-based systems show the highest levels of accuracy and automation, while QR code and RFID systems provide cost-effective alternatives with moderate reliability. GPS-based tracking offers flexibility for remote environments but may face location-based limitations. In conclusion, there is no one-size-fits-all solution; the choice of a smart attendance system should be tailored to the institution's goals, infrastructure, and budget. Future developments may focus on hybrid systems that integrate multiple technologies to create a more robust, secure, and intelligent attendance management solution.

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