

# **Fingerprint Based Attendance System Using LabVIEW and GSM**

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**ABSTRACT:** Attendance is one of the work ethics which is valued by most employers. In educational institutions also, attendance and academic success are directly related. Therefore, proper attendance management systems must be in place. Most of the educational institutions and government organizations in developing countries still use paper based attendance method to monitor the attendance. There is a need to replace these traditional methods of attendance recording with a more secure and robust system. Fingerprint based automated identification system based are gaining popularity due to unique nature of fingerprints. In this paper, a novel approach for fingerprint based attendance system using LabVIEW and GSM technology is proposed. Optical fingerprint module is used for capturing and processing fingerprints. Features such as recording of attendance in a text file along with the date and time of attendance are also incorporated in the system. GSM technology is used to intimate the parents about student's attendance. The proposed system is implemented in the university and its performance is evaluated based upon user friendliness, accuracy, speed, security and cost.

**KEYWORDS:** Biometrics, Fingerprint module, LabVIEW, GSM, RFID

## **I. INTRODUCTION**

The term biometrics has been derived from two Greek roots "bios" meaning life and "metrics" meaning measurement. Biometric technology uniquely identifies an individual based on certain characteristics which can be physiological or behavioural. There are mainly nine biometric techniques that are widely used including face, fingerprint, hand vein, hand geometry, iris, retinal pattern, voice print, signature and facial thermograms[1]. These techniques use data that is unique to the individual and remains so throughout one's lifetime. Fingerprints are emerging as the most popular biometrics technology due to its uniqueness, stability, permanence and ease of acquisition [2].

Impression that is left by the friction ridges of a finger is called a fingerprint. Major parts of a fingerprint are ridge, valley and minutiae. Single curved segment of a fingerprint is known as ridge. Valley is the space between two adjacent ridges. Local discontinuities in the patterns of ridges are called minutiae. These can be ridge endings or bifurcations as shown in Fig.1. Minutiae provide information about ridge-valley structures.

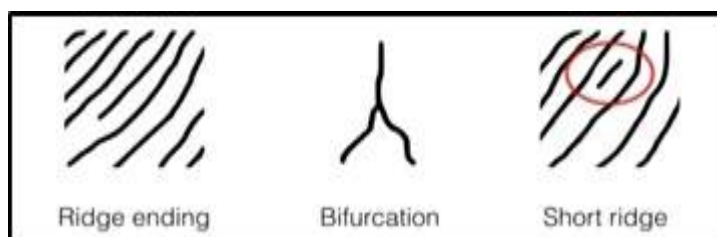


Fig.1 Ridge endings and bifurcation

# International Journal of Innovative Research in Science, Engineering and Technology

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Presently in most of the educational institutes, the attendance of students is taken by conventional method in which teacher calls the name of student and marks his attendance in a register. There are various disadvantages to this approach such as paper based attendance registers are not uploaded to any centralised system therefore the data is not available for analysis, effective lecture time gets affected due to the time taken for data collection and the system can also be cheated by students (buddy students might sign on behalf of absent students). Some universities also use wall mounted RFID swipe card systems. RFID is a wireless communication technology which uses electromagnetic waves for communication between the RFID reader and the RFID tag. RFID reader automatically collects the stored information and uniquely identifies the RFID tag. There are various problems in using RFID systems such as the system is not available in every room, teachers cannot access and analyse the attendance data and system can also be cheated by the students.

Biometrics technology can solve these problems and proposed fingerprint based attendance system would be ideal for implementation in universities for identification and also by organizations for attendance monitoring of their employees. Proposed system is designed using Arduino UNO and optical fingerprint acquisition module. There are mainly three types of fingerprint sensors:

1. **Optical fingerprint sensor:** In these types of sensors, a digital image of the print is captured using visible light. This type of sensor can be considered as a specialized digital camera. The top layer of the sensor is known as the touch surface. Below this layer, there is a layer of light emitting phosphor which illuminates the surface of the finger. Light gets reflected from the finger and reaches solid state pixels array or charged coupled device which is used to capture a visual image of the fingerprint. Optical fingerprint sensor provide a high resolution image, electrical durability and highly stable performance.
2. **Ultrasonic fingerprint sensor:** Ultrasonic sensors use principles of medical ultrasonography to create fingerprint image. Ultrasonic sensors use very high frequency sound waves to penetrate into epidermal layer of skin. Reflected wave measurements can be used to form fingerprint image. These type of sensors eliminate the need for clean and undamaged epidermal skin.
3. **Capacitive fingerprint sensor:** Capacitive fingerprint sensors use principles associated with capacitance to form fingerprint images. In this method of fingerprint imaging, the sensor array pixels act as one plate of a parallel plate capacitor and the electrically conductive dermal layer acts as the other plate. Non- conductive epidermal layer acts as a dielectric. Apple iPhone 6 also uses a capacitive fingerprint sensor.

Paper is organized as follows. Section II provides a review of work done in the field of biometric attendance systems. Proposed fingerprint attendance system using LabVIEW and GSM is described with its block diagram, working and software design in Section III. Testing of the system and results are discussed in Section IV. Finally conclusion is presented in Section V.

## II. RELATED WORK

Various approaches have been used for the implementation of fingerprint based authentication systems. A LabVIEW based system has been implemented for attendance management [3] which provides user friendly graphical interface and low power consumption. Two microcontrollers are used for hardware implementation and system has limited functionality. A novel approach using internet of things technology [4] has been used for the interaction of various devices of the attendance system. It allows for real time attendance monitoring and processing using a website. Information regarding attendance records can be obtained from the website. Additional vein recognition feature is added to make the system more secure. Major drawback of this system is the complexity involved in software development. Attendance system which uses hand geometry for identification [5] is less secure as compared to fingerprint based system. A system which combines biometrics technology with RFID has also been implemented [6]. Student has to swipe RFID card along with his fingerprint to mark the attendance. An android application is

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

developed through which system can be accessed from any remote location and attendance record of any student can be checked. The system can detect the current location of faculties, students, and other members within the campus. A portable attendance system is proposed using ZigBee wireless technology [7]. The system comprises of transmitter section, receiver section element and attendance supervision terminal. Digital signal processor makes the processing faster. Drawbacks of such a system are high cost and low range of ZigBee module. ZigBee module can be replaced by low cost wireless doorbell for transmission of user information [8]. RF module can be used to transmit the data as it has higher range than ZigBee module [9]. GSM technology can be integrated into the system for intimating parents about student's attendance [10]. Attendance of student can also be communicated to respective authorities [11]. Graphics processing unit can be used for large databases [12]. Cryptographic security is added to the attendance system so that data cannot be manipulated by unauthorized user [13]. System using NFC (Near Field Communication) has been implemented [14] but NFC based system has lower range than RFID based systems. RFID and GSM technology are integrated to design a system with more security and functionality [15]. Implementation of efficient biometric attendance system requires certain parameters to be satisfied such as high speed, high security, low cost, low power consumption and easy software development. More functionality requires more complex circuit and complex software development. Existing fingerprint based attendance systems are compared based on these parameters. Embedded system platform with software development using LabVIEW appears to be promising for the implementation of Fingerprint based authentication system because of relative simplicity of the hardware and software development. GSM technology can be used to add more functionality to the system.

## III. SYSTEM DESIGN

### A. Block Diagram

Based upon comparative analysis of the existing attendance systems, a novel system of attendance management using LabVIEW and GSM technology is proposed. Block diagram of the proposed attendance system is shown in Fig.2.

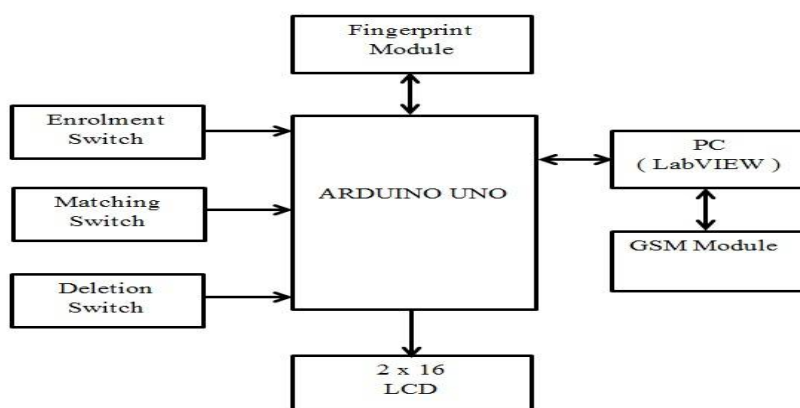


Fig.2 Block diagram of fingerprint based attendance system

Different blocks of the system are explained below:

**1. Arduino UNO:** Arduino UNO is the brain of the whole system. It is based on ATmega328P 8 bit AVR microcontroller. It is powered up via USB cable. Programming of Arduino UNO is done using Arduino IDE software. Peripherals such as fingerprint module, switches and LCD are interfaced with Arduino. Input to Arduino UNO is from switches and output is displayed on LCD.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

**2. Fingerprint module:** Optical fingerprint sensor R305 is shown in Fig.3.



Fig.3R305 fingerprint module

It is used for capturing and processing of fingerprints. There is a high powered DSP chip inside the module. Fingerprint module has the capability of saving large number of IDs. New fingerprints can be enrolled in on-chip flash memory of the module.

**3. Switches:** Three push button switches are used for selecting different operating modes of the system. These switches are:

**a) Enrolment switch:** Enrolment switch is used for enrolling different IDs in the system. This switch is used each time a new fingerprint is to be stored. For each fingerprint, a template is created and stored in the memory of fingerprint module. Different users correspond to different template in the memory.

**b) Matching switch:** Matching switch is used when a student marks his/her attendance. When this switch is pressed, the system enters verification mode. Fingerprint which is captured in this mode is converted into a template and this template is compared with all the templates in the memory of fingerprint module. If a match is found, student's attendance is marked and his/her ID is displayed on LCD.

**c) Deletion switch:** Deletion switch is used for deleting the template or stored fingerprint of a particular user. If a new fingerprint is stored against the same ID, then previously stored template is automatically deleted or overwritten.

**4. LCD:** LCD is the user interface of the system. 2x16 JHD162A LCD is used. Different modes of operation such as enrolment of new IDs, marking attendance and deletion of IDs are displayed on LCD.

**5. PC:** Arduino IDE and LabVIEW are installed on PC. New fingerprints are enrolled into the system by entering IDs through serial monitor. Similarly IDs can be deleted using serial monitor. Different stages which the system undergoes while in use are also displayed. The main use of LabVIEW in the system is for generating report of attendance in a text file. Serial data is also displayed on LabVIEW front panel.

**6. GSM module:** SIM 300 is a GSM/GPRS module that works on three frequencies 900 MHz, 1800 MHz and 1900 MHz and requires a +12V supply. There are two LEDs on the board. One is power LED and the other is network LED. Power LED turns ON when SIM card is inserted into the slot and module is powered up. After few seconds the network LED starts blinking at 3 seconds interval. Coding of GSM module is done in LabVIEW. GSM module is used to send SMS to the parents that their ward has reached the college when student marks his/ her attendance.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

## B. Working

Working of the proposed attendance system is depicted in the flowchart shown in Fig.4.

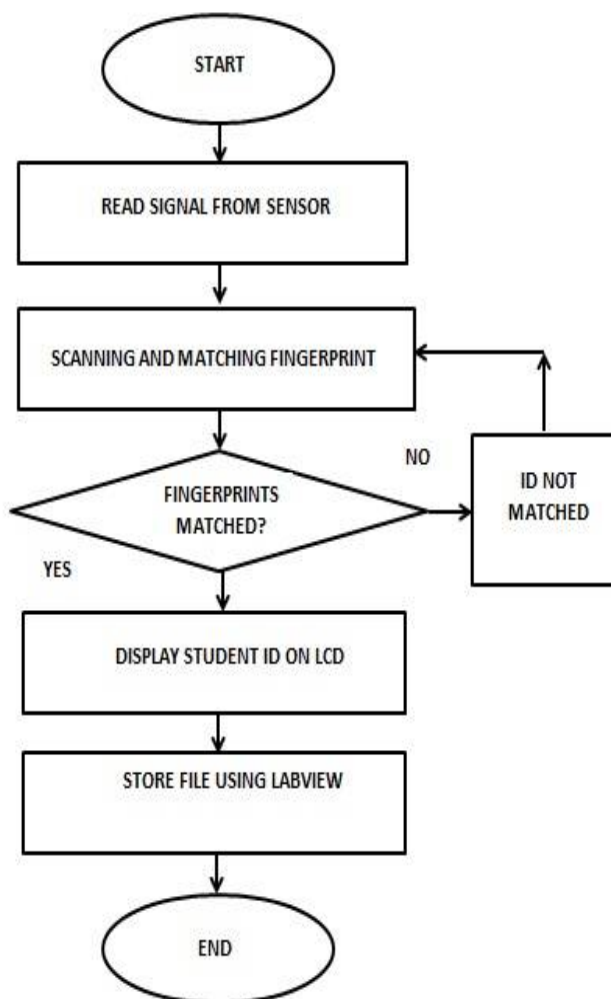


Fig.4 Working of fingerprint based attendance system

Firstly image acquisition is done using fingerprint module. Captured fingerprint is then compared with the templates of fingerprints stored in the memory of fingerprint module. If the fingerprints are matched, corresponding ID is displayed on LCD and also on the graphical user interface of Arduino IDE and LabVIEW. Finally the attendance record is stored in a text file using LabVIEW.

## C. Software design methodology

Proteus design suite, Arduino IDE and LabVIEW development environment are used for software implementation of the system. Proteus software is used for simulation of circuit before it is actually implemented in hardware. The Arduino Integrated Development Environment or Arduino Software IDE is used to write program for Arduino UNO. LabVIEW code is written to store text file of attendance and sending SMS using GSM module. Two COM ports of PC are used in the system for Arduino UNO and GSM module respectively. Serial communication between Arduino and PC is displayed in LabVIEW front panel along with the serial monitor of Arduino IDE. Text file where attendance

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

record is to be saved is specified in the front panel window of LabVIEW. Attendance record is stored in a text file along with date and time of attendance.

## IV. IMPLEMENTATION AND RESULTS

Different steps involved in testing the system for its proper operation are as follows:

Attendance system is switched ON by supplying power to Arduino board via USB cable. Fig.5 shows the system after it is switched ON.

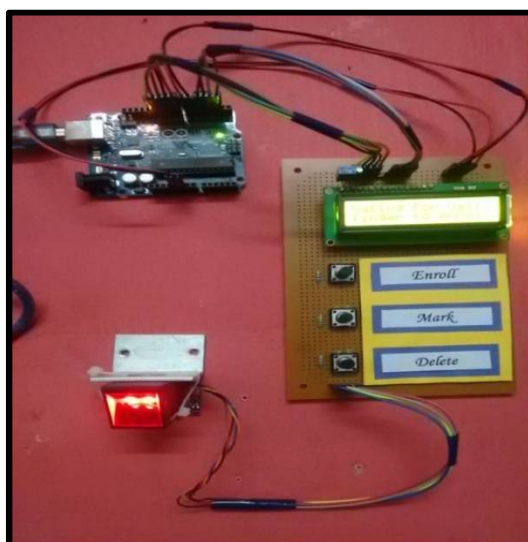


Fig.5 Switching ON the attendance system

Three modes of operation can be selected from the switches. These are enrolment of new ID, marking attendance and deletion of existing ID as shown in TABLE I. A text file as depicted will contain all the records of a student's attendance. Student's attendance percentage can be calculated with the help of this text file. When a student marks attendance, SMS is sent to parents that their ward has reached the college.



# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

TABLE I Enrolment of a new ID

Steps	Description	Output on LCD
<b>Enrolment of new ID</b>	Open Arduino IDE serial monitor. Press the “Enroll” switch	Type the ID no. to enroll
	Enter the ID no. using keyboard	Waiting to enroll finger
	Place the finger on fingerprint module twice	ID 1 Stored!
<b>Marking attendance</b>	Open LabVIEW front panel. Press the “Mark” switch	Waiting for Attendance !
	Place the finger on fingerprint module	Roll No.#1 Present
<b>Deletion of existing ID</b>	Open Arduino IDE serial monitor. Press the “Delete” switch	Delete the ID No...
	Enter ID no using keyboard	Deleting ID # 5
		Deleted !

Performance of the system is evaluated based upon user friendliness, accuracy, speed, security and cost. To evaluate these parameters, fingerprints of 10 students were enrolled into the system. After enrolment, attendance is marked .If fingerprints are matched, roll number of the student is displayed on the LCD. Time taken by the system for the whole process of marking the attendance is also recorded.

System provides inaccurate results in rare cases which can be due to improper alignment of finger on fingerprint module, finger might be oily, dirty or wet or there may be skin problem. Finger might be placed for a very short time such that fingerprints are not properly captured. Results are summarized inTABLE II.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 7, July 2016

**Table II:**Summary of results

Parameter	Performance evaluation
<b>User friendliness</b>	System has user friendly interface with provision of entering the data from switches and keyboard. Different stages of operation of the system are clearly displayed on LCD screen as well as on PC. Therefore system, as a whole is simple and easy to use.
<b>Accuracy</b>	Results show that the system can achieve 100 % accuracy. False acceptance rate of the system is around 0.001% and false rejection rate is less than 0.1%. In normal practice, accuracy is between 90-95 %.
<b>Speed</b>	Speed is a measure of system's response time. Time taken to record attendance of 10 students comes out to be 49 seconds. Therefore average time for marking attendance is approximately 5 seconds making it more suitable to use in colleges and organizations as compared to schools.
<b>Security</b>	Biometric technology makes the system secure. It is difficult for an imposter to fool the system.
<b>Cost</b>	The prototype is designed at a cost of INR 5000. Therefore the system can easily be implemented in colleges and organization as a low cost solution to attendance management.

## V. CONCLUSION

Biometric technology is an efficient tool to detect fraud and verify identity and. The prototype of fingerprint based attendance system using LabVIEW and GSM system is implemented. It provides a simple and cost effective method of attendance monitoring in organizations and educational institutions as compared to traditional methods of attendance management. The system is also user-friendly as manipulation and retrieval of data can be easily done through graphical user interface. After enrolment of new IDs in the system, the whole process of marking the attendance is automated. It is concluded that using fingerprint based attendance systems provides high security and accuracy than conventional attendance system. Most importantly implementation of such a system will help in saving the trees which are cut rapidly due to ever increasing demand of papers. The proposed system can be made wireless by using a high range and low cost wireless technology to transmit the attendance data to a centralized server. A mobile application or a website can be assigned to access the system remotely. System can be modified to generate the attendance performance graph of students automatically.

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Vol. 5, Issue 7, July 2016

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