Smart Track Attendance

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***Abstract*— This paper introduces the development and deployment of an innovative attendance management system titled "Smart Track Attendance," which integrates RFID tapping and facial recognition technologies. The system aims to modernize conventional attendance tracking approaches in educational institutions by providing a seamless and effective solution. Through RFID tapping, students can conveniently record their attendance using ID cards embedded with RFID tags, complemented by facial recognition for enhanced authentication. The theoretical framework behind RFID technology and computer vision algorithms is thoroughly examined, emphasizing the reliability and efficiency of the system. Additionally, stringent security protocols are implemented to safeguard the confidentiality and integrity of attendance data. Beyond improving operational efficiency, the "Smart Track Attendance" system fosters transparency and accountability in attendance management practices. Furthermore, the paper explores potential future enhancements and discusses the broader implications for educational administration, highlighting the system's potential to revolutionize student tracking and engagement strategies..**

Keywords- Attendance Tracking, RFID, Facial Recognition

I. INTRODUCTION

In an era marked by rapid technological advancement, the traditional methods of attendance tracking in educational institutions are increasingly becoming outdated. Recognizing this need for innovation, our project, "Smart Track Attendance," endeavors to revolutionize the attendance-taking process through the integration of RFID (Radio Frequency Identification) technology and facial recognition systems.This project aims to streamline and enhance the accuracy of attendance management by employing a double-step verification process. Students will tap their ID cards equipped with RFID tags against a smartphone, initiating the first step of verification. Subsequently, facial recognition technology implemented on a laptop will authenticate the student's identity, ensuring a robust and foolproof attendance record.In this report, we delve into the design, development, and implementation phases of the "Smart Track Attendance" system. We explore the technical intricacies of RFID integration with mobile devices and the implementation of facial recognition algorithms for precise identification. Additionally, we analyze the effectiveness and feasibility of our solution in real-world educational settings.

Through this report, we aim to provide insights into the potential benefits of adopting such a system, including increased efficiency, accuracy, and transparency in attendance tracking. Furthermore, we address any challenges encountered during the project's execution and propose recommendations for future enhancements.For a comprehensive understanding[1] of the "Smart Track Attendance" system and its implications, this report offers a detailed overview of its components, functionality, and potential impact on educational institutions.

II. LITERATURE REVIEW

T.S. Lim, S.C. Sim, M.M. Mansor [2009] proposed TJE paper titled “RFID based attendance system”. Their work highlights many educational administrators express concerns regarding student absenteeism, which can significantly impact overall academic performance. Traditional methods of attendance tracking, such as calling out names or signing paper sheets, are not only time-consuming but also insecure, leading to inefficiencies. An effective solution to this problem is the implementation of a Radio Frequency Identification (RFID) based attendance system. This system is applicable in various educational settings, including schools, colleges, and universities, as well as in workplaces for employee attendance tracking. By uniquely identifying individuals based on their RFID-tagged ID cards, this system streamlines the attendance process, making it faster, easier, and more secure compared to traditional methods. Students or employees simply need to place their ID cards on the reader, and their attendance is recorded instantly. With the system's real-time clock

functionality, attendance records are accurately time stamped, enhancing data accuracy. Attendance data can be conveniently stored in a database, accessible via computer connectivity through RS232 or Universal Serial Bus (USB) ports. Additionally, recorded attendance can be viewed using HyperTerminal software[1]. A functional prototype of the system has been successfully developed and tested.

Kashif Ishaq [2023] proposed “IoT Based Smart Attendance System Using Rfid: A Systematic Literature Review”. This paper underscores the significance of authentication in computer-based communication system control. Human face recognition serves as a crucial aspect of biometric verification and finds widespread application in various fields such as video monitoring systems, human-computer interaction, door control systems, and network security. The document outlines a method for implementing a Student Attendance System that integrates face recognition technology using the Personal Component Analysis (PCA) algorithm. This system will automatically record student attendance in classroom environments and provide faculty members with easy access to student information by maintaining a log of clock-in and clock-out times. [2]

In the paper titled ”Face Recognition by Humans and Machines: Three Fundamental Advances from Deep Learning” by Alice J. O’Toole, Carlos D. Castillo [2022]. This paper presents an extension and refinement of the author's theory for human visual information processing, which is then applied to the problem of human facial recognition. Several fundamental processes are implicated: encoding of visual images into neural patterns, detection of simple facial features, size standardization, reduction of the neural patterns in dimensionality, and finally correlation of the resulting sequence of patterns with all visual patterns already stored in memory. In the theory presented here, this entire process is automatically "driven" by the storage system in what amounts to an hypothesis verification paradigm.Neural networks for carrying out these processes are presented and syndromes resulting from damage to the proposed system are analyzed. A correspondence between system component and brain anatomy is suggested, with particular emphasis on the role of the primary visual cortex in this process. The correspondence is supported by structural and electrophysiological properties of the primary visual cortex and other related structures. [3]

Woodward Jr., John D [2003] proposed “Biometrics: A Look at Facial Recognition”. During the 2002 General Assembly, Delegate H. Morgan Griffith introduced legislation aimed at establishing legal guidelines for the public sector's use of facial recognition technology in Virginia. This legislation, labeled House Bill No. 454 and included in the Appendix, was approved by the House of Delegates with a vote of 74-25 earlier this year. It is currently awaiting review by the Senate Courts of Justice Committee while the Virginia State Crime Commission conducts an examination. The Virginia State Crime Commission, a standing legislative commission of the Virginia General Assembly, is tasked with making recommendations on all aspects of public safety in the Commonwealth of Virginia. Presently, Virginia Beach stands as the sole municipality in Virginia preparing to integrate facial recognition technology into its public safety initiatives. Last year, the Virginia Beach City Council sanctioned the installation of a facial recognition system in the city's Oceanfront tourist area. After testing, the system has now been fully deployed. Senator Kenneth W. Stolle, Chairman of the Virginia State Crime Commission, formed a Facial Recognition Technology Sub-Committee to delve into the topic of facial recognition technology. This briefing commences by defining biometrics and presenting examples of the technology. It then elaborates on how biometrics can serve authentication and surveillance purposes. Facial recognition is thoroughly examined, encompassing technical, operational, and testing considerations. The briefing concludes with a discussion on the current legal landscape concerning the public sector's use of facial recognition. While not offering a specific policy recommendation regarding House Bill No. 454, this briefing aims to furnish valuable information for Sub-Committee members, the Virginia State Crime Commission, and other concerned parties. [4]

A. Juels [2006] suggested the paper “RFID security and privacy: a research survey”. This paper surveys recent technical research on the problems of privacy and security for radio frequency identification (RFID). RFID tags are small, wireless devices that help identify objects and people. Thanks to dropping cost, they are likely to proliferate into the billions in the next several years-and eventually into the trillions. RFID tags track objects in supply chains, and are working their way into the pockets, belongings, and even the bodies of consumers. This survey examines approaches proposed by scientists for privacy protection and integrity assurance in RFID systems, and treats the social and technical context of their work. While geared toward the non-specialist, the survey may also serve as a reference for specialist readers. [5]

John Curtin, Robert J. Kauffman [2007] proposed ”Making the ‘MOST’ out of RFID technology: a research agenda for the study of the adoption, usage and impact of RFID”. This paper discusses how radio frequency identification (RFID) technology significantly enhances an organization's ability to gather a vast array of data about the location and characteristics of any entity that can be physically tagged and wirelessly scanned within certain technical constraints. RFID can be applied across various tasks, structures, work systems, and contexts along the value chain, including business-to-business logistics, internal operations, business-to-consumer marketing, and after-sales service applications. With the increasing adoption of RFID in industry, academic researchers are becoming increasingly interested in conducting scholarly investigations to comprehend how RFID intersects with mobility, organizational dynamics, and systems technologies (MOST). In this paper, we delve into RFID and propose a research agenda aimed at addressing a series of overarching research questions regarding how RFID technology: (1) is developed, adopted, and implemented by organizations; (2) is utilized, supported, and evolved within organizations and alliances; and (3) impacts individuals, business processes, organizations, and markets. Similar to many technological advancements, as

the technical challenges associated with implementing and utilizing RFID are tackled and resolved, managerial and organizational issues will emerge as critical areas for Information Systems (IS) research. [6]

In the paper titled "Does Attendance Matter? An Examination of Student Attitudes, Participation, Performance and Attendance" written by P. Massingham , T. Herrington[2006] . Non attendance of lectures and tutorials appears to be a growing trend. The literature suggests many possible reasons including students' changing lifestyle, attitudes, teaching and technology. This paper looks at the reasons for non attendance of students in the Faculty of Commerce at the University of Wollongong and identifies relationships between attendance, participation and performance. The results indicate that there are valid reasons for non attendance that are both in the control of learners and teachers. There are also clear benefits for students to be gained in attendance; however, changes in the way we learn, teach, assess and use technology are recommended if we wish to reverse the trend.[7]

Shreyak Sawhney et al. [2003] proposed "Real-Time Smart Attendance System using Face Recognition Techniques". Managing attendance manually can be a significant burden for teachers. To address this issue, smart and automated attendance management systems are being employed. However, authentication remains a crucial concern in these systems. Typically, smart attendance systems utilize biometrics, with facial recognition being a prominent method. As a key aspect of biometric verification, facial recognition is widely used in various applications such as video monitoring, CCTV systems, human-computer interaction, indoor access systems, and network security. Implementing such a framework can effectively address issues like proxies and erroneous marking of students as present when they are not physically there. The primary steps in implementing this system involve face detection and recognition of the detected faces. This paper proposes a model for implementing an automated attendance management system for students using facial recognition techniques, specifically employing Eigenface values, Principle Component Analysis (PCA), and Convolutional Neural Network (CNN). Following these steps, the identified faces can be connected by comparing them with a database containing student face data. This model is expected to be an efficient approach for managing student attendance and records. [8]

In the paper titled "Student attendance system in classroom using face recognition technique" by Samuel Lukas [2016].The paper describes about the Authentication of Human face recognition (HFR). It stands out as a recognized technique for user authentication. As a vital aspect of biometric verification, HFR finds extensive application in various domains, including video surveillance, human-computer interaction, access control systems, and network security. This paper introduces a method for student attendance tracking in classrooms using facial recognition technology.[9] The proposed approach combines Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT) to extract facial features, followed by the application of Radial Basis Function (RBF) for facial object classification. Experimental results conducted with 16 students in a classroom setting demonstrate successful recognition of 121 out of 148 faces.

Abhishek Jha [2007] proposed "Class Room Attendance System Using Facial Recognition System" It talks about the methods to exploit this physical feature have seen a great change since the advent of image processing techniques. The accurate recognition of a person is the sole aim of a face recognition system and this identification maybe used for further processing. Traditional face recognition systems employ methods to identify a face from the given input but the results are not usually accurate and precise as desired. The system described in this paper aims to deviate from such traditional systems and introduce a new approach to identify a student using a face recognition system i.e. the generation of a 3D Facial Model. This paper describes the working of the face recognition system that will be deployed as an Automated Attendance System in a classroom environment. [10]

III.DIAGRAMS [MODEL ARCHITECTURE / FLOWCHART]

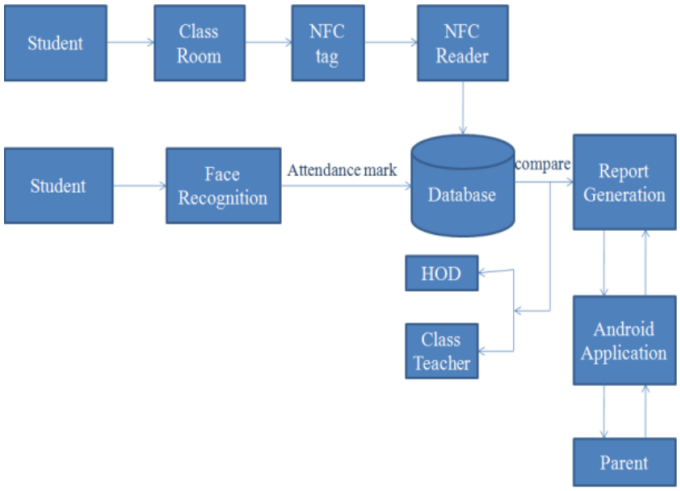

Figure 1. Block Diagram of Smart Track Attendance.

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IV.HARDWARE AND SOFTWARE DESCRIPTION WITH FUNCTIONALITY INVOLVED-

Hardware Description:

The RFID-based attendance system primarily relies on two main hardware components: a smartphone with NFC (Near Field Communication) capabilities and a laptop equipped with a front-facing camera for facial recognition.

Smartphone with NFC Reader :The smartphone serves as a portable device for capturing attendance through RFID tapping. It is equipped with an NFC reader, which enables communication with RFID tags embedded in student or employee ID cards. The NFC reader can detect RFID tags within close proximity, typically a few centimeters, allowing for quick and convenient attendance logging.

Laptop with Front-Facing Camera :The laptop is the central processing unit responsible for facial recognition authentication. It features a front-facing camera capable of capturing high-resolution images of individuals' faces. The camera serves as the input device for facial recognition

algorithms, capturing facial features and landmarks necessary for identity verification.

Software Description:
The software components of the RFID-based attendance system encompass both mobile and desktop applications, each serving specific functionalities tailored to RFID tapping and facial recognition.
Mobile Application (Smartphone):The mobile application running on the smartphone facilitates RFID tapping for attendance logging. It includes the following functionalities : a. NFC Reader Interface: The application interfaces with the smartphone's NFC reader to detect and read RFID tags present in student or employee ID cards. Upon tapping the ID card against the smartphone, the NFC reader captures the unique identifier embedded in the RFID tag. b. Attendance Logging: Once the RFID tag is detected, the application records the attendance data, including the timestamp of the tap and the unique identifier associated with the ID card. This information is then transmitted to the central database for further processing. c. Real-Time Sync: The mobile application maintains real-time synchronization with the central database, ensuring that attendance records are promptly updated and accessible to authorized users.
Desktop Application (Laptop):The desktop application installed on the laptop facilitates facial recognition authentication for attendance tracking. It encompasses the following functionalities: a. Facial Recognition Algorithm: The application utilizes advanced facial recognition algorithms to analyse images captured by the laptop's front-facing camera. These algorithms identify facial features, such as eyes, nose, and mouth, and generate a unique facial signature for each individual. b. Identity Verification: Upon capturing an image of an individual's face, the application compares it against pre-registered facial templates stored in the system's database. By matching facial signatures, the application verifies the identity of the individual and logs their attendance accordingly .The desktop application features a user-friendly interface that provides real-time feedback on facial recognition results. It displays the detected individual's name, along with relevant attendance information, allowing users to review and confirm attendance records.

Functionality Involved
RFID Tapping: It constitutes a core functionality within the attendance system, facilitated by the smartphone's NFC reader. This feature enables the detection and reading of RFID tags embedded in ID cards. As users tap their ID cards against the smartphone, the NFC reader swiftly captures the unique identifiers stored within the RFID tags. Subsequently, the mobile application swiftly records pertinent attendance data, encompassing timestamps and RFID tag identifiers. This information undergoes seamless transmission to the central database, ensuring real-time updates of attendance records.

Figure 1. Google Form is Made for the attendance.

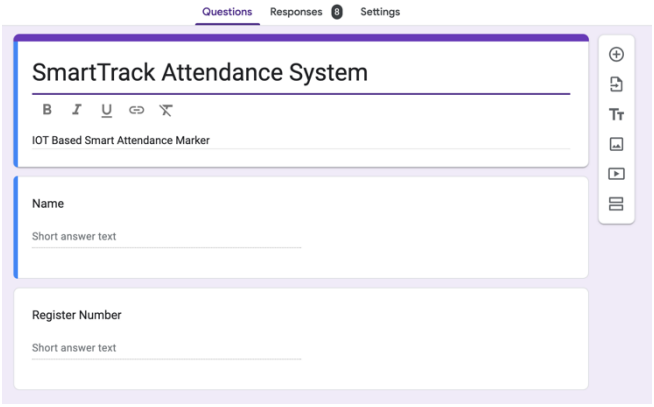

Figure 2. Parameters such as Name, Register Number is made.

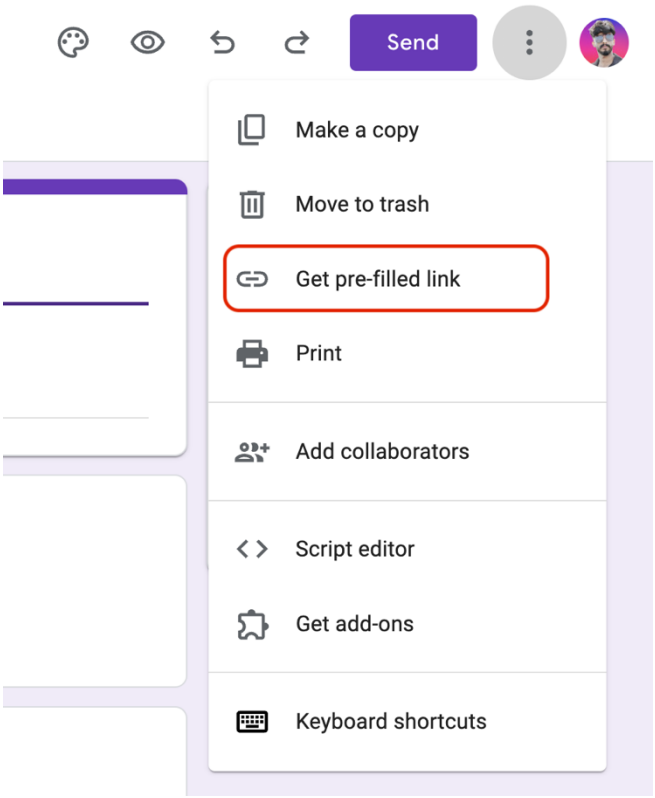

Figure 3. This form is then collected as a pre-filled link.

Figure 4. Attendances that are tapped is collected in the excel sheet.

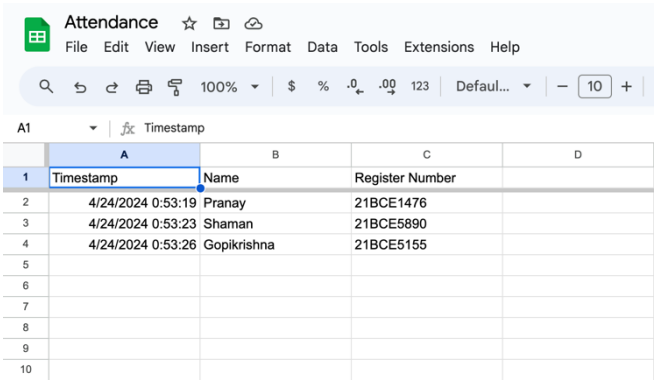

Figure 5. Attendances of students who have tapped their ID Cards.

Facial Recognition: The facial recognition feature, integral to the attendance system, operates through the laptop's front-facing camera. Upon activation, this component captures images of individuals' faces for identity verification. Sophisticated facial recognition algorithms then analyse these images, extracting distinctive facial features and generating unique facial signatures. Subsequently, the captured facial data undergoes comparison with pre-registered facial templates stored within the system's database. Upon successful verification, the application logs attendance data, incorporating the individual's name and timestamp, based on the results of the facial recognition process.

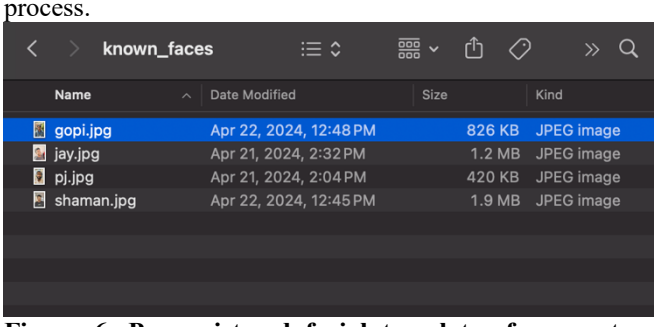

Figure 6. Pre-registered facial templates from system database.

Figure 7. Face is recognized from the database provided.

	A	B	C
1	Name	Register Number	Branch
2	PRANAY JILJITH	21BCE1476	Computer Science
3			
4			

Figure 8. Detected face names are then stored in a seperate excel sheet.

Integration and Synchronization: Central to the attendance system's functionality is the seamless integration and synchronization of data between the mobile and desktop applications. Following RFID tapping or facial recognition authentication, attendance data is swiftly transmitted to the central database. This process ensures that attendance records are promptly updated and accessible to authorized users in real-time. Additionally, the mobile application maintains continuous synchronization with the central database, facilitating immediate access to attendance data and enabling users to review and verify attendance records on-the-go. Such integration and synchronization mechanisms enhance the system's efficiency and reliability in attendance management.

V. Conclusion and Future Work

The RFID-based attendance system, augmented by facial recognition technology, represents a transformative solution for attendance management in educational institutions and workplaces. Through seamless integration of hardware and software components, this system offers unparalleled efficiency, accuracy, and security in tracking attendance. One of the key strengths of the system lies in its ability to leverage RFID tapping for swift and convenient attendance logging. By equipping smartphones with NFC readers, users can effortlessly tap their ID cards to register their attendance. This eliminates the need for manual registration methods, reducing administrative burden and streamlining the attendance process. Moreover, the real-time synchronization of attendance data ensures that records are promptly updated, providing stakeholders with up-to-date insights into attendance patterns.

Facial recognition technology serves as a complementary feature, enhancing the system's authentication capabilities. The utilization of sophisticated algorithms enables the accurate identification of individuals based on their facial features. This not only adds an extra layer of security to the attendance system but also enhances user experience by providing a seamless and non-intrusive authentication method. The integration of facial recognition further reinforces the system's reliability and robustness, mitigating the risk of fraudulent attendance practices .Furthermore, the system prioritizes data integrity and privacy through robust security measures. By encrypting sensitive information and implementing access controls, the system safeguards attendance data from unauthorized access or tampering. Compliance with regulatory standards ensures that privacy rights are upheld, instilling confidence among users regarding the confidentiality of their personal information.

In addition to its immediate benefits, the RFID-based attendance system holds promise for future advancements in attendance management. The scalability and adaptability of the system allow for customization according to specific institutional requirements. As technology continues to evolve, the system can be seamlessly integrated with emerging technologies, further enhancing its capabilities and functionality. Overall, the RFID-based attendance system represents a significant step forward in modernizing attendance management processes. By harnessing the power of RFID tapping and facial recognition, this system empowers educational institutions and workplaces to efficiently track attendance, promote accountability, and optimize resource allocation. As institutions embrace digital transformation, the RFID-based attendance system stands as a beacon of innovation, ushering in a new era of streamlined and data-driven attendance management.

VI. SNAPSHOTS OF OUTPUT - RESULTS

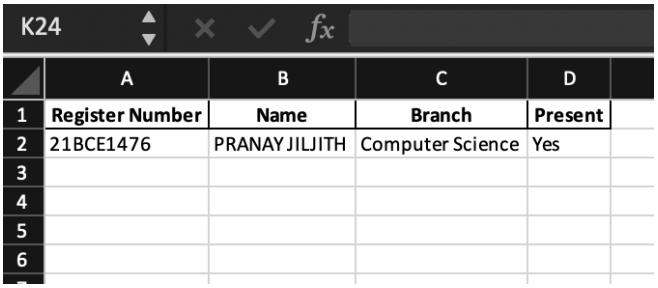

Figure 9. Final data obtained after double verification from tapped data and detected faces excel sheets.

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