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SMART BIOMETRIC ATTENDANCE MONITORING SYSTEM USING IOT FOR WORKPLACE AUTOMATION

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ABSTRACT: The rapid advancement of biometric technologies has significantly improved the reliability and efficiency of automated attendance systems. This paper presents a Smart Biometric Attendance Monitoring System that integrates IoT-based fingerprint recognition with secure cloud storage to streamline attendance management in workplace environments. The proposed system employs a compact and portable fingerprint module to authenticate individuals and instantly upload attendance records to the cloud through an IoT gateway. By eliminating manual data entry and preventing proxy or fraudulent attendance, the system ensures high data integrity and operational accuracy. The cloud-enabled architecture allows authorized personnel to access real-time attendance logs remotely from any secure location, enhancing administrative convenience and decision-making efficiency. This smart, automated, and scalable solution demonstrates how IoT and biometrics can be effectively combined to modernize conventional attendance tracking, reduce workload, and improve overall workplace productivity.

Keywords:*Biometric,Fingerprint,IoT,FingerprintScanner,Attendance.*

1.INTRODUCTION

Attendance plays a vital role in academic institutions, serving as a key indicator of student engagement, discipline, and overall learning outcomes. Traditionally, attendance is recorded either by calling out students' roll numbers or by passing around a physical attendance sheet during class. Although widely used, these manual methods are time-consuming, prone to human error, and increasingly inefficient as class sizes grow. Additionally, issues such as proxy attendance and the misplacement of attendance records compromise the reliability and integrity of the process.

Recent advancements in biometric authentication have enabled the development of portable, accurate, and user-friendly systems that can be seamlessly incorporated into academic environments. Biometric modalities such as fingerprint and iris recognition offer high reliability due to their uniqueness and resistance to manipulation. Parallel to this, the evolution of cloud computing technologies has made secure, scalable, and easily accessible data storage a practical reality for educational institutions. Cloud-based platforms allow authorized users to retrieve attendance data remotely, ensuring both convenience and robust data management.

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This paper proposes a biometric-based attendance monitoring system that leverages IoT-enabled fingerprint scanners and secure cloud storage. The system verifies each student's identity by matching their fingerprint with a pre-registered database and automatically updates a secure Google Spreadsheet in real time. By eliminating manual intervention and reducing opportunities for misinformation or fraud, the system enhances accuracy, accountability, and administrative efficiency. This integration of biometrics and cloud computing represents a significant step toward modernizing attendance tracking in educational settings.

2.RELATEDWORK

Using RFID technology, the attendance system shortens lecture times, streamlines documentation, and tracks attendance. To authenticate their attendance, students must present their RFID cards to the RFID reader. The instructor may then keep a daily attendance log by telling students to send the collected data to their mobile devices over Bluetooth.

The attendance system includes a small, extremely high-resolution camera for ocular capture. The computer then processes the image and compares it to data saved in the database. A user's existence can be determined by comparing entered data to existing data in the system. The increased expense of this technique is due to the high-resolution camera, but it is the most dependable way available because each person's iris pattern and pigment are unique.

By leveraging biometrics, the wireless fingerprint attendance management system removes both the trouble of configuring the requisite network and the possibility of incorrect attendance records. It can help people attend in a more efficient and convenient way.

Digital Fingerprint of a Persona The server uses USBSensor to enroll fingerprints, and fingerprint templates are delivered to the client via the network for verification. This system automatically generates an attendance record, which is then emailed to professors. In addition, when a student is absent, an SMS notification is delivered to the parent's cell phone.

3.SYSTEM OVERVIEW

The suggested biometric attendance system consists of an ESP8266 NodeMCU expansion board and a fingerprint reader. The fingerprint scanner detects the user's fingerprint to confirm the student's attendance. NodeMCU sends attendance data to Google Spreadsheet via the PushingBox API method.

ESP8266NodeMCU

The open-source development board

ESP8266NodeMCU has GPIO, PWM, I2C, and ADC. The ESP8266-12E hardware and NodeMCU firmware serve as the base.Each of the 10 GPIs on board can be configured for PWM.Its hardware I/O, similar to Arduino, can substantially speed up the time-consuming process of configuring and fine-tuning hardware. Because of their small size, lightweight design, and wireless capabilities, IoT devices may be prototyped quickly. It is possible to program NodeMCU using Lua scripts.

Writing NodeMCU firmware with Lua script has several disadvantages, including the requirement to learn a new programming language, a limited number of available pins, and a lack of detailed documentation. The board can be easily programmed using the Arduino IDE

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after wiping the NodeMCU firmware because its hardware IO is identical to that of an Arduino. The Arduino IDE provides a wider support network and documentation, as well as being easier to use.

Finger print scanner

Every person on the earth has an imprint. These dings generate a configuration known as a fingerprint

They have evolved into the best biometric identifying approach since they are unique and immutable.

The biometric scanner captures the user's fingerprints. This image is known as a "live scan." A biometric template made up of retrieved attributes is digitally created and saved from the live scan for later matching [8]. Individual fingerprints are detected using a combination of hardware and software techniques.

Finger print Processing

Fingerprint processing has three main functions: enrollment, searching, and verification. Enrollment is one of the most important considerations.A snapshot of the user's fingerprint is required. The act of searching entails the methodical study and comparison of an input fingerprint to a maintained collection of fingerprints. The verification method comprises determining a match between the fingerprint provided as input and a pre-existing fingerprint in the database.

Internet of Things

IoT is a situation in which items, including humans, animals, and other things, are assigned unique identities (IDs) that allow them to communicate data wirelessly across a network, eliminating the need for direct human-to-human or human-to-computer interaction [9]. The Internet of Things (IoT) is a technical framework designed to improve machine-to-machine communication. It is made up of actuators and wireless embedded sensors, which allow users to monitor and control equipment remotely and efficiently [5]. This breakthrough will be made possible by electronics' capacity to effortlessly merge into everyday physical objects and communicate with current infrastructure.

Pushing BoxAPI

An API (Application Programming Interface) is a set of protocols and procedures that allows users to interact with web-based software applications and utilities.PushingBox is a cloud utility that sends cloud alerts using API calls.The PushingBox API requires only one argument to initiate the notification scenario, which is DeviceID. These instances may include sending and receiving emails, posting files to Google Docs, and tweeting. The service's integrative functionality is given using the PushingBox API.

Google Spreadsheet

Google Sheets allows you to create, modify, and update spreadsheets online while also sharing

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data in real time. Google Sheets are dynamic since they were developed using Ajax. Similar to Microsoft Excel, it allows for the organization and storing of a wide range of data formats. While Google Sheets does not have all of the functionality present in Excel, it is nonetheless a simple program for creating and editing spreadsheets of any complexity. Google Sheets is compatible with Microsoft Excel and CSV (Comma Separated Values), and it also supports HTML saving.

4.IMPLEMENTATION

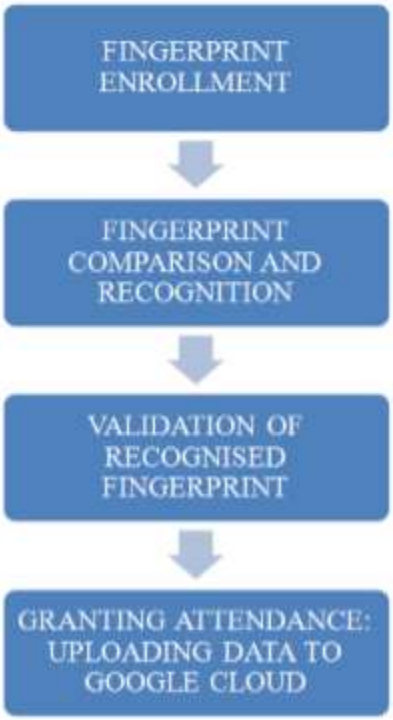

Fig.1Block Diagram

Fingerprint Enrolment

Fingerprints are acquired from each infant as part of the enrolling process. The fingerprint is collected by the biometric scanner built inside the machine. Every fingerprint is allocated an ID number. The ID number is displayed on the NodeMCU board. Each student is given a unique number. Enrollment via fingerprint is only done once. Student IDs can be amended and updated as necessary. Describe the steps in Figures 2 and 3.

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Fig.2Enrolment Process

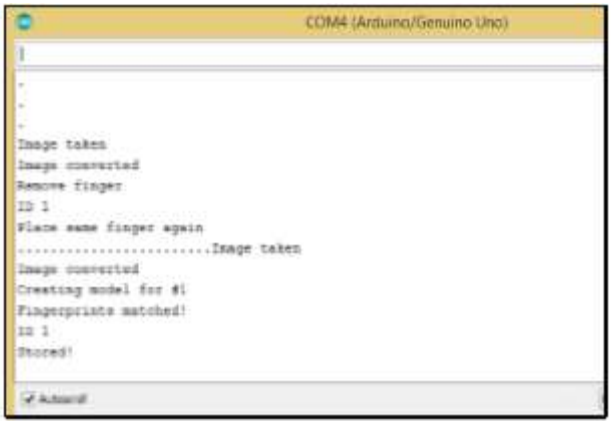

Fig.3Enrolment Process

Fingerprint Comparison and Recognition

Because of its portability, students can use the technology to track attendance during lectures. During the fingerprint comparison and recognition phase, the pupil's fingerprint will be compared to prior fingerprints saved on the NodeMCU board.Figure 4 depicts a yellow LED that will illuminate during this technique. The pupil will be notified when the system's fingerprint entry capability becomes operational. The learner then needs to place a fingertip on the fingerprint scanner. Next, the biometric input is confirmed using the previously recorded fingerprints.

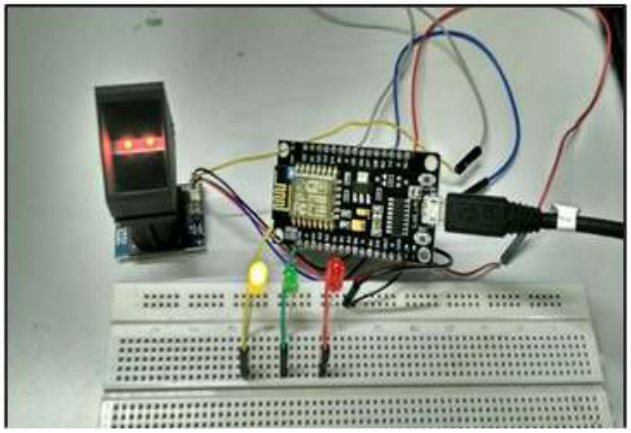

Fig.4Ready for Input

Validation of Recognised Fingerprint

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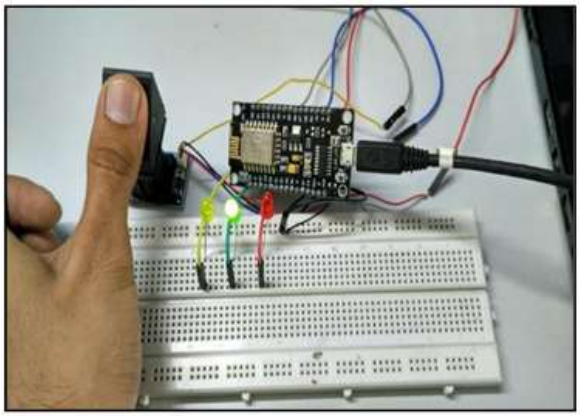

Fig.5Fingerprint Matched

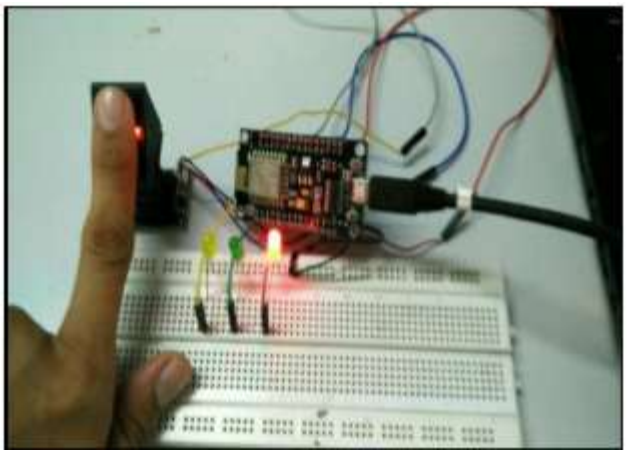

Fig.6Fingerprint Not Matched

Authorizing Attendance via Google Spreadsheet by Entering Data

The procedure of granting attendance begins immediately when the fingerprint is identified. Each pupil's unique identifying number is acknowledged. Figure 7 illustrates how attendance data is entered into a Google Spreadsheet using the student's ID number. The PushingBox API is used to upload the ID number to a Google Spreadsheet. After attendance verification, which includes entering the ID into a Google Spreadsheet, the fingerprint comparison and identification procedure begins. Following that, an extra student has access to the system.

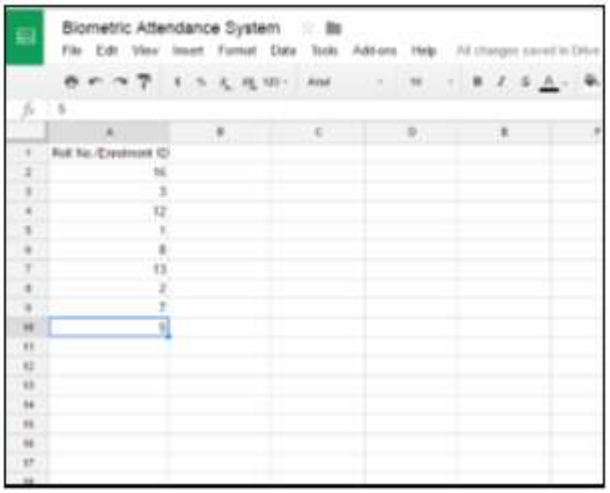

Fig.7Attendance Data on Google Sheets

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5.CONCLUSION

The traditional method of manually recording and tracking student attendance requires a significant expenditure of time and effort. The deployment of the biometric authentication-based attendance monitoring system has the potential to improve the overall efficiency of the process. Because of its excellent efficiency and security, educational institutions can benefit significantly from using a portable biometric attendance system based on the Internet of Things (IoT). This system's building costs are much cheaper than those of a typical biometric attendance system. Attendance records are managed on the cloud, making it easier for teachers to access and retrieve data. The use of a biometric scanner ensures the accuracy of the attendance record. Because of its simple design, the system is intuitive and easy to understand.

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