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## **DESIGN AND CONSTRUCTION OF A MICROCONTROLLER BASED FINGERPRINT ATTENDANCE SYSTEM WITH WIRELESS TECHNOLOGY**

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### **Abstract**

*The application of biometric recognition in personal authentication enables the growth of this technology to be employed in various domains. The implementation of biometric recognition system can be based on physical or behavioral characteristics, such as iris, voice, fingerprint and face. Currently, the attendance tracking system based on biometric recognition for education sector is still underutilized, thus providing a good opportunity to carry out interesting research in this area. As evidence in a typical classroom, educators tend to take the attendance of their students by using conventional methods such as by calling out names or signing of an attendance sheet. In this work, design and construction of a microcontroller based fingerprint attendance register was successfully carried out using Arduino ATmega, WiFi Module, Real Time Counter, Storage Data Card Module, Keypad and the Thin- Film-Transistor (TFT) display unit as hardware components. Application Program Interface (API) and C++ were used as the software components. Four individual scanned fingers were matched with the four digits Identity (IDs) numbers and stored in the database. The routine attendance process displayed 'Registered' for matched scanned fingers of users with their IDs while an 'Error' for unregistered user. From the design perspective, only the authorized or otherwise called the registered users (attendees) who were enrolled in the database were allowed to sign-in for attendance. The results for the four enrolled individuals showed 'registered' status while the fifth un-enrolled individual showed an error message. Implementation of this proposed work definitely would reduce the chance of impersonation and buddy signing apart from having timely and comprehensive attendance register.*

**Keywords:** *Arduino, WiFi, TFT, Keypad*

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## **INTRODUCTION**

Attendance management is the act of managing attendance or presence in a work setting to minimize loss due to employee downtime. Attendance control has traditionally been approached using time clocks and timesheets, but attendance management goes beyond this to provide a working environment which maximizes and motivates employee attendance (Paul and Vanessa, 2008). The benefit of this application in an educational institute or organization cannot be overemphasized. The fingerprint recognition and verification technique has been adopted to replace the conventional method as it saves time and eliminates all the set-backs identified with the attendance register booklet (Ezeoba & Ogherowho, 2016).

Biometrics technologies verify identity through characteristics such as fingerprints, faces, retinal patterns, palm prints, voice, hand-written signatures, and so on. These techniques, which use physical data, are receiving attention as a personal authentication method that is more convenient than conventional methods such as a password or ID cards because it uses data taken from measurements and such data is unique to the individual and remains so throughout one's lifetime.

To make the identity management system more secure and reliable for authentication, biometrics data and wireless technology are integrated in the attendance management systems. Successful implementation of this project mean the staff's attendance credibility can be queried or put to test anytime, and result are produce fast and accuracy, without stress.

## **LITERATURE REVIEW**

Anuradha *et al.*,(2018 ) presented a design on fingerprint based attendance monitoring system using android application. This system employed the use of android application platform, keypad module and fingerprint module for enrolment an authentication. Keypad was connected to system and it was used to enter data such as name & roll number, while fingerprint module was used to scan the fingerprint of students. Then android application created on mobile phone gave access to teacher which was readable/writeable, while student access was to read only. When student scanned the fingerprint, the information related to identity, attendance report and other information were displayed on the screen of phone. Later, data could be updated on server automatically and monthly report generated. If a student has attendance below 75% then report will be sent to registered parent's mobile number. Also, the stored data can be used to generate identity data report whenever needed.

Farzad (2012) presented a design on a location based time and attendance monitoring system. This system employed four hardware and software components described as

follows; The smartphone was built-in with a GPS receiver, which could receive radio signals from GPS satellites, respectively. The Google maps Application Programming Interface (API) was used here for finding personal meaningful location; based on the GPS readings, the application performed geo-locationing to estimate the current location of the user. Then the application sent the location and user ID to Time and Attendance Management Software for further process. After processing the data, the management software stores the required data.

Tushar *et al.*, (2020) presented a design on Fingerprint Based Attendance Monitoring System. In this project the Fingerprint Sensor (R307) was used to sense the fingerprint of a particular person; a buzzer and Led gets activated whenever a person placed his finger on the sensor. Then the fingerprint was stored in cloud with identity number. Many people can store their fingerprints. Then next time any person puts their finger on the sensor it checked whether there were any matching fingerprints or not. If fingerprint matched with any of the stored fingerprints, then the LCD display showed the identity of the person, time & date of checking. In this model, all the fingerprints were stored each and every time someone placed his finger. User can connect the system wirelessly with the cloud and monitor the process. When the application was running on the computer, data sent by R307 fingerprint module was received and stored on the cloud; and displayed in serial monitor and 16 by 2 LCD display module.

## METHODOLOGY

This project was implemented using two basic components namely; software and hardware. The software component was developed using the C++ programming language while Thinkspeak was used for the cloud storage. On the other hand the Hardware component involved integrating the hardware devices that include the Power Supply, Arduino ATmega, WiFi Module, Real Time Counter, Storage Data Card Module, Keypad and the Thin- Film- Transistor (TFT) display unit. The block diagram showing the integration of the hardware is shown in Fig.1

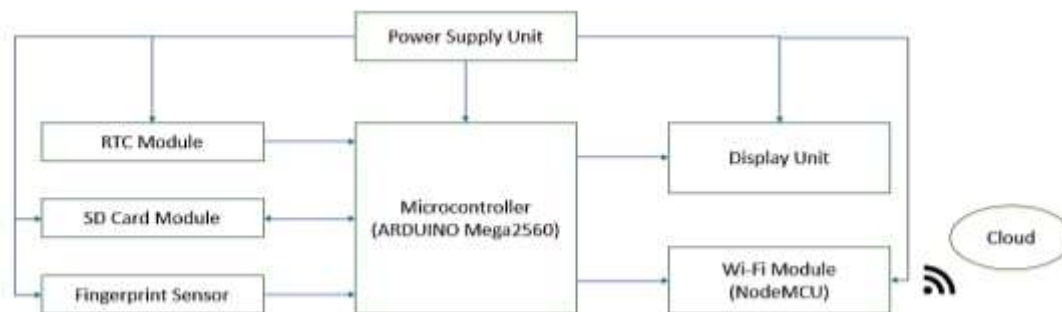


Fig. 1: Hardware Block diagram for Microcontroller Based Finger Print Attendance System

The software implementation was done according to the following steps;

1. Flow chart was designed based on how the system works as shown in Fig.2
2. The computer program for the system was developed using Arduino IDE and uploaded to the microcontroller using the Arduino ATmega development board. The program source code is shown in the Appendix I.

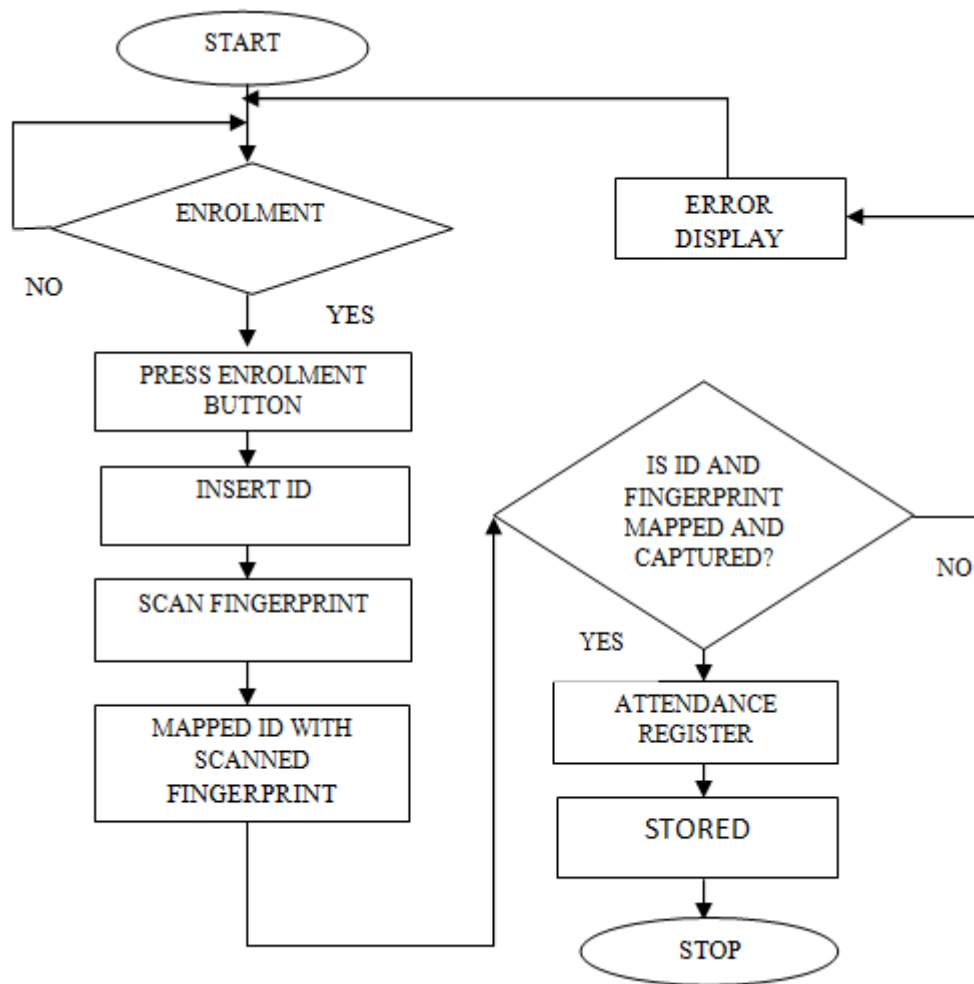


Fig. 2: Flowchart for Microcontroller Based Finger Print Attendance System

### Operational Procedure

With reference to Fig.2, the proposed attendance system consists of the enrollment and the routine attendance processes. The enrolment was meant to

store the biometric data of intended people (staff, students and so on) in the attendance database system. This was done by scanning any of the fingers and putting corresponding four digit identity (ID) code using the TFT and Keypad systems respectively. In this way, each scanned finger was mapped onto the corresponding ID code and stored in the database. During the routine attendance process, the scanned finger (s) was compared with the already stored data to find whether it matched or not. If it matched, the system showed ‘user registered’ and the individual logging details were stored and display. On the other hand if no matching is found, the system would ask for enrollment.

## RESULTS AND DISCUSSION

### Results

The results for enrollment and routine attendance for the proposed system are shown in Tables I and II respectively. Fig. 3 showed the logging detail for user 3.

Table I: Fingerprint Module Test Result Table for Enrollment

	User 1	User 2	User 3	User 4
<b>Place finger</b>	ID1	ID2	ID3	ID4
<b>Fingerprint</b>	matched	matched	matched	matched
<b>TFT</b>	stored	stored	stored	stored

Table II: Fingerprint Module Test Result Table for Routine Attendance

	User 1	User 2	User 3	User 4	Unregistere
<b>Place</b>	ID1	ID2	ID3	ID4	No ID
<b>Fingerprin</b>	matched	matched	matched	matched	No match
<b>SD card</b>	Registere	Registere	Registere	Registere	Error



Fig. 3: Logging details for attendee User 3

## Discussions

The enrolment process registered the intended attendees User 1, User 2, User 3 and User 4 with identities ID1, ID 2, ID 3 and ID 4 respectively. The individual scanned finger was matched with the ID and stored in the data base as shown in Table1. The routine attendance process displayed 'Registered' for matched scanned fingers of users with their Ids while an 'Error' for unregistered user as shown in Table II. Querying the logging details of User 3 showed the logging details which comprised of the date and time of registering the attendance.

## CONCLUSION

The design and construction of a microcontroller based fingerprint attendance system with wireless technology was successfully conducted. From the design perspective, only the authorized or otherwise called the registered users (attendees) who are enrolled in the database are allowed to sign-in for attendance. Therefore, it could be concluded that the proposed fingerprint based attendance monitoring system would be a better alternative to use in staff, students or other areas of applications like banks and so on where attendance is of utmost importance. This definitely would reduce the chance of impersonation and buddy signing apart from having timely and comprehensive attendance register.

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## APPENDIX I: THE PROGRAM

```
#include "Thingspeak.h"
```

```
#include ESP8266WiFi.h>

char ssid[] = "YOUR SSID";
char pass[] = "SSID PASSWORD";
WiFiClient client;
unsigned long myChannelNumber = YOUR CHANNEL ID;
const char * myWriteAPIKey = "YOUR CHANNEL WRITE API KEY";
String Final = "";
String Date = "";
String Enter = "";
String Exit = "";
String Name = "";
String WT = "";
void String_Analyze(String input) {
  int index1, index2, index3, index4;
  index1 = input.indexOf('*', 0);
  index2 = input.indexOf('*', index1 + 1);
  index3 = input.indexOf('*', index2 + 1);
  index4 = input.lastIndexOf('*');
  Name = input;
  Date = input;
  Enter = input;
  Exit = input;
  WT = input;
  Name.remove(index1);
  Date.remove(index2);
  Date.remove(0, index1 + 1);
  Enter.remove(index3);
  Enter.remove(0, index2 + 1);
  Exit.remove(index4);
  Exit.remove(0, index3 + 1);
  WT.remove(0, index4 + 1);
}
void Get_String()
{
  while (Serial.available()) {
    Final = Serial.readString(); // read the incoming data as string
    //Serial.println(Final);
  }
}
void setup() {
  Serial.begin(9600);
  WiFi.mode(WIFI_STA);
  Thingspeak.begin(client);
  pinMode(LED_BUILTIN, OUTPUT);
  digitalWrite(LED_BUILTIN, HIGH);
}
```

```
void loop() {
  if (WiFi.status() != WL_CONNECTED) {
    //Serial.print("Attempting to connect to SSID: ");
    // Serial.println(ssid);
    while (WiFi.status() != WL_CONNECTED) {
      WiFi.begin(ssid, pass); // Connect to WPA/WPA2 network. Change this line if using open
or WEP network
      Serial.print("0");
      delay(5000);
    }
  }
  digitalWrite(LED_BUILTIN, LOW);
  //Serial.println("\nConnected.");

  Get_String();
  String_Analyze(Final);
  if (!Final.equals(""))
  {
    Thingspeak.setField(1, Date);
    Thingspeak.setField(2, Name);
    Thingspeak.setField(3, Enter);
    Thingspeak.setField(4, Exit);
    Thingspeak.setField(5, WT);

    int x = Thingspeak.writeFields(myChannelNumber, myWriteAPIKey);
    if (x == 200) {
      delay(100);
      Serial.print("1");
    }
    else {
      delay(100);
      Serial.print("0");
    }
    delay(17000);
    Final = "";
  }
}
```