A Comprehensive Review on Smart Attendance System

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Abstract— Attendance marking is a task that occurs regularly in the day-to-day life of any organization. Attendance works as a quantitative metric to measure the consistency of a candidate. The traditional way of marking attendance is a bothersome, lingering, and error-prone task. This task, as time progresses for any organization to deal with collective troubles the Smart attendance marking system aims to tackle all the hurdles. It is completely automated and diligent as it rules out human error and lends more time to complete the task at hand.

Index Terms— Internet of Things (IoT), Machine Learning (ML), Smart Attendance Marking Systems (SAMS), OpenCV, CNN

I. INTRODUCTION

The purpose of this review article is to investigate and evaluate how IoT, AI, and ML are integrated into the creation of intelligent attendance marking systems. These solutions pro- vide a revolutionary method of tracking attendance by utilizing the power of networked devices, sophisticated algorithms, and data analytics. They guarantee improved accuracy, real-time monitoring, and insightful insights.

A. Smart Attendance Marking System (SAMS)

Smart Attendance Marking System transforms traditional attendance monitoring by combining IoT, AI, and ML. By using RFID/NFC technology, IoT sensors, or face recognition, it can automatically gather data as people enter the building. To improve accuracy, AI systems examine this data and identify trends and abnormalities. ML gradually improves the system, making it more flexible to various settings and user actions. Administrators may optimize resource allocation and inter- vention methods by accessing real-time attendance records and forecast insights. Through ongoing learning, the system develops, increasing productivity and decreasing manual work. To handle any issues, privacy and security measures must be strong. This integration promises simplified operations and in- sightful data-driven decision-making across several industries.

B. Internet of Things (IoT)

The Internet of Things (IoT) is a technological advancement that is redefining connection by integrating sensors and soft- ware into common objects to collect and share data online. IoT improves productivity, efficiency, and convenience in a variety of ways, and also brings up issues with data management, security, and privacy. IoT promises to change how we interact with technology and the environment around us as it develops further.

C. Artificial Intelligence (AI) and Machine Learning (ML)

Artificial Intelligence (AI) and Machine Learning (ML) are two game-changing technologies that enable computers to learn from data, see patterns, and make intelligent decisions without the need for explicit programming. AI encompasses a larger spectrum of technologies than machine learning (ML), which focuses on techniques that help computers perform better based on experience.

II. LITERATURE REVIEW

Examining several papers, got to know about different methodologies used to replace several traditional practices to advance the approaches to the management for attendance system. The collective study of the approaches used by mul- tiple papers assisted in comprehending on IoT, AI and ML based technologies and integration of them helps the system in solving the difficulties.

Sarker et al [1] total hardware based C application for system developed with the combined use of RFID, Raspberry Pi, Motion sensor, monitoring system, Biometric fingerprint, Arduino Mega, key- pad, and LCD will do a specific task which is taking attendance with the architecture are password authentication, biometric fingerprint sensors, and RFID read- ers. The usage of passive RFID tags and Grove 125kHz RFID readers is highlighted as the report explains the relationship between these parts and the processing unit. It gives a thorough

overview of the biometric fingerprint sensor enrollment and verification procedures while emphasizing the significance of DSP chips and algorithms for precise person identification. It also describes how to authenticate using a password, which guarantees safe access to the attendance

tracking system. The integration of serial port connection for data reception from hardware devices—which guarantees real-time atten- dance tracking—is explained in this study. It also covers the functionality and design of the user interface, highlighting its resilience against student abuse and instructor- friendliness. The study includes studies on biometric fingerprint sensors, password-based systems, and RFID, highlighting their useful- ness in a range of applications that go beyond attendance tracking. It also looks at pertinent literature on software development techniques, identity verification methods, and system design, providing a foundation for the suggested smart attendance system. It highlights the affordability, dependabil- ity, and efficacy of the suggested system, providing a viable way to improve attendance monitoring and accountability in the educational field. It also suggests areas for growth and development of the smart attendance system prototype, outlining future research possibilities.

Arsenovic et al [2] as a result, a Deep Learning, Convolutional Neural Network (CNN) based face recognition architecture with systems based on algorithms for machine learning and computer vision provides possibilities in search of practical solutions to be flexible and reduce errors. the aspects are face embeddings: FaceNet CNN, SVM Classifier, face landmarks and image placement, face detector: CNN cascade. The findings make it possible for additional study to achieve even greater precision. A thorough explanation of the development process, beginning with dataset preparation and augmentation, is given in the techniques section. It presents a unique method of picture augmentation designed specifically for face recognition tasks and justifies the use of a limited dataset. The creation of the face recognition model is then covered in detail, including the stages involved in face detection, picture preprocessing, em- bedding formation, and classification. The practical application of the suggested approach is demonstrated by the discussion of the model's integration into an already-existing RFID- based attendance system. Outcomes and conversation The created facial recognition system's three-month assessment is shown in this section. The model's efficacy is demonstrated by the confusion matrix and accuracy analysis, which yielded an overall accuracy of 95.02.

Heng Lee et al [3] a Real- time facial recognition using machine learning algorithms like deep learning with camera factor and data processing for the facial recognition for Smart Attendance. Field-of-view plays a prominent role in the camera factor an optimistic camera with good video resolution and proper installation using deep learning model can sig- nificantly increase the accuracy and reliability. The suggested accuracy technique, which includes modules for sampling, filtering, and decision- making, is explained in depth in the materials and methods section. In order to minimize false positives and negatives, sliding window filtering and sample frequency are discussed in the study. One way to ascertain if people are present is to use decision logic that relies on majority vote. The findings of tests carried out to gauge the viability of the suggested strategy are shown in the section on assessment and testing. The research contrasts statistical multiframes analysis with frame- based accuracy measures using example video sequences from educational contexts. The outcomes show a notable increase in attendance marking accuracy following a convergence time, demonstrating the effectiveness of the suggested technique.

Yadav et al [4] the study on existing attendance recording approaches of RFID-based and biometric-based systems, highlights their advantages and limitations. It also discusses the potential of using smartphones for attendance marking and hybrid approaches combining RFID and biometrics can assist for paperless, easy execution. Cloud-reliability by Google App Engine, REST web service, web application built using PHP, Google Cloud SQL, MQTT protocol. With an emphasis on RFID and biometric-based systems, the literature review section looks at various methods of recording attendance. It discusses the advantages and disadvantages of each method while highlighting the importance of biometric recognition in preventing imitation. The report also highlights the ways in which attendance systems are evolving, such as the use of cellphones for the purpose of documenting attendance. The section on system design and development contains a detailed explanation of the hardware components and software architecture utilized in the creation of the Smart Attendance System. A comprehensive approach to system implementation is shown by the use of Google Cloud services for software development and Raspberry Pi, fingerprint scanner, keypad, and LCD screen as hardware components. Overall, the research advances our understanding by providing a description of an actual IoT implementation in the field of education. This suggested Smart Attendance System gives educational institutions an economical and effective approach to control student attendance by eliminating the drawbacks of conventional attendance systems and proposing an automated alternative.

Sawall et al [5] during Covid-19 to tackle several challenges the executive team embraced blended learning. The data is sent to the cloud using Wi-Fi technology, where it is gathered. Students' Wi-Fi-enabled devices provide their RSSI readings to a remote server, which collates the readings to determine which students are present and which are absent. So Smart Atten- dance Marking Systems (SAMS) using wireless technology protocol Wi-Fi (Wireless Fidelity) makes it easier to mark student attendance. A detailed description of the attendance system's design and functioning is provided in the proposed system model. The technology uses trilateration—using access points and students' Wi-Fi equipped devices—to figure out where each student is in the classroom. With client-side and server-side interactions to provide smooth data gathering and verification, the architecture is logically organized. Through empirical testing, the experiment section shows that the sug- gested attendance

method is accurate and feasible. Many controlled studies are carried out to evaluate location accuracy and success rate. The findings show promise, with high success rates and reasonably precise location estimates, confirming the suggested system's effectiveness. Ultimately, the study offers a strong response to the problems with conventional attendance tracking, especially in light of the COVID-19 epidemic. The suggested approach provides a smooth, sanitary, and effective way to check student attendance by utilizing Wi-Fi technology and already-existing classroom infrastructure.

Zhao et al [6] the zige network-based architecture attendance system is integrated with RFID sensors. When the number of readers and positioning performance are entered into the database, the simulation results are shown as the CDF distribution. Once the student's ID has been correctly scanned, the attendance will be instantly noted for them.

In order to create intelligent classroom attendance systems, the study suggests fusing IoT technology with RFID and facial recognition technologies. The drawbacks of conventional tech- niques are addressed by this novel strategy, which provides effective, real-time attendance management solutions. The development and operation of face recognition and RFID- based attendance systems are both thoroughly explained in this article. It improves the readability and comprehension of the suggested solutions by providing technical specifications, architectural schematics, and mathematical derivations. To assess how well the suggested systems operate, the research runs simulation experiments. It examines variables including user happiness, reaction speed, and positioning accuracy and provides empirical data to back up the systems' efficacy.

III. COMPARATIVE ANALYSIS

Literature Survey

S. No	Year of publication	Authors	Title	Technology and Dataset Used	Summar y	Future Scope
1	2016	Dhima n Kumar Sarker, Nafize Ishtiaque Hossai n, Insan Arafat Jamil.	Design and implementation of Smart Attendance Management System Using Multiple Step Authentication	RFID (Radio Frequency Identification), Biometric Fingerprint Sensor, Arduino Mega, Passwords, C# Language. The fingerprints and RFID tags need to be registered is done with an input ID and enroll the ID's.	Examining Several difficulties in the traditional attendance management system increased remarkably such as making access of attendance e sheet to the students to sign the proxies are taken, faking the attendance records, and time consuming, So to overcome this difficulties this interpretation represent a smart attendance system prototype which is integrate d by technologies such as sensors make at ease for management and reliable system to record the identity of the student and this also makes the management to time saving.	To improve this work in future with co- opt IoT with existing Systems. then can be seen in mobile devices connected to dedicated servers, GPRS & lightweight Protocol. As MQTT is light weight data transmission Protocol since it's a Perfect choice.
2	2017	Marko Arsenovic, Srdjan Sladojevic, Andras Anderla, Darko Stefano vic.	FaceTime – Deep Learning Based Face Recognition Attendance System	Face recognition, Deep Learning, Convolutional Neural Network, Deep Learning, and training dataset and augmentation and Five volunteers Photograph s.	According to this study, the typical forms of attendance systems will be replaced with RFID ones that need the carrying of proper RFID cards together with GPS. There are drawback s to both of the attendance e system methods indicated above. Workers could misplace the RFID card or the tracking device, or another person could make the check in their place. Consequently, this may rely on machine learning and computer vision, which may be more adaptable and error- free.	NA

3	2019	Kuan Heng Lee, Sanjay V Addicam, Ilya Krylov, Sergei Nosov, Mee Sim Lai, Zhan Qiang Lee, Chung Shien Chai	Statistical Multi-frames Accuracy Methodology For Atten- dance Marking System	Multiframe Statistics For the purpose of marking attendance, accuracy and an accuracy tool based on OpenVINO were created and assessed. The evaluation was conducted using a video sequence from an internal test.	The evaluation's findings indicate that because of students' uncooperative position fluctuation and occlusion, the traditional frame- based accuracy measure is unable to resolve the attendance marking problem. The suggested statistics After a convergence time (i.e., 110 seconds), it has been demonstrated that using multiframes with sliding window filtering and majority voting improves the accuracy of student attendance markings	Future research will concentrate on employing various camera settings to enhance the low- resolution and severe occlusion circumstances. As an example, one camera has a wider field of view (FOV) and focuses on the first few rows of students, while the second camera has a smaller FOV. This technique resolves the problem of low-resolution precision.
4	2019	Vikas Yadav, G. P. Bhole	Cloud Based Smart Attendance System for Educational Institutions	Raspberry Pi 3, Finger print scanner, Google App Engine, Google Compute Engine, Google Cloud SQL	An end- to-end IoT system prototype for efficient attendance management in education al institutions is presented in this study. It may be used in place of attendance sheets with a more dependable and effective attendance system. It illustrates how the Internet of Things may be used to intelligently manage an education al institution's attendance system. Attendance data is easier to get and utilize for various apps to examine, monitor, report, and trigger alerts since it is kept in the cloud.	product with an attractive appearance for use as a portable device to take attendance in classes.
5	2021	Emily Sawall, Amber Honnef, Moha med Moha med, Al i Abdull ah S. AlQaht ani, Thamraa Alshayeb.	COVID-19 Zero-Interaction School Attendance System	Received Signal Strength Indicator, Wi-Fi enabled Devices and There was a smart gadget everywhere in the 18 by 9-foot space. Within the space, the access points were arranged in a triangle. For the experiment, the access points' locations were measured.	The studies demonstrate that the suggested attendance system is a zero- effort, zero-interaction, and efficient way to track attendance in a post-pandemic society. Based on the experiment findings, we think that our suggested attendance system is a good approach because of its 95.24% success rate. The trials were conducted at various times of the day, and we think that this approach would motivate teachers to collect attendance in a secure and reliable manner.	NA

| 6 | 2022 | Mingta o Zhao, Gang Zhao, Meiho ng Qu. | College Smart Classroom Attendance Management System Based on Internet of Things | zige'S 3G Sensor Network RFID technology, Face Recognition technology and RFID and Face recognition database from the corresponding author. | In development of college education management, process of building smart classrooms, to deal with issues related to regular attendance, such as doing repeated roll calls and random roll calls in class based on the circumstances to keep an eye on students and their tardiness, early departure, and absenteeism. As a result, this suggests an intelligent attendance management system based on RFID technology, which can precisely detect student absences and substitutions as well as properly record and identify student arrivals and exits from the classroom. | NA |

IV. CONCLUSION

Using IoT (Internet of Things) and Machine Learnings(ML) algorithms leverages the Smart Attendance Marking System (SAMS). At first the systems were introduced with individual technology based on hardware running prototype monitored with the software in computer system similarly to reference [1]. The sensors, such as Biometric and biometric reading system, embedded with microcontroller Raspberrypi 3 which collects and analyzes the vast amount of data from the real time environment along with Google cloud which improves the machine as in instance [4]. Convolutional Neural Networks (CNN), Deep Learning, OpenCV, and computer vision are examples of machine learning (ML) algorithms that aid in facial identification of individuals and have demonstrated promising outcomes in [2] and [3]. The Face recognition technology integrated with IoT for excess Authentication improved Smart Attendance marking system (SAMS) has significantly increased the accuracy, re- liability and efficiency of the system tested in [4] [6]. IoT collects useful data from the real time environment with the help of the existing technology and autonomous flow of data between the devices. The Smart Attendance Marking System's intelligence and functionality are significantly influenced by the application of machine learning (ML) methods. Calculate the required time in IoT data using methods such as time series analysis. The integration of the IoT and Machine Learning (ML) provides the real time data analysis, decision making and Representation of the complex data. The Smart Attendance Marking System (SAMS) with extent of technology eliminates the management troubles and makes this daily task hassle free and the best replacement for the Traditional Attendance System.

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