VOL. 15, NO. 20, OCTOBER 2020 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

DESIGN AND DEVELOPMENT OF A RADIO FREQUENCYIDENTIFICATION (RFID) BASED DIGITAL ATTENDANCE SYSTEM WITH MASTER'S E-IDENTITY CARD CONTROLLED ACCESS TO THE ATTENDANCETAKING MODE

Anthony C. Ohajianya, Victor N. Ebomuche, Chinonso E. Agbo and Greg A. Ikeh
Department of Physics, Federal University of Technology, Owerri, Imo State, Nigeria
E-Mail: anthony.ohajianya@futo.edu.ng

ABSTRACT

The rate of students' truancy in our Universities especially in developing countries has become alarming. Efforts made so far to curb this menace, including the class attendance policy which stipulated a percentage of class attendance that a student must meet in order to qualify to take an examination in any course, have proved futile. This is due to the tedious and unreliable current way of taking attendance in our Universities using pen and paper. The advent of Radio Frequency Identification (RFID) technology has led to the development of digital attendance systems but the absence of a form of master controlled access to the attendance taking mode has made the existing ones unreliable. A digital attendance system with master's e-identity card controlled access to the attendance taking mode was designed and developed using the RFID reader module and Arduino Nano 3.x board as the principal components. The constructed device was tested and the test results showed that the device was effective in taking class attendance of students. We, therefore, recommend that this new design of digital attendance system with attendance taking mode access control feature be locally mass-produced and used in taking attendance in the Universities of Countries where high level of students' truancy exist.

Keywords: attendance register, E-identity card, RFID reader, arduino nano.

1. INTRODUCTION

Skipping classes is a very common problem among Secondary School and University students, especially in developing countries. It is more profound in the Universities because students are mostly not living with their parents and therefore not under close monitoring of their parents. It can be considered as truancy and can be categorized as one of the disciplinary problems in universities. Studies conducted in Nigeria and some other countries have revealed a high level of truancy among secondary and tertiary institution students and a strong correlation between attendance to classes and performance of students(Musa, 2014)(Ishak & Fin, 2013)(Ojo, Adu, & Adu, 2017)(Sa'ad, Sabo, & Dahuwa, 2015)(Oluremi, 2013). Truant students usually have bad academic performances. To reduce the high level of absenteeism among university students, many universities have enshrined in their regulation, a minimum percentage of class attendance which a student must fulfil to qualify for examination in any course. To implement this policy, records of students' attendance to classes must be kept for all the courses. This has proven to be difficult due to the current cumbersome way of taking attendance in classes which involves passing an attendance sheet round for students to write their names and/or sign their signatures. This attendance taking method is not only cumbersome but also unreliable as students tend to write names and sign for their absent friends, which renders the whole effort to check truancy, futile. To solve this problem, researchers have developed better ways of taking attendance which can be deployed in our universities. One of such developed technologies is the Radio Frequency Identification (RFID) system.

1.1 The Radio Frequency Identification (RFID) Technology

Radio Frequency Identification (RFID) technology is a wireless technology essentially used for automatic identification by using radio-waves to detect, track, identify, and thus manage various objects and people(Pal & Sharma, 2011).It is generally believed that the root of RFID can be traced back to World War II when the Germans, Japanese, Americans, and British were using RADAR (discovered in 1935) to monitor airplanes. But the RADAR technology could not give them exactly what they wanted which was to identify whether the plane belongs to the enemy or friend camp. This led the Germans to advance their RADAR technology to the first passive RFID system which could identify whether an aircraft belonged to Germany or not (Roberti, 2005). The RFID technology is mostly applied nowadays in managing supply chains, tracking product and livestock, averting counterfeiting, controlling building access, and supporting automated checkout(Datta, 2016).

The RFID technology has engendered a lot of publicity in recent years. This development has been made possible by the successful application of the technology in the tagging of physical objects, people, places, and things with a single chip radio so that they can interface with computers which can identify whether the chip is ON or OFF (Fine, Klym, Tavshikar, & Trossen, 2006). For instance, the RFID single chip tagging technology is now used in stores and libraries such that each item has a 1-bit

ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

chip in the ON-state until paid for or properly borrowed. At the instant the item is paid for, the chip is automatically turned OFF so that the item can be taken out of the store or library without the sensor at the door raising alarm(Rieback, Crispo, & Tanenbaum, 2006). Therefore this technology has proved to be a better alternative to the barcode technology which is mostly used today for the tagging and identification of items in a warehouse or supermarket. With this RFID technology, there is no human involvement in searching for the code and pointing of scanner to it like in the barcode technology, which reduces cost and time.

The RFID system consists of five components: Tag (attached to an object, unique identification), Antenna (tag detector, creates magnetic field), Reader (receiver of tag information, manipulator), Communication infrastructure (enable reader/RFID to work through IT infrastructure), and Application software (user database/application/interface) (Ajami & Rajabzadeh, 2013).

1.1.1 Types of RFID tags

Basically there are three types of RFID tags. They are the passive tags, the semi-passive tags, and the active tags. The basic difference between these types of RFID tags is as follows: the active tag has a battery that supplies power to all functions and therefore, is capable of radiating its own radio frequency signals to transmit the data that contains in the microchip, without depending upon the Reader's signals to power up; the Semi-passive tag has a battery used only to power the tag IC, and not for communication; the Passive tag has no battery on it and because of that, passive tags are much cheaper and more reliable than active tags(Pal & Sharma, 2011)(Datta, 2016).

1.1.2 RFID operating frequencies and range

The range of the RFID tags is a function of their frequency. Most RFID systems operate in the Industrial - Scientific - Medical (ISM) bands, which are without restraint available to low-power, short-range systems(Weis, 2010)(Datta, 2016). The Operating Frequencies include the low-frequency system(125-134 kHz) which uses passive tags and has a read range of 0 to 0.5 m; the high-frequency system (13.56 MHz) which uses passive tags with a read range of less than 1.5 m; the ultra-high frequency system (850-950 MHz) which uses both active and passive tags with read range of 3 - 10 m for active and greater than 10 m for passive; and the microwave system (2.45 or 5.8 GHz) using both active and passive tags with read range of 3 - 10 m for active and greater than 10 m for passive (Datta, 2016).

1.2 RFID Based Attendance System

The RFID technology has been successfully designed and implemented in digital attendance systems which can be deployed in educational institutions, companies, or anywhere attendance keeping is required. This can be seen in literature (Kariapper & Razeeth, 2019)(Ehikhamenle & Okeke, 2017)(Mishra, Marwah, &Verma, 2015)(Ukoima, Ekwe, & Ezeonye, 2019)(Mustapha, Abdulkadir, Sarki, & Omale, 2018)(Mistri, Kishore, Nidhi, Pushpakumari, & Vikrantkumar, 2018)(Arulogun, Olatunbosun, Fakolujo, & Olaniyi, 2013)(Shoewu, Makanjuola, Ajasa, & Ayangbekun, 2015)(Desai, Gore, Jankar, & Patil, 2018)(Walia & Jain, 2016)(Kumbhar, Wanjara, Trivedi, Khairatkar, & Sharma, 2014). RFID based attendance system involves the use of RFID scanner designed to work together with a microcontroller to read and identify the unique identification codes of the RFID tags in e-identity cards of staff members of an organisation or students of an institution so as to be used in attendance taking.

All the existing designs of RFID based attendance system lack one important feature which rendered them unreliable. The attendance can be taken without the permission of the person in charge of the event once the device activation pin is known. This is the problem our design intends to address. In this new design, a feature will be added to secure the attendance taking mode of the system. Here, each course lecturer's e-identity card must be used to activate the attendance taking mode of the system for the particular course to ensure that the attendance is not taken without his/her permission.

The only limitation this our design has is that it does not incorporate a finger print scanner device for biometric identification of the students. We believe that this is not too necessary as to justify the cost of adding it as class attendance taking is between Lecturers and their Students which they should easily identify facially.

2. MATERIALS AND METHODS

The starting point in the design of any electronic circuit or system is the articulation and development of a block diagram for the circuit or system. The articulated block diagram for the RFID based digital attendance system with master's e-identity card controlled access to the attendance taking mode is shown in Figure-1.

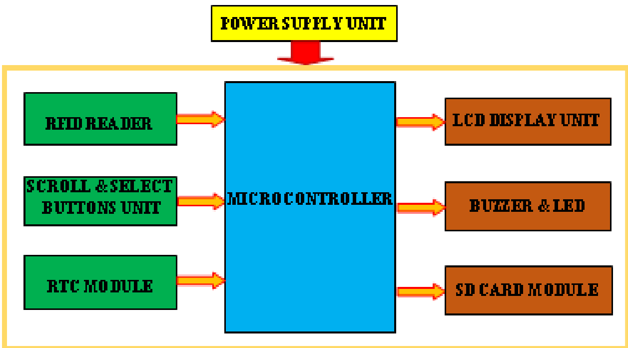

Figure-1. Block diagram of the RFID based digital attendance system.

In the block diagram of Figure-1, the Microcontroller Unit is the coordinating center of the system. Three input and three output units are interfaced with it. It is a programmable unit and has features for interfacing with a computer. RFID Reader is an input unit

VOL. 15, NO. 20, OCTOBER 2020 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

that uses radio frequency signal to communicate with an e-identity card brought close to it and passes the card information to the microcontroller unit for further processing. The Real Time Clock (RTC) Module serves as a clock input module for the microcontroller. It is the time keeper of the system. It stores and provides the set Binary Coded Decimal (BCD) clock and calendar information to the microcontroller. The articulated system also has a Scroll and Select Buttons Unit to be used for the operation of the device. The Liquid Crystal Display (LCD) Unit is one the three output units of the system. Its function is to help the operator visualize what he/she is doing. It interfaces with the microcontroller unit to display the different selected and activated modes of operation of the system. It also displays the registered courses so as to enable the operator scroll through and select the required course for which class attendance is to be taken. The second output unit of the system is the Buzzer and Light Emitting Diode (LED) Unit. While the buzzer beeps to show that an intended action has been carried out by the system, the LED blinks to communicate the same message. The Secure Digital (SD) Card Module is the third output unit of the system. It has the SD card for saving and transfer of the collated attendance data. The Power Supply Unit supplies the needed voltage to power the system. It also comprises a switch for turning the system ON and OFF.

2.1 Design Considerations and Components Selection

The next step was the selection of components for the different units of the block diagram following design acumen and ensuring that the components can work together to achieve the purpose of the units.

2.1.1 Microcontroller unit

The microcontroller board selected for this project was the Arduino Nano 3.x board which is an ATmega328P based 8-bit AVR family microcontroller. This was chosen because it is a small and complete microcontroller board that can easily be programmed using the Arduino software freely available online. The Arduino nano board picture with pin-out is shown in Figure-2.

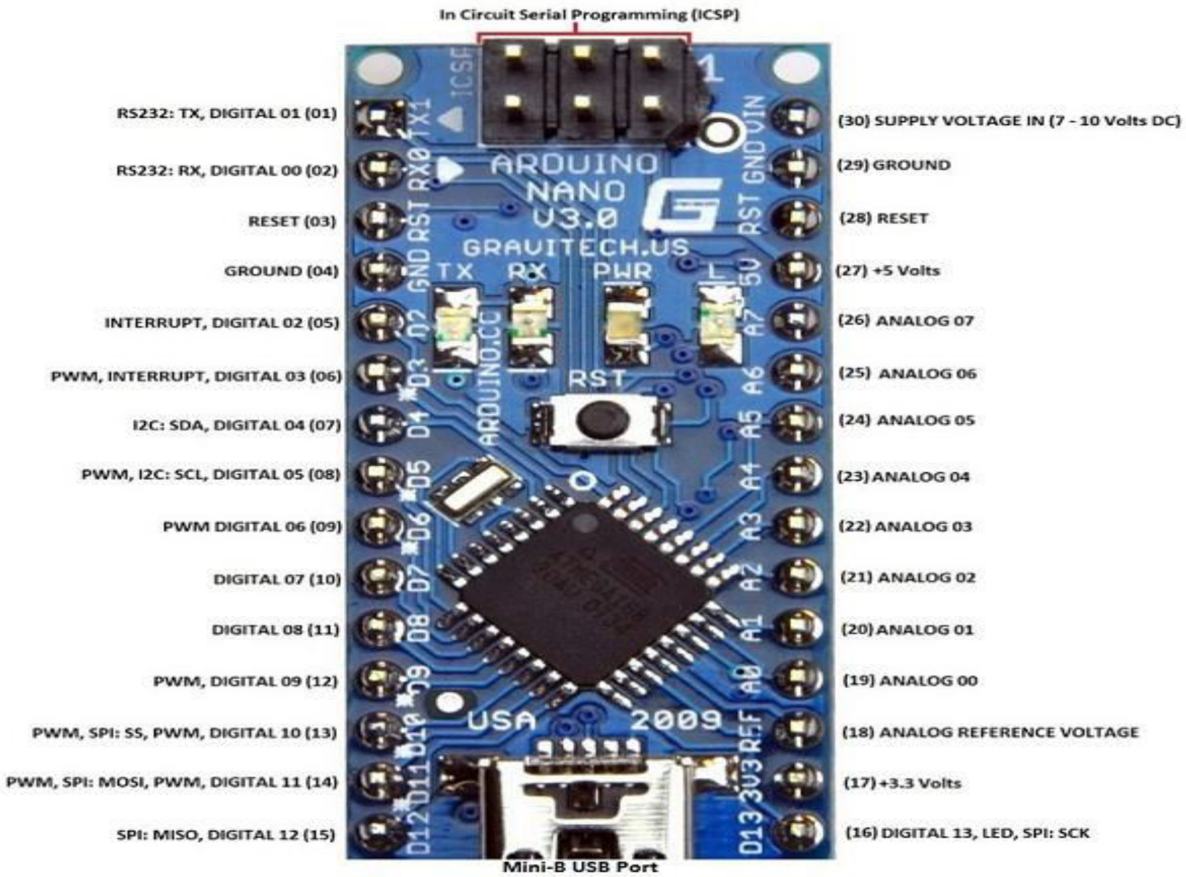

Figure-2. Arduino-Nano board top view and pin-description (John, n.d.).

From Figure-2 we can see that the Arduino Nano has 36 pins which include 14 Digital Input/output and Pulse Width Modulation (PWM) pins, 9 Analog pins, 7 Power pins, 3 Serial Peripheral Interface (SPI) pins, and 3 Reset pins.

Arduino Nano Digital Pins (Pins 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16) are employed for digital input or output. They work with 5 V and 0 V voltages as digital high and low, respectively. Each of these pins can supply or draw a current of 40 mA, and has a pull-up resistance of about 20-50k ohms. The pins also have some additional functionality other than their digital input and output functions. Serial Communication Pins (Pins 1 (RX-receive) and 2 (TX-transmit)) are used for transistor-transistor logic (TTL) serial data communication. They are linked to the corresponding pins of the USB-to-TTL Serial chip.PWM Pins (Pins 6, 8, 9, 12, 13, and 14) provide an 8-bit resolution Pulse Width Modulation Signal in addition to their digital input and output functions.External Interrupts (Pins 5 and 6) can be used to set off three types of interrupt - interrupt on a low value, a rising or falling edge interrupt and a change in value interrupt.SPI Pins (Pins 13, 14, 15, and 16): The four Serial Peripheral Interface pins are used for synchronous communication with SCK as the synchronous clock.LED Pin (Pin 16) is linked to the blinking Light Emitting Diode on the Arduino nano board.Arduino Nano Analog Pins (Pins 19, 20, 21, 22, 23, 24, 25, and 26) and AREF (Pin 18): The eight analog pins marked A0 to A7 are used to connect 8 channel analog sensor inputs for processing. Each of the analog pins has an inbuilt Analog to Digital Converter (ADC) with resolution of 1024 bits. The AREF (Analog Reference) pin is used as a reference voltage input pin for the ADC conversion. By default, the analog pins measure signals from 0V to 5V but if they are required to measure signals from 0V to 3.3V, 3.3 V is supplied to the AFEF pin. Like the digital pins, analog pins also have other functions.I2C Pins (Pins 23 and 24): The two analog pins A4 and A5 also serve as I2C (Inter-Integrated Circuit) pins. I2C protocol is employed for long distance communication. It supports multi master and multi slave communication with only two wires. Pin 23 is for serial data (SDA) while pin 24 is for serial clock (SCL).

Reset Pins (Pin 3 and 28) are used to reset the microcontroller. They are active LOW pins which mean that a LOW (0 V) pulse is supplied to these pins via a reset button to reset the microcontroller. ICSP (In Circuit Serial Programming) Pins are the six pins on top of the Arduino nano board. These pins serve as an alternative port for the programming of the Arduino board if the boot loader is missing or damaged. Each ICSP pin is cross-linked to another Arduino pin with the same name or function. The name and function of the ICSP pins include MISO (Master In Slave Out), Vcc (5V Supply Voltage), SCK (Clock from Master to Slave), MOSI (Master Out Slave In), RST (Active Low Reset), and GND (Supply Ground). Power Pins (Pins 4, 17, 27, 29, 30 and ICSP Vcc and GND pins): Pin 30 (Vin) is the power pin through which input voltage is supplied to the Arduino when using an external power source (6 - 12V); Pin 27 (5V) provides 5V regulated power supply used to power microcontroller and other components on the board; Pin 17 (3.3V) supply 3.3 V generated by on-board voltage regulator. The maximum current that can be drawn from it is 50 mA; and Pins 4 and 29 are the power supply ground pins.

2.1.2 RFID reader unit

The low-cost MFRC522 based RFID Reader Module was selected for this unit because it is easy to use and can be used in a wide range of applications. The MFRC522 is a highly integrated reader/writer IC for contactless communication at 13.56 MHz. This RFID module typically comes with 8 pins namely Pin 1 (Vcc), Pin 2 (GND), Pin 3 (IRQ), Pin 4 (RST), Pin 5 (MISO/SCL/Tx), Pin 6 (MOSI), Pin 7 (SCK), and Pin 8 (SS/SDA/Rx). A picture of the MFRC522 based RFID module and the Pin names are shown in Figure-3 while a description of the functions of the pins is given in Table-1.

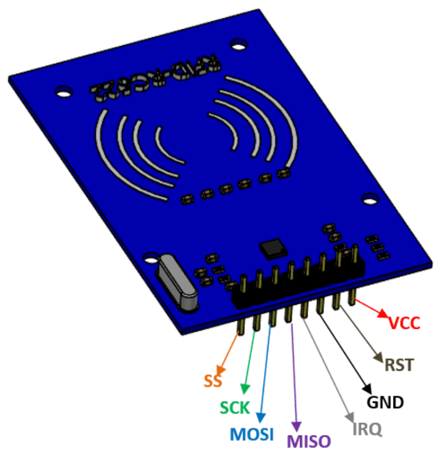

Figure-3. RFID module and pin names (COMPONENTS101, 2019).

ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

Table-1. RFID module pin names and description (COMPONENTS101, 2019).

PIN	NAME	DESCRIPTION
1	Vcc	In order to run the module, it must be powered via the V_{CC} pin. The allowable voltage is up to 3.3V. Unlike most of the modules RC522 doesn't accept 5V as an input.
2	RST (Reset)	This is an active LOW pin. When logic 0 is applied to it, the RFID reader will be switched OFF.
3	GND	In order to make a closed circuit, the GROUND terminal is required, just like in every other circuit or module.
4	IRQ (Interrupt Request)	It goes HIGH when an RFID tag comes into the proximity of an RFID reader. It helps in interrupting the microcontroller to pause or perform the task as designed.
5	MISO (Master In-Slave Out)	MISO is used to send data to the master (microcontroller) from the salve (peripheral device).
6	MOSI (Master Out-Slave In)	From the MOSI pin, Master sends data to the peripheral devices.
7	SCK (Serial Clock)	The clock pulses from the SCK pin is used to synchronize the data transmission between the master and slave
8	SS (Slave Select)	In case the slave devices are more than one, the SS can be used to select the desired device when required.

2.1.3 RTC module unit

The DS1307 based serial real-time clock (RTC) module was chosen here because it can keep accurate time for years using a tiny coin cell, and it is easily connected to the Arduino module. It is a low-power; full binary-coded decimal (BCD) clock/calendar with 56 bytes of NV SRAM. The back view and front view with pin names of the DS1307 RTC module are shown in Figure-4.

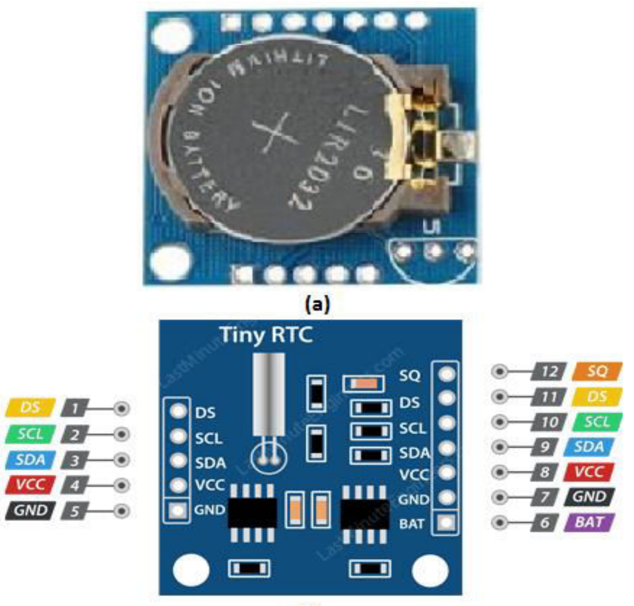

Figure-4. RTC-DS1307 Module (a) back view and (b) front view with pin-out.

The DS1307 RTC module has 12 pins with functions as follows: Pin 1 or 11 is the DS pin which outputs the temperature reading if the module has a DS18B20 temperature sensor mounted close to the battery holder; Pin 2 or 10 is the Serial Clock (SCL) input for the I2C interface and is used to synchronize data movement on the serial interface; Pin 3 or 9 is the Serial Data (SDA) input/output for the I2C interface; Pin 4 or 8 is the pin through which the module is powered with a voltage of 3.3 V to 5.5 V; Pin 5 or 7 is the power supply ground pin; Pin 6 is a backup power supply input pin internally connected to a 3V lithium cell mounted at the back of the module or can also be connected to other energy source to maintain accurate timekeeping in the event of main power supply interruption; while Pin 12 is the square wave outputs pin that sends out one of four square-wave frequencies 1Hz, 4kHz, 8kHz or 32kHz.

2.1.4 LCD display unit

A 16x2 LCD module with an I2C Interface device was selected for this unit. This module is preferred over seven segments LED display module because it is programmable and can display special and custom characters. It can also display animations. The 16x2 LCD as the name implies, can display 16 characters per line and has two lines. Each character is displayed in a 5 x 7-pixel matrix. It has two registers called Command and Data. The command register stores the command instructions given to the LCD module while the data register stores the data to be displayed. The I2C interface device drives the LCD module and helps in linking it to the Arduino Nano 3.x board with a fewer number of pins. The LCD module with I2C interface is shown in Figure-5.

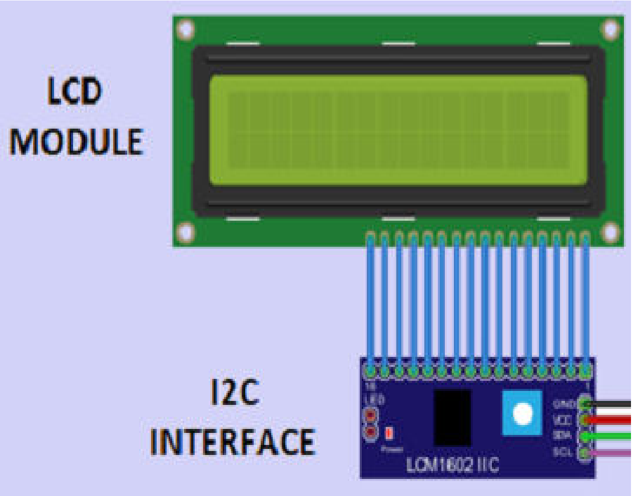

Figure-5. 16x2 LCD module with I2C interface.

The LCD Module has 16 pins which are connected to the 16 corresponding pins of the I2C Interface device. The module is then connected to the Arduino nano board via the other 4 pins (GND, Vcc, SDA, and SCL) of the I2C Interface Device.

2.1.5 SD card module

An SD card module with a micro SD card slot for inserting memory cards was selected for this unit. This was chosen over other memory devices because micro SD cards of different memory sizes can be slotted in and removed after data storage so as to connect the cards to other devices like a computer where the data will be used or further processed. The SD card module is designed to interface with the Arduino board. Figure-6 shows the micro SD card module with its components and pin-out.

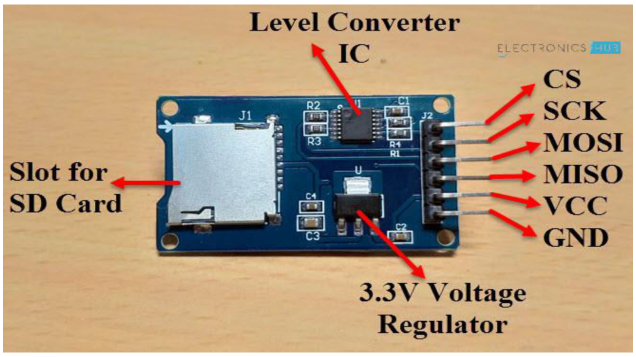

Figure-6. Micro SD card module (Ravi, 2018).

The Micro SD Card Module has 6 pins through which it is connected to the Arduino nano microcontroller board. The pins include Pin 1(GND) which is the power supply ground of the module; Pin 2(Vcc) through which the module is powered by connecting it to the 5V output of the microcontroller board; Pins 3(MISO), 4(MOSI), and 5(SCK) which are connected to the corresponding pins of the Arduino nano board; and Pin 6(CS) which is connected to the D4 pin of the Arduino nano board, is the chip select (or slave select) pin used by Arduino(Master) to enable and disable specific devices on SPI (Serial Peripheral Interface) bus.

2.1.6 Buzzer and LED unit

This unit has a buzzer or beeper made of a piezoelectric device and a red LED. These two components are indicators. While the buzzer indicates when an action takes place on the device by beeping, the LED does its own indication by blinking.

2.1.7 Power supply unit

The power supply unit has a 9-volt battery with an LM7805 voltage regulator. The digital attendance register requires a 5-volt dc power supply to function and with a 9-volt battery, a voltage regulator is needed to get the required voltage out of the battery.

2.2 Circuit Diagram and System Flow Charts

After articulating and developing the block diagram, the next step was to interlink the components selected for the different units of the system using their pins or terminals. This was done and the realized complete circuit diagram of the digital attendance system is given in Figure-7 while the flowcharts of the system operation processes are shown in Figures 8, 9 and 10.

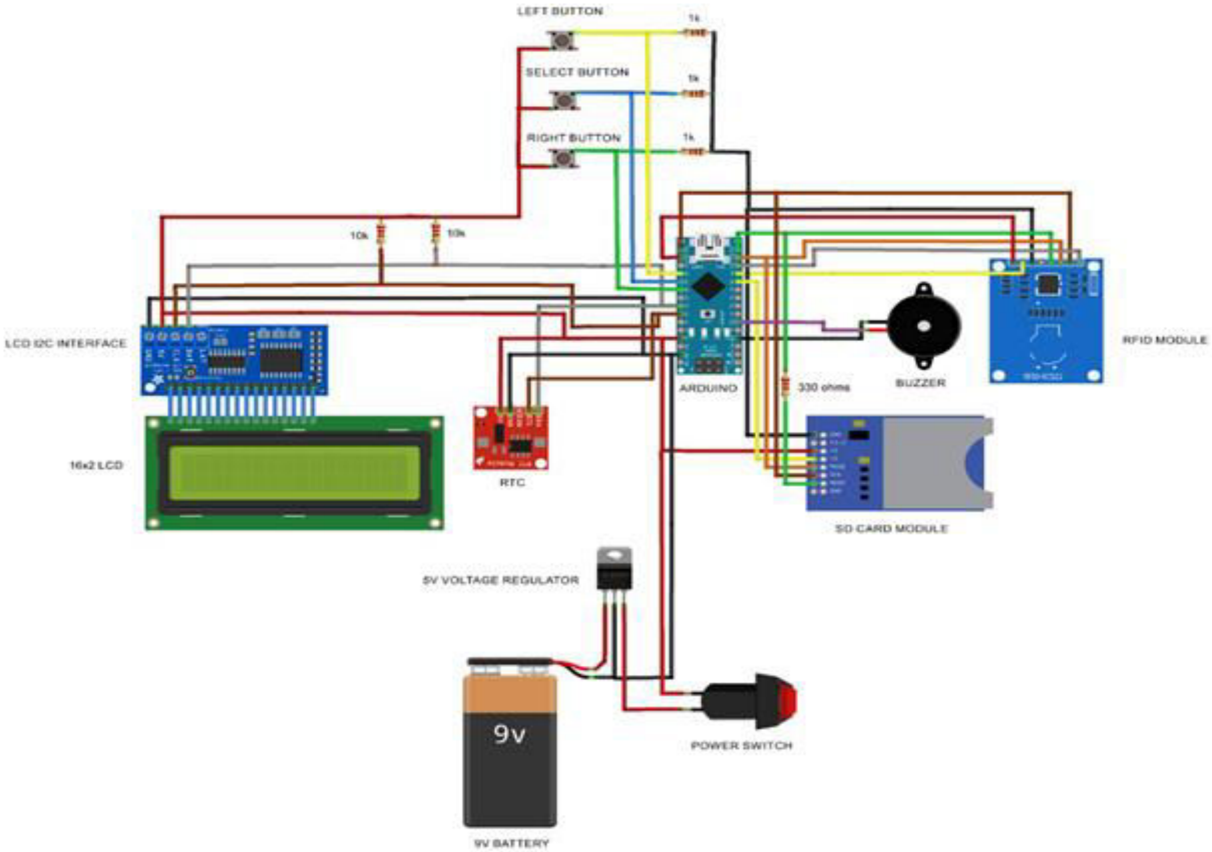

Figure-7. The circuit diagram of the designed digital attendance system.

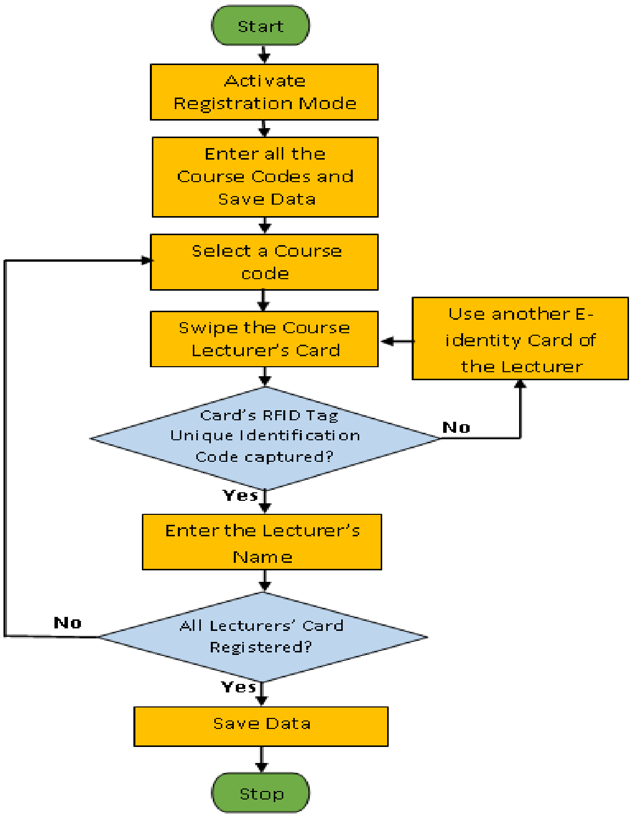

Figure-8. The flowchart of course codes and lecturers registration process.

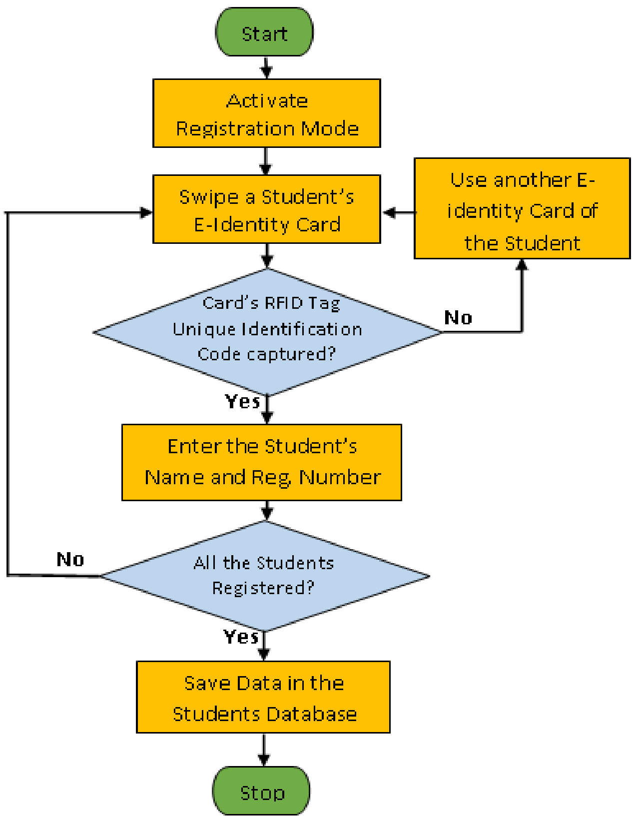

Figure-9. The flowchart of students registration process.

VOL. 15, NO. 20, OCTOBER 2020 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

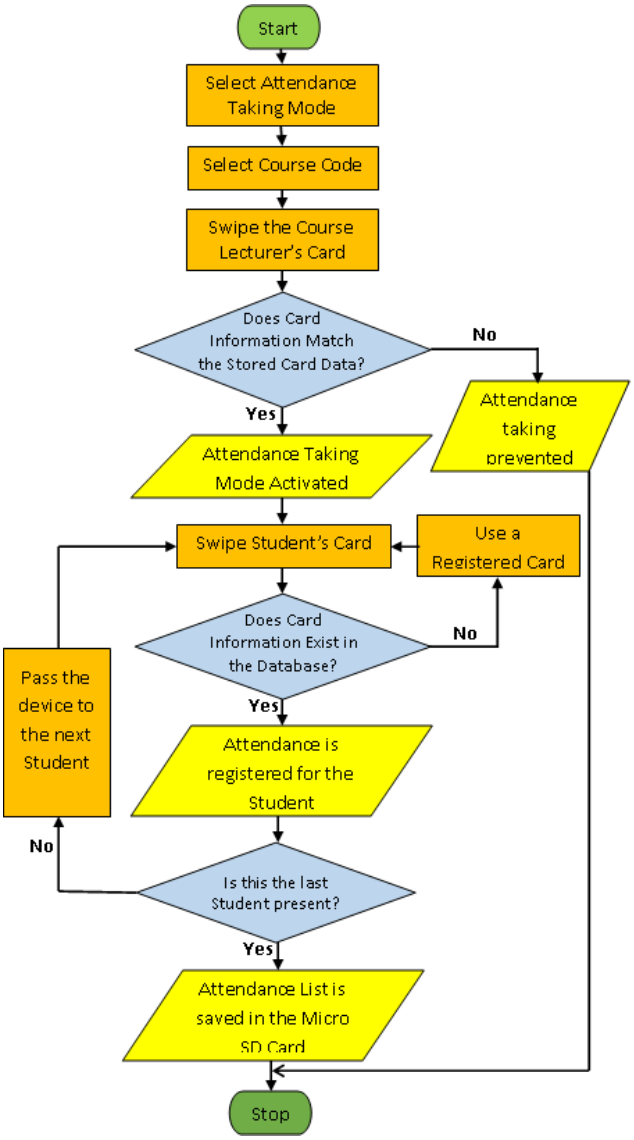

Figure-10. The flowchart of class attendance taking process.

2.3 Construction

The components were arranged on a Vero board and soldered into place. The interconnections were made with jumper wires and the Vero board's copper strips. The casing was made with plastic material and the LCD module was attached to the face cover of the casing. The RFID reader was also attached to the casing face cover but towards its other end. A picture of the constructed device with the casing's face cover part opened to reveal the constructed circuit installed inside the casing is shown in Figure-11.

Figure-11. The constructed RFID based digital attendance system.

2.4 Device Programming

The constructed digital attendance system was programmed by interfacing it with a computer using a USB cable. The programming software which is the Arduino Integrated Development Environment (IDE) was first downloaded online and installed on the computer before the constructed device was now connected to the computer and programmed. The list of final year courses offered by the Department of Physics, Federal University of Technology Owerri (FUTO) was registered on the device. The master E-Identity card of Dr. Anthony Ohajianya which must be swiped through the device to activate the attendance taking mode was also registered.

2.5 Registration of Students

At this stage, the device was put in the registration mode by holding the center (enter) button of the device and also clicking on the serial monitor displayed on the laptop computer. This brought up the platform for the registration of the E-Identification Card of the students. The E-Identification Card was then brought close to the device to be scanned by the sensor (RFID scanner module). Once the E-Identification card was scanned, it displayed a code (which is the unique identification number for that particular RFID tag) on the laptop. However, it will display "student exist" if the E-Identification card has been swiped or scanned before. A picture of the device in registration mode as depicted by the LCD module is shown in Figure-12.

Figure-12. The constructed device in registration mode.

ARPN Journal of Engineering and Applied Sciences

2.6 Device Testing

To test the device, it was turned ON and set to take attendance for PHY 501.The pre-registered Lecturer's e-identity Card was brought near the device scanner to activate the attendance taking mode. Three students' cards were one after the other brought near the device scanner to register attendance for each of the students. In the end, the micro SD card was brought out from the device and slotted into a laptop computer to save the attendance data.

3. RESULTS AND DISCUSSIONS

The result of the PHY 501 attendance taking test using three students E-Identity Cards is given in Table-2.

Table-2. Result of the PHY 501 attendance taking test.

Name of student	Registration number	Department	Option	Time of attendance
Ikeh Greg Amaobi	20141908005	Physics	Electronics	12:33pm
Ebomuche Victor .N	20141898345	Physics	Materials	12:34pm
AgboChinonso . E	20141907765	Physics	Materials	12:34pm

It was observed that the device worked as designed as without the Lecturers E-Identity card used first to activate the attendance taking mode, the device could not record attendance for any of the pre-registered students' e-identity cards brought close to its scanner. Also, the device did not record attendance for non-registered e-identity cards brought close to its scanner.

4. CONCLUSION AND RECOMMENDATION

An RFID based digital attendance system was designed and constructed using an RFID reader module and Arduino Nano 3.x board (which is an ATmega328P based 8-bit AVR family microcontroller) as the major components. The constructed device was tested and it worked as designed by registering class attendance for students whose e-identity cards were brought close to the device's scanner after the Lecturer's e-identity card has been used to activate the attendance taking mode of the device.

We, therefore, recommend that this new design of digital attendance system with attendance taking mode access control feature be locally mass-produced and used in taking attendance in the Universities of Countries where high level of students' truancy exist.

REFERENCES

Ajami S. & Rajabzadeh A. 2013. Radio frequency identification (RFID) technology and patient safety. Journal of Research in Medical Sciences. 18(9): 809-813.

Arulogun O. T., Olatunbosun A., Fakolujo O. A. & Olaniyi O. M. 2013. RFID-Based Students Attendance Management System. International Journal of Scientific & Engineering Research. 4(2): 1-9.

COMPONENTS101. 2019. Introduction to RFID Modules - Construction, Types and Working. Retrieved August 20, 2019, from https://components101.com/index.php/articles/introduction-rfid-modules-construction-types-and-working

Datta D. B. 2016. Radio Frequency Identification Technology : An Overview of its Components, Principles and Applications. International Journal of Science, Engineering and Technology Research. 5(2): 565-574.

Desai V., Gore Y., Jankar S. & Patil S. V. 2018. Attendance Management using Biometrics with SMS Alerts. International Journal for Research in Applied Science and Engineering Technology, 6(1): 3468-3471. https://doi.org/10.22214/ijraset.2018.1483

Ehikhamenle M. & Okeke R. O. 2017. Design and Construction of an Rfid Based E-Attendance Register. International Journal of Engineering Research and General Science. 5(1): 161-172.

Fine C., Klym N., Tavshikar M. & Trossen D. 2006. The Evolution of RFID Networks (Paper 224). Cambridge.

Ishak Z. & Fin, L. S. 2013. Truancy among Malaysian Students: an Analysis Based on Ethnicity. Journal of Teaching and Education. 2(2): 331-338.

John. (n.d.). Arduino Nano Tutorial – Pinout & Schematics. Retrieved April 28, 2020, from http://www.circuitstoday.com/arduino-nano-tutorial-pinout-schematics

Kariapper R. K. A. R. & Razeeth S. 2019. RFID Based (IoT) Automatic Attendance System: A Survey Analysis. SSRN Electronic Journal, (May). https://doi.org/10.2139/ssrn.3372734

Kumbhar A. A., Wanjara K. S., Trivedi D. H., Khairatkar A. U. & Sharma D. 2014. Automated Attendance Monitoring System using Android Platform. International Journal of Current Engineering and Technology, 4(2): 1096-1099. Retrieved from International Journal of Current Engineering and Technology.

Mishra, Y., Marwah, G. K., & Verma, S. (2015). Arduino Based Smart RFID Security and Attendance System with Audio Acknowledgement. International Journal of

Engineering Research & Technology (IJERT), 4(1): 363-367. Retrieved from www.ijert.org

Mistri R. K., Kishore K., Nidhi P., Pushpakumari& Vikrantkumar. 2018. RFID based Attendance System. International Journal for Research in Applied Science and Engineering Technology, 6(5): 2237-2241. https://doi.org/10.22214/ijraset.2018.5364

Musa T. M. 2014. Absenteeism and Truancy on Academic Performance of Secondary School Students in Ogun State, Nigeria. Journal of Education and Practice. 5(22): 81-87.

Mustapha, M., Abdulkadir, M., Sarki, M. A., & Omale, S. P. (2018). RFID Based Student Attendance Monitoring System with GSM Module Incorporated. 9(2): 23-33.

Ojo O. A., Adu K. O. & Adu E. O. 2017. Truancy and Academic Performance of Colleges of Education Students in South-Western Nigeria: Implication for Evaluation. The Anthropologist, 29(1): 1-7. https://doi.org/10.1080/09720073.2017.1335811

Oluremi F. D. 2013. Truancy and Academic Performance of Secondary School Students in Southwestern Nigeria: Implications for Counselling. International Journal for Cross-Disciplinary Subjects in Education, 3(Special 2): 1424-1428. https://doi.org/10.20533/ijcdse.2042.6364.2013.0198.

Pal N.& Sharma A. K. 2011. Implementation of RFID Technology in Library System. Thesis: Lathi University of Applied Sciences. 7(2): 70-79.

Ravi. 2018. Arduino SD Card Module Interface – Hook-up Guide and Data Logging. Retrieved August 10, 2019, from https://www.electronicshub.org/arduino-sd-card-module.

Rieback M. R., Crispo B. & Tanenbaum A. S. 2006. The evolution of RFID security. IEEE Pervasive Computing, 5(1): 62-69. https://doi.org/10.1109/MPRV.2006.17.

Roberti M. 2005. The History of RFID Technology. RFID Journal, 2. Retrieved from http://www.rfidjournal.com/articles/view?1338.

Sa'ad T. U., Sabo S. & Dahuwa A. A. 2015. Investigation into the Causes of Truancy among Public Senior Secondary School Students in Azare Metropolis of Bauchi State, Nigeria. IOSR Journal of Research & Method in Education Ver. I, 5(5): 2320-7388. https://doi.org/10.9790/7388-05514045.

Shoewu O., Makanjuola N. T., Ajasa A. A. & Ayangbekun O. J. 2015. Design and Implementation of an Rfid Based Automated Students Attendance System R BASAS. Journal of Advancement in Engineering and Technology. 3(2): 1-6.

Ukoima K. N., Ekwe O. A. & Ezeonye C. S. 2019. Radio Frequency Identification (RFID) Based Attendance System with Short Message Service (SMS) Backup, 21(2): 1-8. https://doi.org/10.9790/0661-2102010108.

Walia H. & Jain N. 2016. Fingerprint Based Attendance Systems-A Review. International Research Journal of Engineering and Technology (IRJET), 03(05): 1166-1171.

Weis S. A. 2010. RFID (Radio Frequency Identification): Principles and Applications. Emerging Technologies. 1-23.