Design and Implementation of An RFID (Radio Frequency Identification) Attendance System Using Pic Microcontroller Data Log. The Case of Nigeria.

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Abstract-   Radio   Frequency   Identification Techniques have evolved in the modern era with great developmental stride. RFID applications and designs are applied in industries, transportation sector, agriculture sector, hospital, and health care gadgets. RFID facilitates have embedded automatic wireless identification that has passive or active tags to be read electronically. This work illustrates a system that includes the application of RFID and wireless database record entries. This system eliminates time consumption experienced in manual attendance and maintains record entries that are statistical for proper allocation of appropriate attendance in scoring students for administrative use.

Indexed Terms- RFID, Attendance, LCD, Data Log, PIC microcontroller, microSD card.

I. INTRODUCTION

In many institutions and organizations, attendance plays an important role in accountability. These purposes include record keeping, assessment of students, and promotion of optimal and consistent attendance in class. In developing countries, a minimum percentage of class attendance is required in most institutions and that policy has not been adhered to considering the various challenges of taking attendance.

The use of sheets of paper or books for student attendance remains the manual. This method allows for impersonation or stolen/ loss of attendance sheet. The manual attendance consumes time and poses difficulty to determine the student's minimum percentage [3] for examination eligibility. Thus, a digital system is required to eliminate the problems.

This work solves the above problems by using RFID technology.

RFID is an automatic identification method using devices called RFID tags or transponders. The RFID is a wireless identification system that comprises of two main parts which are RFID Reader and RFID Tag. Attendance is taken from individuals or students by swiping their tags on the RFID reader, the reader captures the information in the card and transmits them wirelessly to the microcontroller. That information is data logged into the microprocessor database. Data logging is an electronic process that captures and records data. Hence, Data loggers are based on microcontroller technology that does not depend on other external devices for data collection and storage. The collected data are saved in the memory with a time stamp. Once the data collection period is completed the device is connected to a PC and the logged data are read from the memory device which helps the PC in analyzing the values offline. These data loggers have [8] Large amounts of internal non-volatile memories interfaced with real-time clock chips. Data loggers use to read data are termed as data capturing data loggers. Either offline or online analysis can perform the collected data. This work is designed with standalone data loggers with the help of a microcontroller. Due to repeated impersonation in class and other establishments.

The problem statement faced in society today, using the RFID attendance system helps to reduce and eliminate the rate of impersonation. The major aim of the work is to develop a system for attendance of students in a class, store the data in a standalone data logger, and access the data whenever it is being required. Hence, the objectives include: (I) To get the personal data of the students (Name, matriculation number, department, and level). (II) Register the data

of the students to the RFID. (III) Install the RFID attendance system in the class. (IV) Retrieve the collated data. The RFID attendance system with data logger is very broad, there are many ways of saving the data, they include saving to a web address, Bluetooth applications, WIFI enabled applications, SMS, e-mail notifications, saving via SD card, etc. this work uses SD card to save the data.

II.   RELATED WORKS

Many different application methods and principles to effectively monitor the attendance of students [9] ascertain a work based on the biometric system. They considered a system where time and attendance software was paired with a time clock that uses biometric technology for authenticating employees. The employees use their fingerprints for clocking in and clocking out using two technologies namely Embedded system and Biometrics. [12] developed an RFID based Attendance System that is commonly used nowadays to track of attendance for community organizations such as educational institutions, business organizations, etc. that uses two technologies namely Embedded system and Biometrics. Most embedded systems are device-based solutions. While GSM-GPRS or IoT based systems [11] where specific position of attendance marking changes dynamically and if changes occur in the schedule wrong attendance marking is inevitable.

The automatic Access Control system using Student ID Card Based on RFID Technology described by [1], stated that the automatic access control system evolves to prevent illegal entry of people into a building and preventing unauthorized persons from gaining access to certain resources.

The system also stores the login and logout information of the user. That information is sent as SMS to notify the presence of any user. RFID Based Notification System described [2] enables parents to monitor the presence of their children when they are in school at a specific time. The time in and time out of every student is generated when the card is swiped at the gate, followed by sending the SMS notification of the attendance to their parents. The limitation of the system is that there is no acknowledgment receipt between the sender and the receiver.

RFID Based Exam Hall Maintenance System demonstrated by [3] provides card reader at the entrance of the building. The system allows student to swipe their tag in front of the reader to gain entry to any hall, on swiping the card the students seat number would be displayed on the LCD.

The application of RFID Technology in Libraries where [4] illustrated the use of RFID based library management system that save library staff's attendance and automation of their task. The task includes borrowing and returning of books from the library automatically using the check-in, check-out system that is RFID based. The limitation of that system is that it is costly to implement in developing countries.

[5] provides a real RFID contactless system with data link that deployed the utilization of the RFID technology in tracking and automated data collection solution.

Time series classification [10] of the attendance system could be used as a human resource management tools to eliminate the spread of any pandemics like COVID-19 in the organization.

III.   METHODOLOGY

The method used in this work incorporates the microcontroller approach where sensors from the integrated system monitor the receipt of signals from radio frequency chips implanted in tags or cards.

It monitors the tags and reconcile record register as attendance in the database and stores the registration information on an SD card through the SD Card Module incorporated in the work. The records stored in the SD card are copied for further manipulation through various software: SPSS, Microsoft Access, Excel, etc.

A. Functional Unit Description [10].
The functional units that make up the RFID circuit to have good, durable, and cost-effective designs are detailed in the choice of materials used.

B. Materials used
The material is divided into several units that includes:

I.   The Micro-Controller Unit
II.   The RFID unit
III. RTC shield (data log and timing unit)
IV.   The Audio Indicator Unit
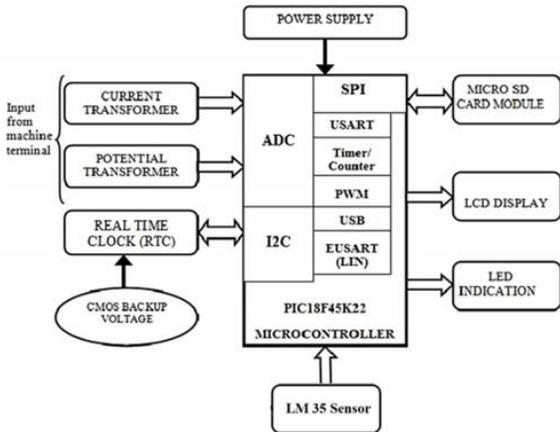V.   The Visual Indicator Unit

Fig.1: Block diagram of standalone Data logger using PIC Microcontroller (*Satheesh et. al*., 2016)

i.   The Micro-Controller Unit
The Micro-controller unit in this case uses Arduino Uno that has a low power as general-purpose with good processing speed. It has small physical dimension, that is durable and cheap.

Fig 2 ARDUINO UNO

The Arduino Uno Micro-controller is a composition of the RC522 Reader, RTC module, buzzer, and led indicators as output. Each pin supply 20mA each that amounted 400mA as maximum current draw from the micro-controller.

ii.   Real-time clock (RTC)
The RTC shield is a shield that comprises a real-time clock and an SD card module, the real-time clock gives the exact time, while the SD card module stores data. The shield is usually fixed on the Arduino UNO board.

Fig 3 RTC module

iii. THE RFID UNIT
The RFID reader is eight pins each pin is connected to the Arduino micro-controller from the RTC shield. The major pins in the reader are, the power pin (VCC, GND, and the Reset), MOSI (master out slave in), and the MISO (master in slave out). The micro-controller is usually the master in this case, while the RFID module is the slave.

The RFID card is just like any other when viewed, but it has some chip implanted in it, this chip cannot be seen expect we flashlight behind the card. The chip in the card makes it connect to the card reader when swiped. Each can be coded to gain access to the system.

Fig 4. RFID module

C. Method used
This session comprises of the hardware and software sessions

i. Hardware

It involves the assembling of components mention below that includes the RTC module on the Arduino micro-controller, then the LCD, buzzer, LED and RFID module is connected
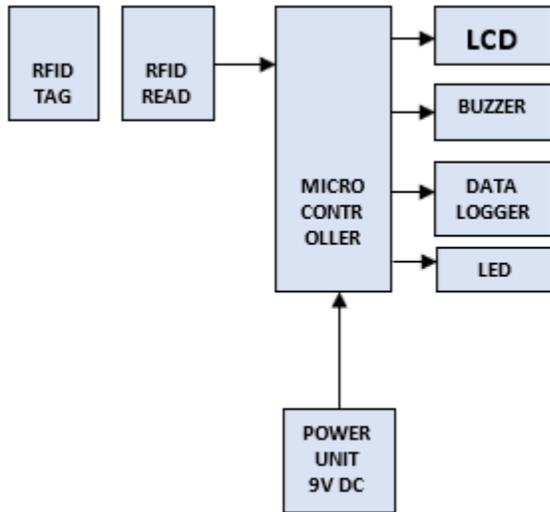

Fig. 5 Block Diagram of Circuit

ii. Software

This involves the use of Arduino IDE to write the sketch program used in designing the circuit. The IDE uses embedded C/C++ programming language, the program is represented with the flowchart above.
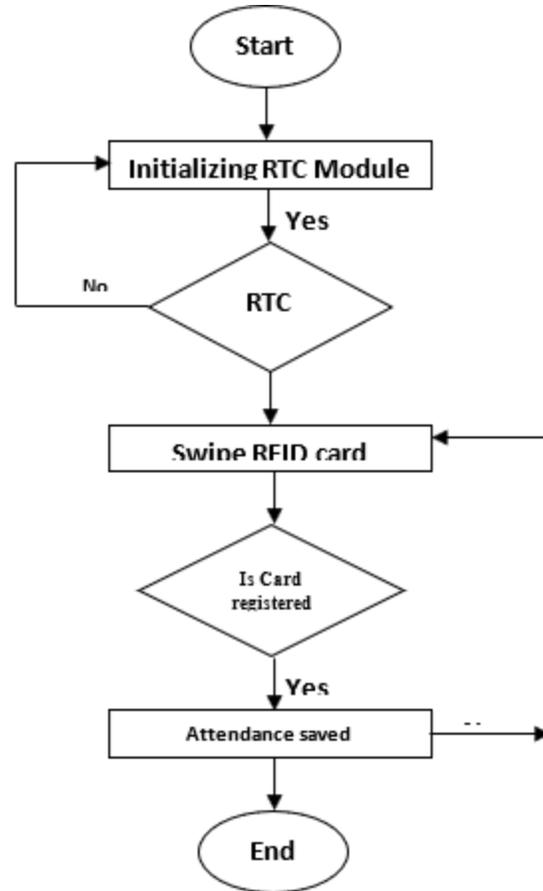

Fig 6. Flow Chart

IV. RESULTS

Several tests were conducted based on a series of design cases to eliminate errors and burnt.

The hardware and software techniques incorporated provides systematic guidance for the design testing steps below:
1) Software components and internal circuitry
2) Testing of the function requirements: the input, output function and desired result of the system.

A. Software test:
i.   Internal program logic
ii. Software requirements

The two software approaches used help to eliminate possible error and avoid time delay.

B. Testing Methodology

This approach enables the designer itemize the functionally requirements whiles adopting same testing technique.

C. Unit Test:

The unit test considered the single components in the combination of the system. This component checks the kind of inputs and outputs of the functional requirement to implementing the RFID design. The function requirements are tested at the unit level to ensure the accuracy.

D. System Test

This test ensures that all the components of the system are duly integrated properly, the integration start from the unit test of individual components and the connecting them together considering the circuit diagram for the design. Most of the components connected together includes the sd Card, the power section the RFID section etc it also checks the individual and general modules in the communication to generated the power required for the system to function normally.

E. Performance Test

This test is a white box test where the input, the output and the desired outcome are considered in the testing process. This test checked the RFID tags as the input and the collection of the details st the database as output. The result of the tags in RFID are mapped to the database where the collective results of all that swipe there tags are collected as the report of the attendance.

F. Test cases

A manual and automatic test cases were examined that combined the system test and the unit test sections where students are given the RFID tags mapped to theirs Matriculation Number, Names, and Phone numbers. These details are registered in the database with a tag label embedded into the different tags given to the students. The students were asked to attend a lecture with their tags swiped before entering the hall. And the report of that was gotten within minutes but the case of the manual for a large class size took about halve an hour before the completion of that attendance system. Also, on submission of the different reports some data manually written has several errors over the

automated system. Those the functional requirements where specified for the examination of the different types of attendance system.

Table 1. Functional Assessment check of RFID Tag

Sn o	Test case id	Test case name	Test case desc	Step	Expected result	Actual Result	Test case status pass/fail
1	Create sudent details	Validate allocation form	To allocate separate roll no for the students	Nothing entered and click submit button	An error message student name not equal to null must be displayed	Inserted succesful	Pass
2	Create staff details	Validate allocation form	To allocate separate subject username password for the staffs	Nothing entered and click submit button	An error message staff details password,username not equal to null must be displayed	Inserted succesful	Pass
3	Create time table	Validate allocate period form	To verify that data stored on database	Nothing entered and click submit button	An error message not click not allocation subject table not equal to null must be displayed	Inserted succesful	Pass
4	View	Check details of all data	To verify that data stored on database	generated	An error message return null will be displayed	An error message return null will be displayed	fail

Fig. 7. Prototype Design.

CONCLUSION

To ensure staff or students attendance status on any particular academics' involvement, the RFID systems is recommended as design and implemented thus the uncertainties of the personification cannot be guaranteed through this design. A better way to access student attendance digitally that grants accurate and quick response to class attendance reports is to consider the RFID systems in Nigerian Higher Institutions.

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