

Fingerprint based Biometric Attendance Systems – A Review

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Abstract— Attendance recording and management is very important now-a-days. It is one of the important ethics which is valued by many employers and educational institutions. Even today, many small scale companies and educational institutions are still using the paper based method for recording and maintaining attendance which is prone to manipulation and impersonation. These traditional methods of attendance recording must be replaced by biometric attendance systems. The unique nature of fingerprint makes these systems more secure. This feature of fingerprint matching makes it ideal to be used in applications such as identity management and access control. This paper reviews the problems in attendance systems used presently, its working, study of different systems, advantages and disadvantages of those systems based on important parameters.

Key words: Attendance Recording, Attendance Management

I. INTRODUCTION

Attendance recording and management is very important now-a-days. The academic performance of a student as well as the overall growth of an organization is directly related with the overall attendance of the individuals. In schools and colleges, attendance by passing the attendance paper or roll calling causes unwanted disturbance during classes and causes unnecessary waste of time. Students can also fake the attendance records of other absent students. Misplacing the attendance registers is common in educational institutes and companies. Also, it takes a very long time to go through all the paper-work and calculate the weekly/monthly/yearly attendance charts of the students or employees.

Wall-mounted RFID swipe card system uses electromagnetic waves for communication between RFID card and RFID reader. Though better than traditional system, the RFID based system has numerous disadvantages such as the system is complex, costly and students can swipe the cards of the absent students.

These problems can be solved by using biometric techniques. The word “biometric” is derived from Greek where “bios” means life and “metrics” means measurement. Biometric system identifies a person based on his unique physiology or behavior. Some of the most widely used biometric techniques include fingerprint, face, hand-vein, hand geometry, iris, retinal pattern, voice print, signature, facial thermo grams, etc. Comparison between all these techniques has shown us that fingerprint is the most reliable, mature and legally accepted technique. Therefore fingerprint based biometric systems are used in many colleges, universities and organizations for keeping track of the attendance of students and employees.

The fingerprint based biometric system has two stages: enrollment and verification. In the enrollment stage, the fingerprint is scanned and the template is stored in the memory of the device. In the verification stage, the

fingerprint sensor continuously scans for a finger press event. If a finger is placed on the sensor it checks if the fingerprint matches any of the templates in its database.

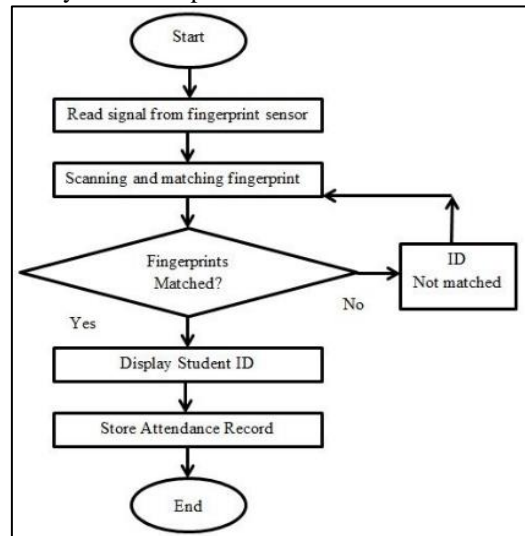


Fig. 1: Working of Fingerprint based attendance system

II. LITERATURE SURVEY

Many people have implemented fingerprint based biometric attendance systems which make use of fingerprint sensors/scanners, along with other technologies. These systems are classified based on tools and techniques used to implement the system.

A. LabVIEW

The system is designed using 8051 microcontroller, R305 optical fingerprint sensor and LabVIEW [2]. The microcontroller communicates with the computer in which LabVIEW is installed and running. LabVIEW is used in the system for storing attendance records in a text file and displaying it to the user in a tabular format. The student ID is displayed on the LCD screen after a fingerprint has been matched.

1) Advantages

- User Friendly (LabVIEW graphical interface).
- High Speed.
- Efficient and low cost embedded platform.
- Low power consumption.

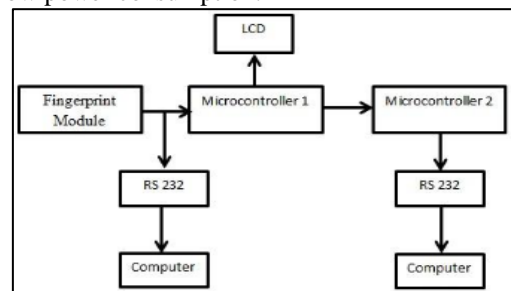


Fig. 2: Block diagram of LabVIEW based system [2].

2) *Disadvantages*

- Limited database
- Limited functionality
- Needs more than one microcontroller

B. *Internet of Things*

Internet of Things (IoT) is an interaction of devices using the internet. In this system, the hardware consists of an ARM9 processor S3C2440 board and FPS200 fingerprint sensor. The embedded Linux OS runs on the processor which supports SQLite database management tool. Along with the fingerprint biometric vein recognition is also used [3]. The system automates the attendance and login process of the grades. Real time attendance monitoring and processing is done on the cloud server.

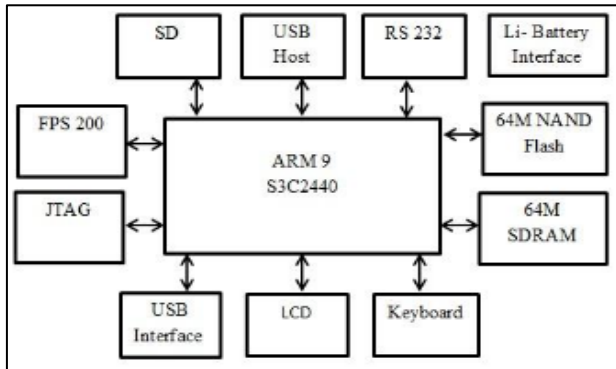


Fig. 3: Hardware block diagram for IoT system [3].

1) *Advantages:*

- More secure
- Based on IoT (most of the work is done on cloud)
- Information can be accessed anywhere.

2) *Disadvantages*

- Complex software system architecture
- High cost

C. *GSM and Zigbee*

This attendance system incorporates ARM7 based LPC2148 microcontroller, SIM900 GSM module, and 2 Zigbee modules [4].

GSM module is used to transmit all the attendance related information to the Head of the Department of a college or to the Human Resource manager of a company. In schools, parents can also receive daily updates of the attendance of their children directly via SMS.

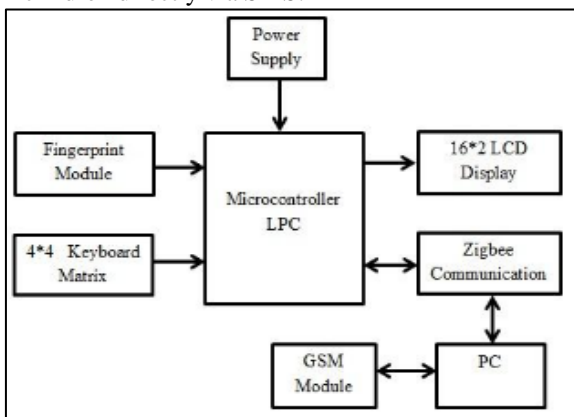


Fig. 4: GSM and Zigbee based system [4].

Zigbee uses low power RF trans-receivers to receive and transmit data wirelessly. Attendance data is transferred

from classroom attendance device to central PC via zigbee. This data is analyzed and stored in the database by an application running on the PC. Attendance system based on GSM and implemented by [5] and [6] and Zigbee based systems are implemented by [7].

1) *Advantages*

- Easy to use
- Portable (wireless)
- Low power consumption
- Functionality can be enhanced further as required

2) *Disadvantages*

- Range of zigbee is limited.
- Low data rate of Zigbee
- High cost (GSM and Zigbee)

D. *RFID and Android*

This attendance system uses RFID technology. In this system, the students have to swipe their RFID cards and press the finger on a fingerprint sensor to mark the attendance. And android application can access the system from any location and the record of any student can be checked on that application. The system can also keep track of the location of students, teachers, and other members anywhere inside the campus [8]. Student's attendance is reported to the parents via online SMS service.

1) *Advantages*

- More secure (RFID + Biometric).
- More functionality.
- System can be accessed remotely.
- Graphs can be generated based on attendance.
- RFID cards can also be used as library cards of mess cards.
- RFID cards are difficult to tamper with.
- Free online bulk SMS service can be used.

2) *Disadvantages*

- Complex software architecture.
- Need to develop an android application

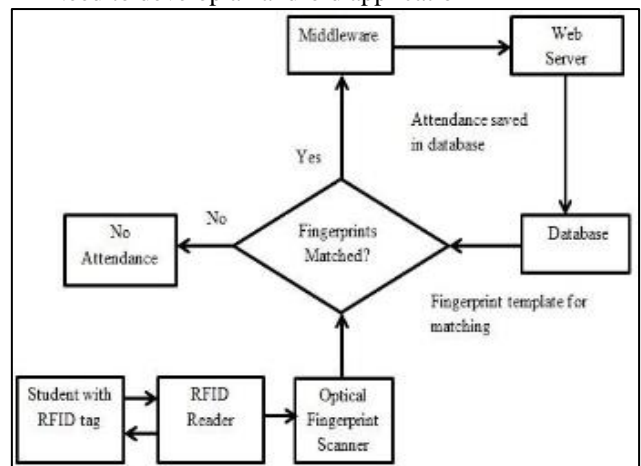


Fig. 5: Flowchart of attendance recording process

E. *Zigbee, DSP and Matlab*

This system consists of a transmission section, receiver section and an attendance monitoring terminal [9]. Transmitter section consists of an optical fingerprint sensor, BF532 DSP processor and zigbee module. Fig 7 shows the block diagram of receiver section which contains zigbee and microcontroller. Image enhancement is done in MATLAB as

shown in fig 8. MS access and Visual Basic are used to implement database. RF module can also be placed instead of Zigbee to increase the range [10].

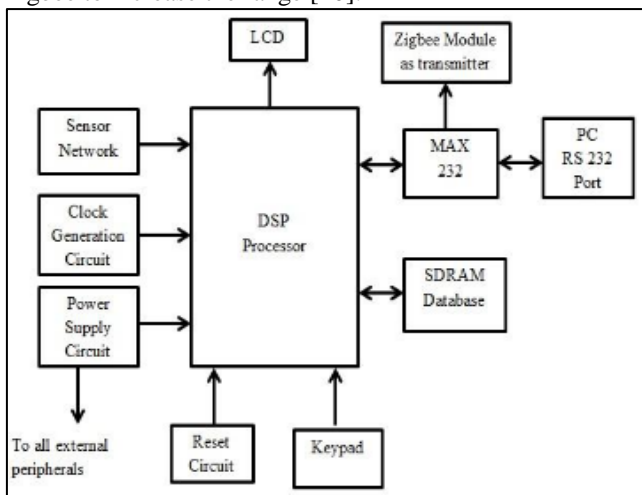


Fig. 6: Transmitter section block diagram

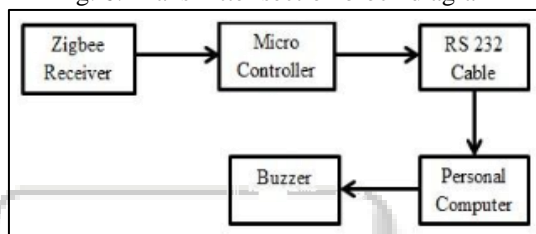


Fig. 7: Receiver section block diagram [9].

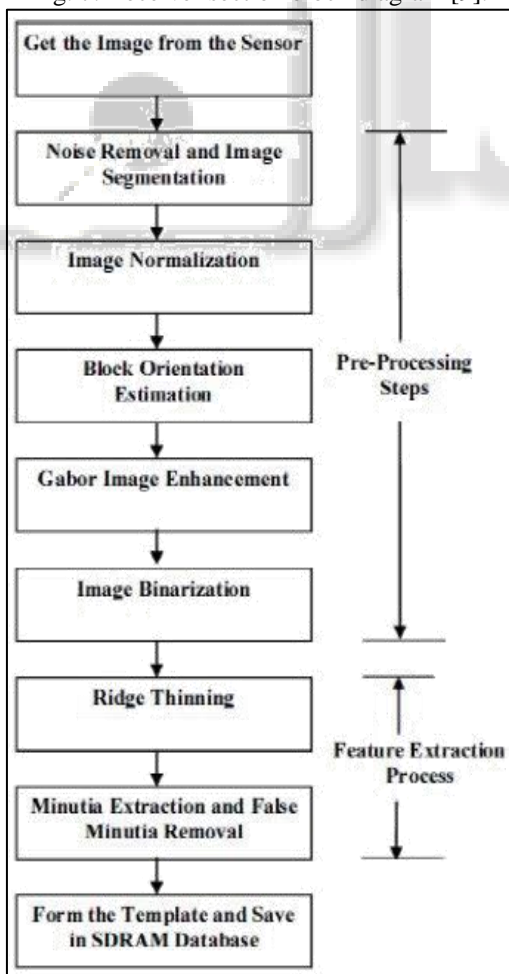


Fig. 8: Image enhancement using MATLAB [9].

1) Advantages

- Low power consumption.
- Good accuracy (Gabor image enhancement).
- Flexible user modes.
- High resolution of fingerprint sensor.
- Wireless (portable).
- Low cost.

2) Disadvantages

- Three different supply voltages required (3.3V, 5V, 12V).

F. Cryptography

A portable fingerprint attendance system is implemented using Arduino ATmega1280, ZFM20 fingerprint scanner, TFT display with resistive touch, SD card interface for storing student's records and RTC to keep track of attendance date and time. To prevent unauthorized access of data, Caesar Cipher cryptographic technique is used [11].

1) Advantages:

- User friendly design.
- Portable.
- Small size.
- Security enhancement (encryption of data).
- Faster than fixed fingerprint reader.

2) Disadvantages

- Limited battery life.
- Limited functionality.

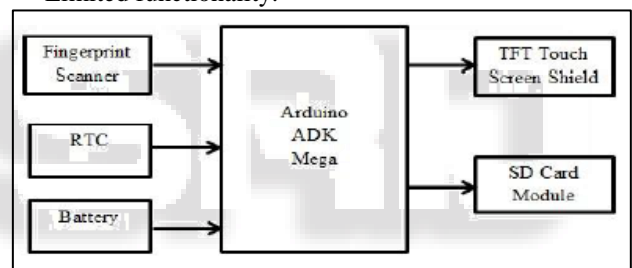


Fig. 9: Portable Attendance system [11].

G. RFID, GSM and .NET

This system consists of RFID and GSM technology for attendance management. The student's ID cards are tagged with RFID tags. When an RFID tag is swiped and the tag is verified by matching it in the database, the attendance is finalized by scanning the fingerprint of the student with fingerprint sensor. The GSM module then sends an SMS to the parents alerting them of the student's attendance. RFID transponders are installed in various parts of the campus such as classrooms, labs, staffrooms, etc. which will help in tracing the location of the students and staff. The attendance record of students and teachers can be viewed by parents by logging into a website. VB .NET is used to design the web server, whereas ASP .NET is used to design the website [12]. System using Near Field Communication (NFC) is implemented by [13]. NFC based systems have range lower than that of RFID based systems.

1) Advantages

- More Secure due to RFID and biometrics.
- System is completely automated.
- Small size of RFID cards.
- Fast processing speed.
- No line of sight required for RFID.
- Many tags can be read simultaneously.

- .net framework simplifies debugging.
- 2) *Disadvantages*
- Software design is difficult.
- System should always be kept ON.
- Costly.

III. COMPARATIVE ANALYSIS

To implement an efficient or application specific biometric system, various parameters have to be satisfied or traded-off. Some of those parameters can be high-speed, low cost, high security, etc. Many existing fingerprint sensors are compared based on various parameters such as speed of the system in recording and maintaining attendance, security of the system, power consumption, battery life, cost, portability, functionality, etc.

Parameter Technique	Speed	Security	Power Consumption	Cost	Portability	Functionality
LabVIEW	High	Moderate	Low	Low	No	Limited
IOT	High	High	Moderate	High	No	Wide
GSM, Zigbee	Moderate	Moderate	Low	High	Yes	Wide
RFID, Android	High	High	Moderate	High	No	Wide
Zigbee, DSP, Matlab	High	Moderate	Low	Low	No	Limited
Cryptography	High	High	Low	Low	Yes	Limited
RFID, GSM, .NET	High	High	Moderate	High	No	Wide

Table 1: Comparison of various attendance systems

From this comparison, we can understand that more functionality requires more complex circuit and software development. Also there exists a tradeoff between speed, power consumption, database size, memory and accuracy of fingerprint matching. This comparison table can help design a particular biometric attendance system as per the client requirement. Many other technologies can be combined to make an efficient attendance system.

IV. CONCLUSION

Biometric is a secure and reliable method for authentication. Various fingerprint based attendance systems have been reviewed. Some of these systems have been commercially developed and are widely used. Web applications, LabVIEW and GSM technology add many functionalities to the system.

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