

**DESIGN AND IMPLEMENTATION OF A SMART ATTENDANCE REGISTER**Abubakar Attai Ibrahim¹, Kpochi Paul Kpochi², Eiyike Jeffery Smith³¹Department of Electrical and Electronics Engineering, University of Agriculture, Makurdi, Nigeria²Department of Electrical and Electronics Engineering, University of Agriculture, Makurdi, Nigeria³Department of Electrical and Electronics Engineering, University of Agriculture, Makurdi, Nigeria

Abstract — This project provides the design method of a smart attendance system using wireless technology. A smart attendance register helps organizations and institutions keep track of students or workers attendance to lectures or work in an easy and effective manner. The project comprises two major processes viz; the Registration and Verification processes. The main component used in this project was a wireless fingerprint device. A My Structured Query Language (MySQL) Database was developed with extended graphic user interface using Microsoft visual studio 2015 to store student information, view and analyze student attendance. The result shows that this automated attendance system has advantages over other automated attendance systems because it more effective and efficient to use since the finger print module can be passed around for finger prints to be scanned instead of students having to queue-up to take attendance. It is also very cost effective to produce as the components are very few and easily affordable.

Keywords- Fingerprint; Wireless technology; Attendance Register; Registration Process; Verification Process

I. INTRODUCTION

Attendance management is the act of monitoring or managing the presence and absence of employee or student in a work or school setting to reduce loss due to employee or student downtime. Attendance control has conventionally been carried out using time clocks and timesheets, but a smart attendance register goes beyond that to provide easy way of tracking student's time and attendance with the touch of a fingerprint scanner [1]. In today's human resource systems, attendance management is paramount; it moves organization towards better human resource practice and good shape, hence consistent attendance and punctuality are expected of all employees or candidates in a work setting. Inadequate attendance caused by unplanned absences and tardiness causes a disruption in work, affects productivity, and creates morale problems when workloads are shifted to other employees. The need of attendance management is not for educational institutes only, many organizations like small-scale companies, hospitals need to mark "in" and "out" time of their staff. Labour oriented organizations for example, factories may carry out time-study to effect time saving leading to cost saving. These companies use magnetic/RFID card. Though this is far better than manual attendance on hard copy there are disadvantages of it. The card can be lost or damaged [2]. Replacement of card may take some time. Unlike these systems, fingerprint scanner comes with lots of advantages; uniqueness, anti-impersonation and ease of use. Thus it is getting more & more recognition and acceptance from people [3].

Moreover, even though we are now living in a digital world with lots of innovations that makes human life much better than ever; student attendance monitoring has been into existence for years. Nowadays most of advanced colleges use attendance sheet printed on paper carrying names of students on left hand side and day-wise columns to make short signature. If the lecturer enter classroom he circulates the attendance sheet. Students pass it around until it is signed by all and returned to the lecturer. In fact there are many drawbacks in it such as some students missing to sign or somebody wrongly or intentionally signing for another student. And if anyone loses the attendance sheet a whole month's attendance data will be lost since there is no back up [4]. In the recent years, computerized methods for taking attendance similar to the proposed project has been developed and they have recorded a good number of improvements over the conventional methods. The problem with these developed models is that the fingerprint device is directly connected to the system using cable and as such it requires students to queue-up to take attendance. This too is stressful and time consuming as the lecturer has to wait until the attendance process is over before the lecture can progress.

The aim of the project is to design and construct a smart attendance register based on biometric wireless fingerprint identification. To achieve this aim; a wired finger print scanner was converted to a wireless scanner so as to enable wireless communication of signals between the fingerprint scanner and the user's computer system, a database was developed in the user's computer to store student information such as names, matriculation numbers, course, fingerprint, students' phone number and parents/guidance phone number. In addition, programming codes were written for the microcontroller (using visual basic and C++ languages) to match the information that is stored in the database with the right fingerprint.

The main component used in this project is a wireless fingerprint device. There are other biometrics technologies that verify identity through characteristics such as faces, irises, retinal pattern, palm prints, voice and hand-written signatures. But fingerprint technology is given attention in this project because of its uniqueness, stability, permanency and

simplicity [5]. The project was designed for the Department of Electrical and Electronics Engineering Federal University of Agriculture, Makurdi and is effective for a sitting capacity of one hundred students; with 20x10 meters squared dimension.

II. CONCEPTUAL FRAMEWORK

The proposed model is a smart attendance register that involves fingerprint authentication with attendance management. It is a wireless technology which integrates fingerprint authentication into the process of attendance management for students. The model comprises three processes namely; enrollment (registration), verification (attendance) and system database.

Enrollment (Registration) Module: The task of enrollment module is to register users and their fingerprints into the system database. During registration, the fingerprint and other bio-data of the student are captured and the unique features are extracted from the fingerprint image and stored in a database as a template. Student bio-data includes; Name, Registration Number, Passport, Phone number, Gender, Level, Department, parent/guardian phone number and Course.

Verification Module: The task of the verification module is to validate the identity of the student who intends to access the system. The student to be verified indicates his/her identity by placing his/her finger on the fingerprint scanner. The fingerprint images captured is enhanced and thinned at the image processing stage, and at feature extraction stage, the biometric template is extracted. It is then fed to a matching algorithm, which matches it against the student's biometric template stored in the system database to establish the identity.

System Database: The attendance management system database consists of tables that stores records, each of which corresponds to an authorized student that has access to the system. Each record may contain the templates of the student's fingerprint and user name of the student or other relevant information belonging to the student. The database designed for the system implements relational data model which is a collections of tables in which data are stored [6].

III DEVELOPMENT OF BLOCK DIAGRAM

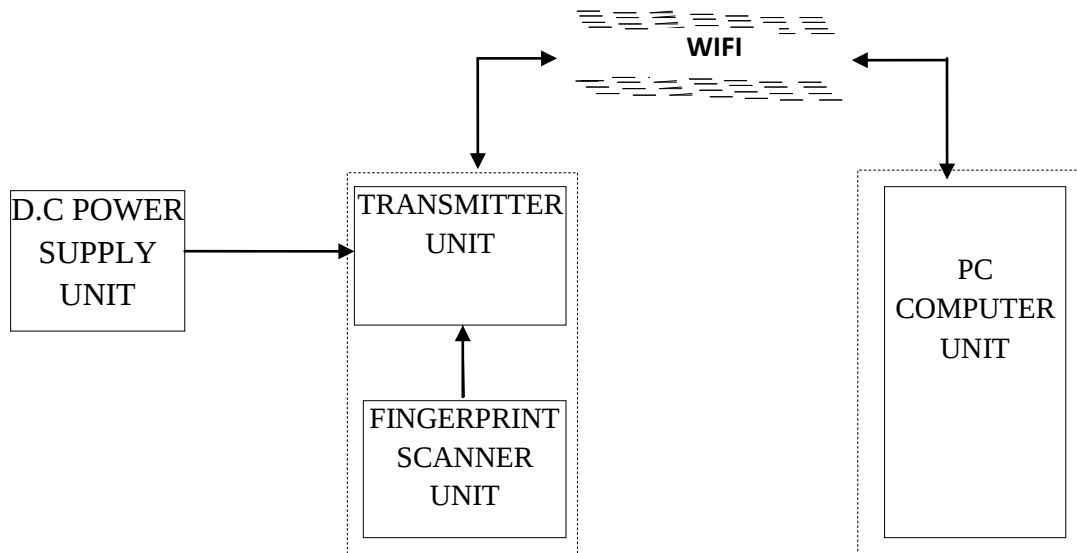


Fig 1: The General Block Diagram of a Smart Attendance Register

The project design is divided into five (5) units of operation namely:

Power Supply Unit: A 9V D.C power supply is used to enable Wi-Fi (ESP8266) module to communicate with Arduino Nano microcontroller.

Fingerprint Module Unit: The fingerprint module serves as interface between the user and system. It also used to capture user's fingerprint template and this template will be transmitted to the microcontroller via serial connection.

Transmitter Unit: It comprises Arduino Nano microcontroller & Wi-Fi ESP8266 module. The microcontroller acts on the template based on the series of programs written on it. The microcontroller transmits the result of its processing wirelessly to the database with the aid of the Wi-Fi module.

Display (LED) Unit: RGB LED is used as a display unit. It blinks BLUE to verify when the information has been received from the other ESP8266, Blinks GEEN if the student is registered on the database and RED when not.

PC Computer Unit: This unit houses the database that stores records, each of which is matched with an authorized student that has access to the system. The attendance of all students can be viewed from this unit. The attendance records of every student is generated and stored into the computer.

IV. CIRCUIT DESIGN AND ANALYSIS

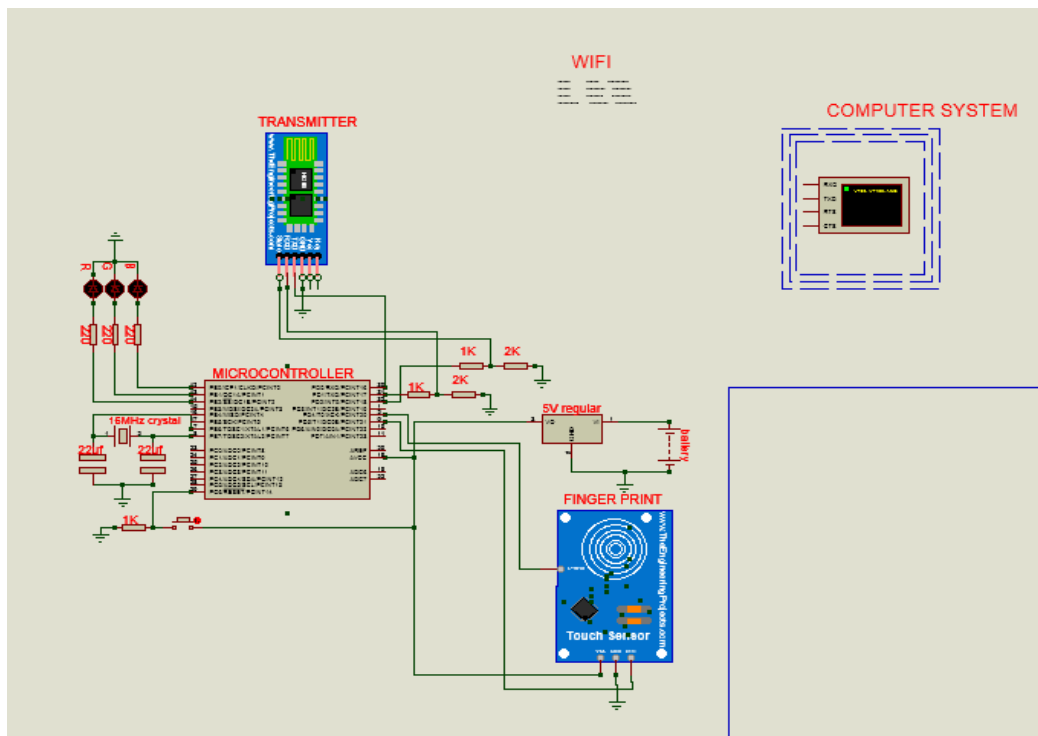


Fig 2: Complete Circuit Diagram

The circuit of the smart attendance register is basically made up of two units: The transmitting and the receiving unit.

4.1 Transmitting Unit Design

This unit as shown in fig. 2 above consists of the fingerprint device, the Arduino Nano microcontroller and ESP8266 Wi-Fi Module which allows wireless communication between the fingerprint module and database based on the series of programs.

4.1.1 Fingerprint Unit

This unit is designed to serve as client in order to communicate with database through a wireless HOST (router or phone hotspot) with the aid of codes. The fingerprint module is connected to the microcontroller via the following pins; the output is connected to V_{IN} of the microcontroller, GND to GND, and the T_X & R_X to D_1 and D_2 of the microcontroller. The model of the fingerprint module chosen for this project is FPM10A fingerprint module. This module serves as interface between the user and system, and also for capturing students fingerprint image so that it can be added to their bio-data and store in the database during enrollment and verification. It has operating voltage (V_{CC}) of 4.5V - 5V, operating current (I) of 20mA - 100mA and logical pins of 5V.

4.1.2 Microcontroller unit

The Arduino Nano is a microcontroller board based on the ATmega328 with a momentary push button switch connected to it for programming the lock patterns. It has a USB host interface to connect with computer based systems. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 8 analog inputs, 4 UARTs i.e. Universal asynchronous receiver transmitter (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a reset button, flash memory of 32KB (of which 2KB can be used by bootloader), SRAM 2KB, EEPROM 1KB and an operating voltage of 5V.

The Arduino Nano can be powered via the USB connection or with an external power supply. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and V_{IN} pin headers of the POWER connector. The Arduino Nano comes with its own power adapter of 7-12V input voltage [7].

4.1.3 ESP8266 Wi-Fi module unit:

The ESP8266 Wifi module has receiver 3.3V, transmitter 5V, logical pin of 5V and operating current of 25mA - 50mA. The ESP8266 Wifi needs to communicate via 3.3V and does not have 5V tolerant inputs. Thus, it is connected in series to the microcontroller via pins 30, 31, and 32 to form voltage divider with a 1kΩ and 2kΩ since it cannot receive 5V signal.

4.1.4 Display (LED) unit design

In this unit, RGB Light Emitting Diode (LED) is used to serve as indicator. The red, green and blue LEDs are connected in series with limiting resistors of value 220Ω each to the microcontroller through pins 12, 13, and 14. It blinks BLUE to verify when the information has been received from the other ESP8266 wireless, blinks GREEN if the student is registered on the database and RED when not. From the manufacturer's datasheet the red LED operates at a 2V and a current of 15mA, the green and blue LEDs operates at a voltage of 2.1V and a current of 15mA. The 220Ω values of the resistors as shown in fig 3.1 were thus obtained as follows.

4.2 Receiver Unit Design

This unit comprises the computer system which hosts the data database (MySQL) that stores students' information. The database is developed with extended GUI by using Microsoft Visual Studio 2015. The system stores students' data in an internal database located on the local memory.

Minimum system requirement

1. RAM: 1GB
2. Hard disk 128GB
3. Processor: Intel Pentium 4 (1.50GHZ) or above
4. Operating system: Windows 7

4.2.1 Flow Chart

The flow charts of design and construction of a Smart Attendance Register is shown below.

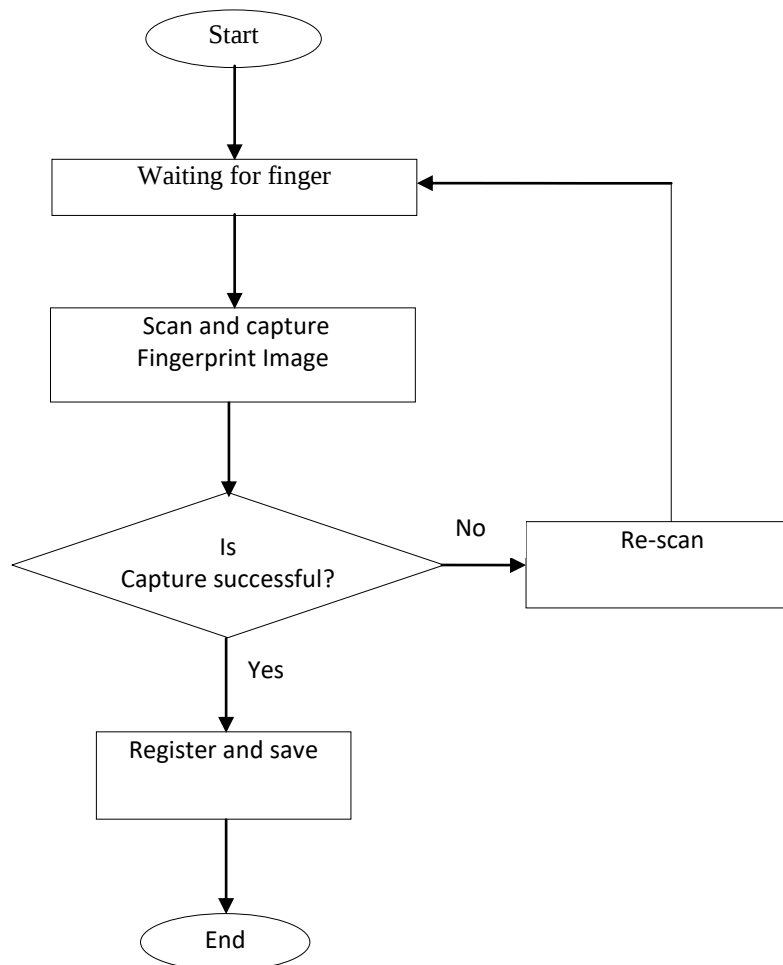


Figure 3: Flow chart showing registration process

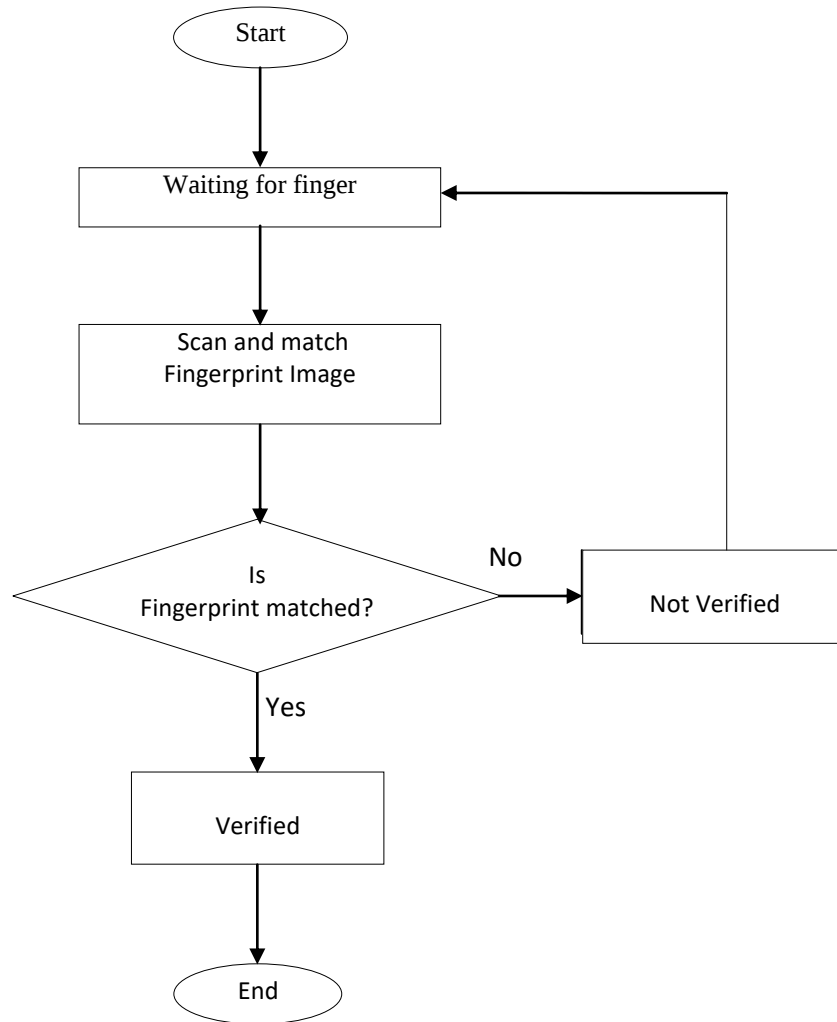


Figure. 4: flow chart showing verification or authentication process

V. RESULTS AND DISCUSIONS

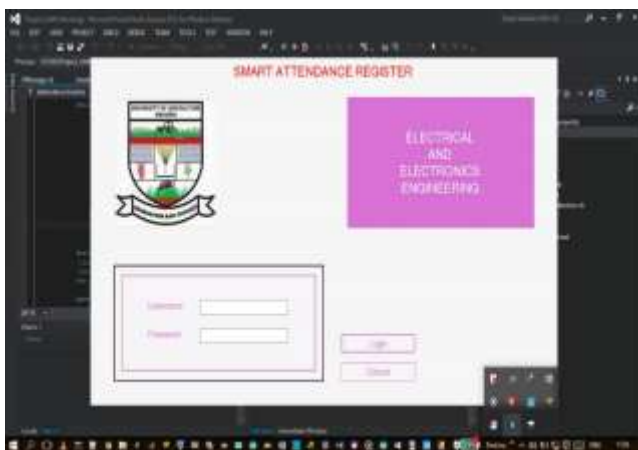


Figure. 5 (a): Shows User Login page.

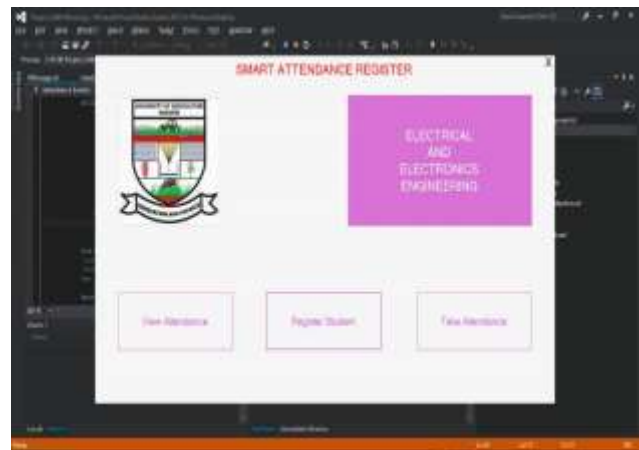


Figure 5 (b): Illustrates Registration, Attendance taking and viewing of attendance page after login.

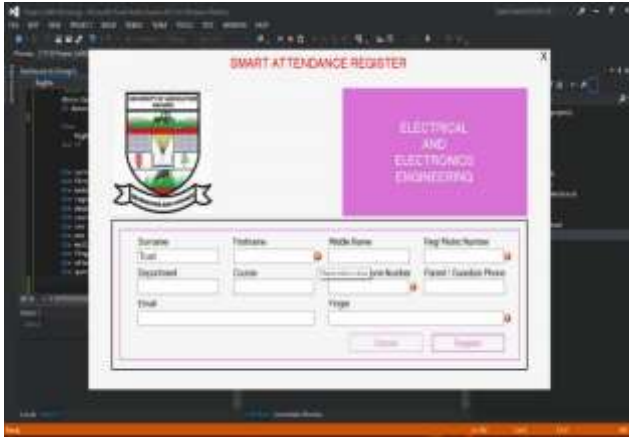


Figure 5(c): Displays registration page

Figure 5(d): Shows attendance page.

Figure 5: Smart Attendance Register software interfaces

The prototype level of a smart attendance register was completed and tested. The device was tested and it worked without error. The database was also tested and it worked perfectly. From the result of the testing process, it was observed that a reliable, secure, fast and an efficient system has been developed replacing a manual and unreliable system.

VI CONCLUSION

In conclusion, a smart attendance register was developed to replace the traditional attendance system that is currently used in many colleges and universities. It also eliminates placing of fingerprint device on the door since it is a wireless technology. This system was designed to make the whole attendance taking process reliable, convenient, efficient, and accurate. Besides, the implementation of biometric technology helps in reducing errors, changed the current system to fully-computerized system, and provide easy way to track student attendance and generate report.

This project work is based on the fact that everyone has a unique fingerprint from which they can be quickly identified through a computer database. Thus, it eliminates problems such as loss of attendance sheet, data entry mistake, impersonation, and fake attendance report. However, this project work is effective over a distance of 20m long. But the data transfer process was efficient enough for the successful functioning of the system. The system developed was used on desktop and laptop; but it is recommended that more research work should be done so that it can be used on smart-phone to further ease the attendance process.

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