IMPLEMENTATION OF AN INTELLIGENT ATTENDANCE SYSTEM

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Abstract

In an event of large gatherings especially in institutions, the need for taking attendance is of high importance. The conventional method of marking students' attendance involves the students writing and signing their names on a sheet of paper. This method is time-consuming; the register may get lost and the possibility of students signing for their friends who are absent is very high. The need to replace this manual and conventional method with a biometric attendance system is highly significant. This paper presents a biometrics and temperature scanning system that uses a fingerprint scanner, microcontroller, temperature sensor, and display to enroll, authenticate and store the fingerprint records of individuals, display room and students' body temperatures and save the attendance record in the memory of the device for future reference. When the system was deployed for use, it was able to record the attendance of 20 students in less than three minutes. This translates to a significant reduction in the amount of time spent using the conventional pen and paper method.

Keywords: Attendance, Biometrics, Temperature scanning system, Fingerprints, Sensor.

Introduction

Attendance and punctuality are integral parts used in the evaluation of students' and employees' performances. Conventionally, this is usually obtained by signing the attendance register for the period under consideration. Some of the disadvantages of this method according to(Walia & Neelu, 2016); (Zainal et al., 2014) include more time consumed while signing the register, manipulation of the attendance, time taken in collecting the record for a specific period, and the tendency of losing records due to rain and fire hazard, etc. Although this increases the student-teacher relationship, however, its shortcomings are more.

Fingerprint as one of the biometric techniques is a unique identity that can be utilized to facilitate faster attendance records and avoid manipulation of records. It is a reliable and widely accepted technique(Fahad-Bin-Mazhar et al., 2016). It provides the solution to these shortcomings listed above.

In the work of (Jain et al., 2020), they utilized a Wi-Fi-based microcontroller(NodeMCU) coupled with a fingerprint scanner to accomplish the task. This system was done in such a way that once the scanner recognizes the student via their fingerprint, it sends the captured attendance to the remote server using Wi-Fi and this can be extracted and viewed anytime any day.

Rohini et al., (2021) looked at the various means of attendance systems and drew a comparison between these means. The various means compared were Manual attendance, Radio Frequency Identification (RFID), Fingerprint Scanner, and the Face Recognition system. The comparison was drawn based on cost, time, security, monitoring data, and how easy to use.

Another system of attendance taking was proposed by (Naen et al., 2021). This system was made up of a fingerprint scanning device and a Convolutional Neural Network (CNN). The CNN is used to track the students' contactless attendance. If the fingerprint detector cannot detect the finger that has been scanned, with CNN, it can find data that closely match the finger feature.

The work in (Ujan & Ismaili, 2011) elucidates the use of an ARM LPC 2148 processor together with a Zigbee transmission and receiving module. The Fingerprint module identifies the already enrolled fingerprint and the Zigbee sends this image to the computer.

Furthermore, Patil et al., (2016) proposed an intelligent fingerprint attendance system that comprises a fingerprint module, Voice IC, and a GMS module. The work was done such that a failed attendance system requires a text message to be sent to the parent's phone number and if the student is missing in class for more than two days, a voice

call will be sent to the parent's phone number. Under either event, where an invalid person enters a fingerprint, the fingerprint is shown on the liquid crystal monitor as unmatched.

An IOT- based attendance system was proposed to be used by every individual at Cross River University of Technology (CRUTECH). This was proposed by Prince et al.,(2022) and in their work, they suggested the use of ESP 32 microcontroller, 0.96" OLED display, and R305 fingerprint module. They included that the website user interface (UI) was developed using PHP, CSS, and JavaScript.

This paper utilizes a fingerprint scanner and a microcontroller as major components for the unique identification of students' presence and a temperature sensor to quickly alert students of their health status. The biometric process includes enrollment, verification, and confirmation. Afterward, the student also goes through a temperature scanning process which is achieved using the Mlx90614 ESF-BAAA sensor.

Methodology

The block diagram of the fingerprint attendance and temperature scanning system (FAATSS) is shown in Figure 1. The system consists of five blocks; the power supply unit, which is designed to supply 12 V to the microcontroller, the fingerprint module which captures the unique fingerprint of students, the temperature sensing module for measuring body and ambient temperature and the microcontroller which does the major work of collecting data from the connected devices and coordinating the operation of the system.

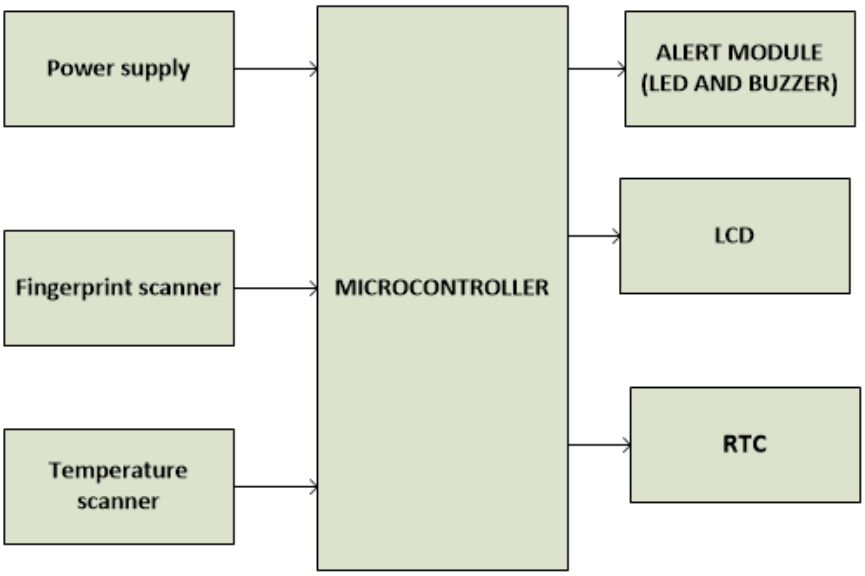

Fig. 1: Block diagram of the system

The fingerprint attendance and temperature scanning system (FAATSS) were designed to enroll and record students' attendance as well as sense their temperature. If it is within the normal temperature range considered in the design the system displays and shows the time and date of the temperature check. The note pad document of the attendance record obtained from the FAATSS is shown in Figure 2 and the schematic diagram of the system developed is shown in Figure 3.

*fingerprint data - Notepad

File Edit Format View Help

```
Found ID #12
Room Temp = 27.65
Object Temp = 28.89

Found ID #2
Room Temp = 27.63
Object Temp = 27.85

Found ID #20
Room Temp = 28.33
Object Temp = 27.79

Found ID #6
Room Temp = 28.09
Object Temp = 31.77

Found ID #13
Room Temp = 27.87
Object Temp = 32.89

Found ID #1
Room Temp = 27.39
Object Temp = 27.63
```

Fig. 2: Temperature sensor display.

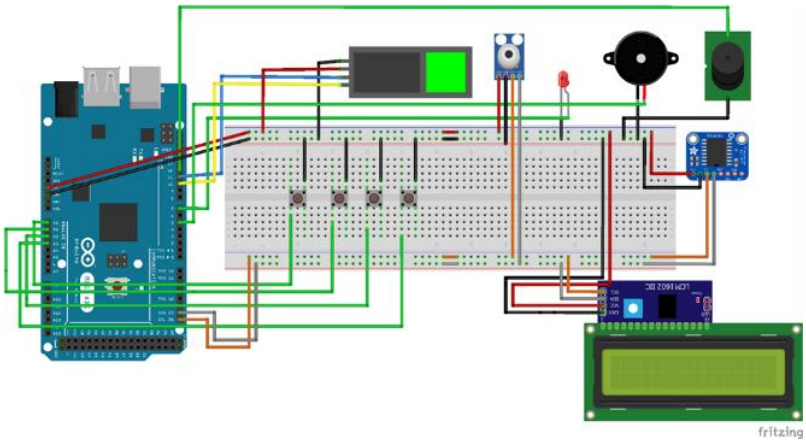

Fig. 3: The schematic diagram of the FAATSS

Power Supply

A power supply is an electrical device that supplies electrical power to an electrical circuit and/or load. The power supply chosen for this project is 12 V. This is because the Arduino MEGA ADK uses 12 V as its input power supply. The power supply circuit is shown in Figure 4. 240 V AC is stepped down to 12 V DC using the LM7912 and is further regulated to the exact 12 V needed after passing through the filtration process. This is shown in Figure 4.

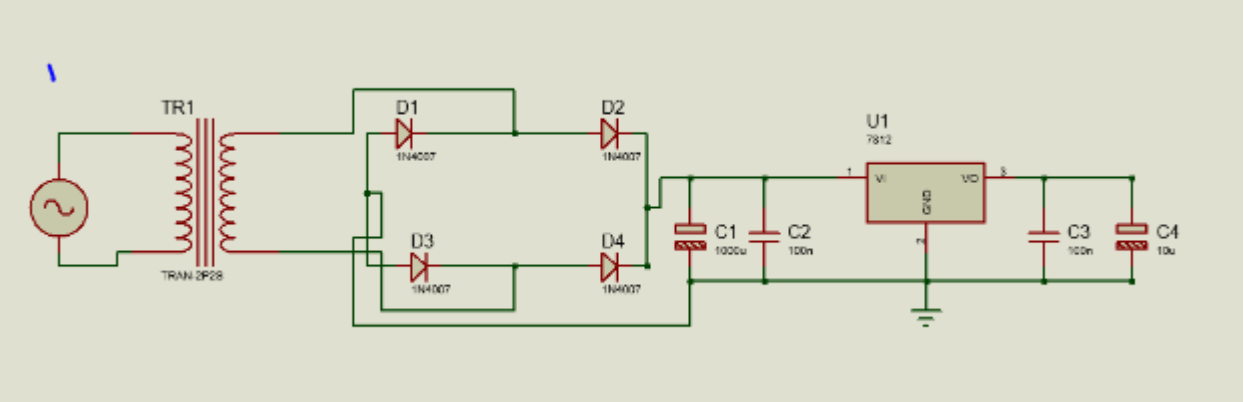

Fig 4: Power Supply Process.

Arduino MEGA ADK

MEGA ADK is a microcontroller board based on the ATmega2560. It has a USB host interface to connect with Android-based phones, based on the MAX3421e IC. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, and a power jack, an ICSP header, and a reset button. In this project, the PINS A0, A1, A2, and A3 were connected to the push buttons used for registering attendants, where A0 serves as REG/BACK, A1 serves as DEL/OK, and A2 serves as UP, A3 serves as DOWN. The PINS 10 and 11 were connected to the fingerprint module with is used to get attendants' biometrics. The PINS 20(SDA) and 21(SCL) were connected to the liquid crystal display, Mlx90614 sensor, and DS3231 sensor which is used for I2C communication. The PIN 7 was connected to the LED used for the identification of fingers. The PIN 5 was connected to the buzzer used for confirming the identification number of the attendant. The PIN 12 was connected to a buzzer used to alert if the attendant temperature is below or above the normal temperature range. Figure 5 shows an Arduino MEGA.

Fig 5: Arduino MEGA ADK

Fingerprint Sensor

An optical fingerprint sensor was used to capture a photo of our finger ridges and it uses certain algorithms to match it with stored data and displays the result of the same stored data consisting of four pins: VCC, GND, TX, and RX. TX is used for transmitting data to the Arduino and RX is used for receiving data from the Arduino. Figure 6 shows the fingerprint sensor.

Fig. 6: Fingerprint Sensor

Mlx90614 Sensor

Mlx90614 is a contactless infrared (IR) digital temperature sensor that is used to measure the temperature of a particular object ranging from -70 degrees Celsius to 382.2 degrees Celsius. It consists of four pins: VCC, GND, SCL, and SDA. It uses IR rays to measure the temperature of the object without any physical contact and communicates to the microcontroller using the I^2C protocol. This is shown in figure 7.

Fig. 7: Temperature Sensor

Liquid Crystal Display

Liquid Crystal Display (LCD) serves as a user interface for the Arduino. It is an excellent way for a microcontroller to present visible information to users. It consists of four pins: VCC, GND, SCL, and SDA. It communicates to the controller using the I^2C protocol.

DS3231 Sensor

DS3231is used with the Arduino to keep track of time and date. It incorporates a battery input, which maintains accurate timekeeping when the main power to the device is interrupted. It consists of four pins: VCC, GND, SCL, and SDA. It communicates to the controller using the I^2C protocol.

Buzzer

A buzzer is an audio signaling device with is used to alert the system users for different purposes. It consists of two pins which are VCC and GND.

Results

A total of five enrolled users were used to test the performance of the system. Ten attempts were made by each registered user; this is an effort to test the sensitivity of the system in recognizing the enrolled users. The success rates recorded by users were shown in Table 1. The time spent was also recorded

Table 1: Success Rate of Fingerprint Sensor

User_ID	No. of success (%)	No. of failure (%)	Average response time (s)
ST1	90	10	2.28
ST2	90	10	2.26
ST3	80	20	2.20
ST4	100	0	2.23
ST5	90	10	2.30
Average	90	10	2.254

The accuracy of the readings of the temperature sensor utilized in this work was also tested by comparison with the readings of a clinical thermometer. Table 2 gives the results of the temperature readings of the five students in comparison to the clinical type thermometer.

Table 2**:**readings of MLX 90614 versus thermometer

User_ID	MLX90614 temperature sensor	Thermometer Reading
ST1	35.52	36.6
ST2	35.63	36.2
ST3	35.75	36.5
ST4	35.63	36.3
ST5	35.49	36.5

Discussion

With the fingerprint module and the temperature scanner powered on, the system became ready to be used. The LED light and buzzer came on for the process to begin. Once the student places the registered finger on the fingerprint module, it automatically confirms the finger ID and takes a reading of the student's temperature simultaneously which displays on the LCD. If the temperature is less than or greater than the value expected, the buzzer alerts.

The result as shown in Table 1 of the success rate of the fingerprint shows that five users were used in testing the workability of the biometric fingerprint scanner. There were 10 attempts each and from the test results, there is an average of 90% success rate, 10% failure rate, and an average of 2.254 s response time

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For the comparative analysis of the accuracy of the MLX-90614 temperature sensor against the clinical thermometer used, the test results presented in Table 2 shows an average of 95.84 % accuracy and 4.64 % error of the temperature scanner used in this work.

Conclusion

The biometric system has been proven to be simpler, easier, faster, and more user-friendly. Its usage will increase the reliability and performance of the attendance system. It is a system that is designed to overcome the shortcoming of the manual attendance system. The system designed is a hybrid one that apart from detecting and confirming a registered fingerprint, also measures the temperature of the student. With this system commercialized, it saves the stress of keeping an attendance register and also keeps track of the user's body temperature. This system is premised on the fact that each individual has an inimitable fingerprint from which he can be identified quickly. Even identical twins have distinct fingerprints.

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