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IoT Based Biometric Attendance System

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Abstract: Biometric student attendance system increases the efficiency of the process of taking student attendance. This paper presents a simple and portable approach to student attendance in the form of an Internet of Things (IOT) based system that records the attendance using fingerprint based biometric scanner and stores them securely over cloud. This system aims to automate the cumbersome process of manually taking and storing student attendance records. It will also prevent proxy attendance, thus increasing the reliability of attendance records. The records are securely stored and can be reliably retrieved whenever required by the teacher.

Keywords: Biometric, Fingerprint, IoT, Fingerprint Scanner, Attendance.

I. INTRODUCTION

Attendance plays a major role in educational institutions. The most common means of taking attendance in the classroom is by calling out the roll numbers of students or asking the students to manually sign the attendance sheet, which is passed around during the lecture. The process of manually taking and maintaining the attendance records becomes highly cumbersome.

Biometric systems have reached a sufficiently advanced stage wherein they can now be deployed in systems without hampering portability. With the recent development of various cloud based computing and storage systems, data can be securely stored and retrieved whenever required. Primarily, fingerprints and iris images are considered to be the most reliable for use in biometric systems [7], [8].

A system that records the attendance making use of biometric scanners and stores them securely over cloud in the form of Google Spreadsheet can help resolve issues. The system consists of a fingerprint scanner which is used for ascertaining a student's identity. If the fingerprint scanned matches with records present in the database, attendance is granted to the student by updating to the Google Spreadsheet.

II. RELATED WORK

The RFID based attendance system simplifies the process of taking attendance and reduces the paper work and saves the lecture time. Student have to display their RFID card to the RFID reader in order to mark their attendance, and then the collected data will be sent to the professor's cell phone via Bluetooth, in this way he/she can keep the record of attendance daily [1].

The iris based attendance system includes a small but very high resolution camera for taking the image of the iris, which is then compared with the data enrolled in the database. If the entered data matches with the already existing data, the attendance of particular person is marked present. This system is costlier because of the high resolution camera, but it's the most fool proof system for the task, as the pattern and the colour of the iris is unique for every individual [2].

The wireless fingerprint attendance management is based on biometrics and wireless technique solves the problem of spurious attendance and the trouble of laying the corresponding network. It can make the users' attendances more easily and effectively [3][10].

Enrolment of fingerprints is done on the Server using Digital Persona Fingerprint USB Sensor and verification is done on the client with the transmission of fingerprint templates over the network. In this system attendance report is generated automatically and is further forwarded to faculty members via Email. In addition to this, SMS is also sent to parent's mobile in case of short attendance of students [4].

III. SYSTEM OVERVIEW

The proposed system involves a biometric attendance system that integrates an ESP8266 NodeMCU breakout board and a fingerprint scanner. The fingerprint scanner processes the user's fingerprint to verify the student's attendance. NodeMCU uploads the attendance data to Google Spreadsheet using a service called PushingBox API.

A. ESP8266 NodeMCU

ESP8266 NodeMCU is an open source development board based on ESP8266-12E chip and NodeMCU firmware that integrates GPIO, PWM, I2C and ADC all in a one board. It has 10 GPIO and every GPIO can be PWM. It has

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Arduino like hardware IO, which can effectively reduce the extravagant work for configuring and manipulating hardware. Due to its low cost, compact design and wireless connectivity, it helps to prototype an IoT product efficiently. NodeMCU can be programmed using Lua script.

Programming NodeMCU firmware with Lua script has certain disadvantages like need to learn new language, reduced pin out and scarce documentation. Since, the board has Arduino like hardware IO; it can be programmed directly using Arduino IDE by erasing NodeMCU firmware. Arduino IDE is more familiar and has vast documentation and support community.

B. Fingerprint scanner

Everyone in this world has marks on their fingers. These marks have a pattern and this pattern is called the fingerprint. Since, they are unique and cannot be removed or changed, they have become ideal means of biometric identification.

An image of the user's fingerprint is captured by fingerprint scanner. This captured image is called as live scan. The live scan is processed digitally to create a biometric template (a collection of certain extracted features) which is stored and used for matching [8]. Identification of fingerprints of individuals is done on the basis of both hardware and software techniques.

C. Fingerprint Processing

Fingerprint processing has three primary functions: enrolment, searching and verification. Out of these, enrolment plays an important role. It involves capturing an image of the user's fingerprint. Searching involves sifting through a set of stored fingerprints and comparing them with the input fingerprint. Verification involves acknowledging a match between the input fingerprint and one already present in the stored fingerprints.

D. Internet of Things

The Internet of Things (IoT) is the scenario in which objects, animals or people are provided with unique identifiers, and the ability to transfer data over a network without requiring human-to human or human-to-computer interaction [9]. IoT revolves around increased machine-to-machine (M2M) communication and encompasses wireless embedded sensors and actuators that assist users in monitoring and controlling devices remotely and efficiently [5]. This innovation will be enabled by the embedding of electronics into everyday physical objects, which will allow them to integrate seamlessly with the existing infrastructure.

E. PushingBox API

API (Application Programming interface) is a set of routines and protocols for accessing a Web-based software application or Web tool. PushingBox is a cloud service that provides cloud notifications based on API calls. Using PushingBox API, it is easy to launch the scenario of notifications by simply attaching DeviceID as the only argument. These scenarios can be linked with anything from tweeting, receiving emails, uploading data to Google Docs, etc. PushingBox API provides the integrative functionality of the PushingBox service.

F. Google Spreadsheet

Google Sheets is a web based application that allows creating, updating and modifying spreadsheets and share data live online. Google sheet is based on Ajax that makes it dynamic. It allows storing and organising different types of data, much like Microsoft Excel. Google Sheets does not offer all advance features of Excel but, it's easy to create and modify spreadsheets ranging from the simple to the complex. Google Sheet is compatible with Microsoft excel and CSV (Comma-Separated Values) and can also be saved as HTML.

IV. IMPLEMENTATION

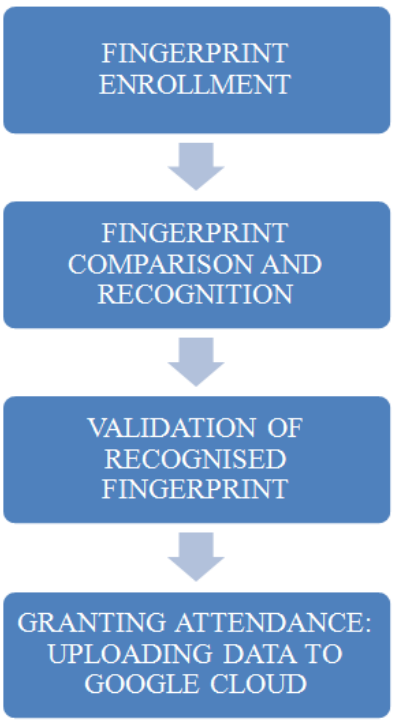

Fig. 1 Block Diagram

A. Fingerprint Enrolment

In the enrolment process, the fingerprint of each student is recorded. The fingerprint of the student is scanned using the fingerprint scanner in the system. Each fingerprint is assigned an ID number. The ID number is stored on the NodeMCU board. This number is unique for each student. Enrolment of fingerprints is performed only once. The student IDs can be changed or replaced as and when required. The process is as shown in Fig. 2 and Fig. 3.

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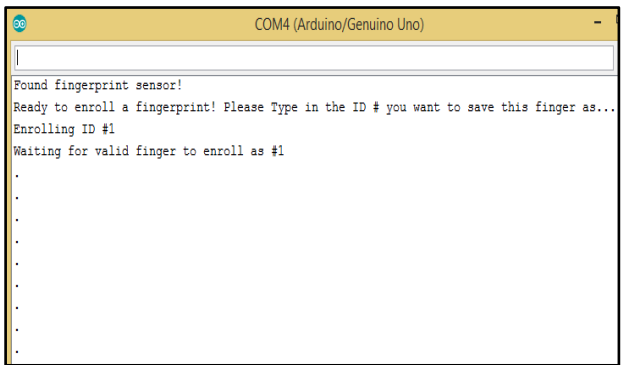

Fig. 2 Enrolment Process

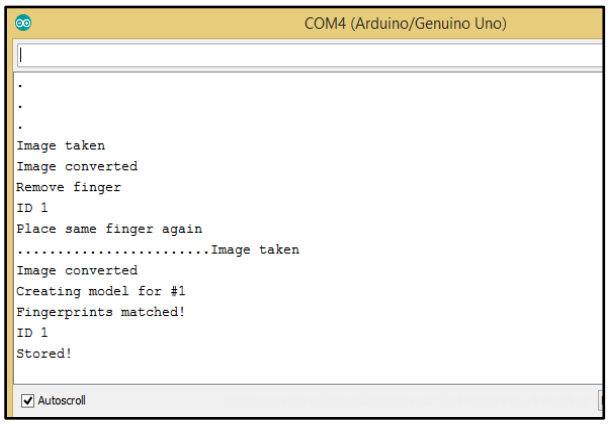

Fig. 3 Enrolment Process

B. Fingerprint Comparison and Recognition

The system, being portable, can be passed around during the lecture from student to student to record attendance. During the fingerprint comparison and recognition process, the student's fingerprint will be compared with the stored fingerprints in the NodeMCU board. During this process, a yellow coloured LED will glow, as shown in Fig.4. This will indicate to the student that the system is ready to take fingerprint input. The student then has to place his/her finger on the fingerprint scanner. The fingerprint input is then verified with the stored fingerprints.

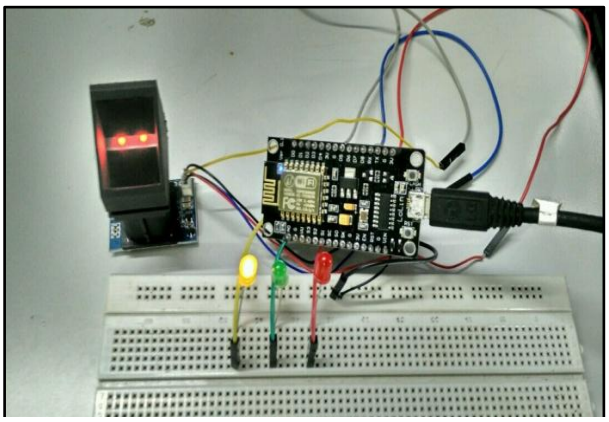

Fig. 4 Ready for Input

C. Validation of Recognised Fingerprint

In the previous process, the fingerprint input is compared with the stored fingerprints. If it matches a fingerprint present in the NodeMCU, a green coloured LED will glow, as shown in Fig. 5. This will indicate to the student that the fingerprint has been recognised successfully. Otherwise, a red coloured LED will glow, as shown in Fig.6. This will indicate that the fingerprint does not match any stored fingerprint. The student can then try again when the yellow LED glows, starting the Fingerprint Comparison and Recognition process again.

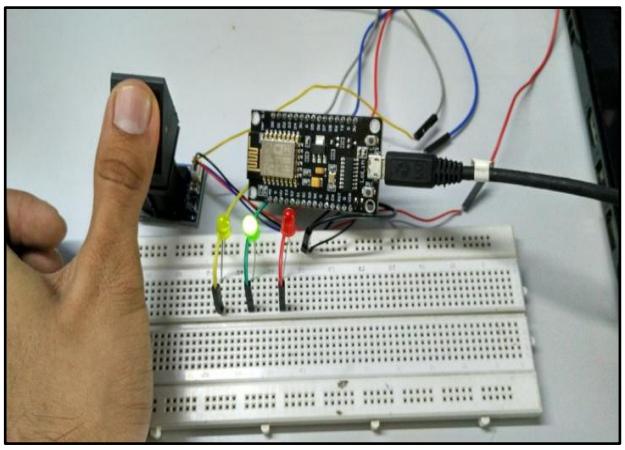

Fig. 5 Fingerprint Matched

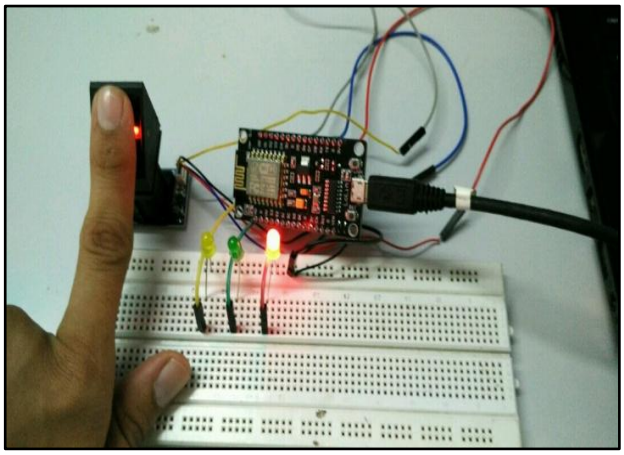

Fig. 6 Fingerprint Not Matched

D. Granting Attendance – Uploading Data to Google Spreadsheet

If the fingerprint is recognised, the attendance granting process starts. The unique ID number of the student is recognised. The attendance data is logged into Google Spreadsheet by uploading the student's ID number in it, as shown in Fig.7. For uploading the ID number in Google Spreadsheet, PushingBox API is used. After the attendance is granted, i.e. the ID is stored in Google Spreadsheet, the Fingerprint Comparison and Recognition process starts. The system can then be passed on to another student.

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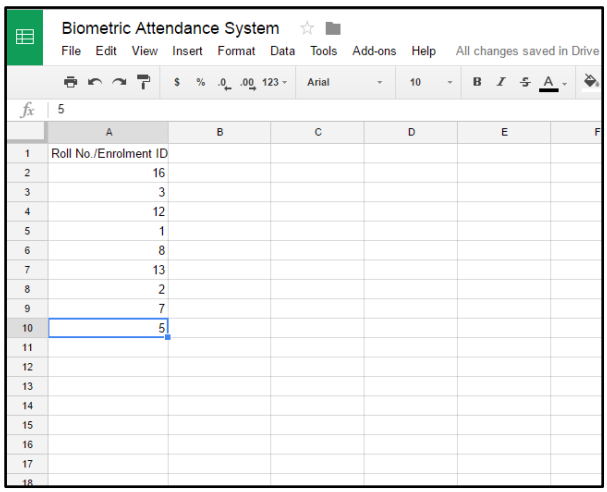

Fig. 7 Attendance Data on Google Sheets

V. FUTURE SCOPE

The system can be improved by encasing it in a plastic covering. This would make it more compact and easy to use in a classroom setting. The system can be configured to enable lecture-wise attendance taking. It can further be improved to automatically calculate attendance percentages of students and intimate the teachers if a student's attendance is below a certain percentage. It can also be modified to fit the corporate environment.

VI. CONCLUSION

The traditional process of manually taking and maintaining student attendance is highly inefficient and time consuming. The attendance monitoring system based on biometric authentication has a potential to streamline the whole process. An Internet of Things (IoT) based portable biometric attendance system can prove to be of great value to educational institutions in this regard as it proves to be highly efficient and secure. The cost involved in making this system is quite less, when compared to conventional biometric attendance system. The use of cloud computing to store the attendance records makes all the data easy to access and retrieve as end when required by the teachers. The use of fingerprint scanner ensures the reliability of the attendance record. The system, due to its lack of complexity, proves to be easy to use and user friendly.

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