International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Door Lock System by RFID using ARDUINO

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Abstract: ***Wireless security-based applications have rapidly increased due to the dramatic improvement of modern technologies. Many access control systems were designed and/or implemented based on different types of wireless communication technologies by different people. Radio Frequency Identification (RFID) is a contactless technology that is widely used in several industries for tasks like access control system, book tracking in libraries, tollgate system, supply chain management, and so on. In this paper, automatic RFID-based access control system using Arduino was designed. The system combines RFID technology and Arduino to accomplish the required task. When the RFID reader installed at the entrance detects an RFID tag, the system captures the user unique identifier (UID) and compares it with the stored UID for a match. If the user UID captured match with any of the stored UID, access is granted; otherwise access is denied. The results clearly show that the system is cheap, effective, and a reliable means of granting or denying access in a secured environment.***

Keywords: wireless, RFID, UID

1. Introduction

Security systems play an important role to prevent unauthorized personnel entry into a secured environment, which may include physical and intellectual property. Various door locks such as mechanical locks or electrical locks were designed to attain basic security requirements. Basically, these locks can be easily hacked by unwanted people thereby allowing unauthorized personnel into secured premises. Automatic access control system has become necessary to overcome the security threats faced by many organizations in Nigeria. By installing the system at the entrance will only allow the authorized personnel to enter the organization. The system is not restricted to main entrance installation, but can be installed at various entrances within the organization to track personnel movement thereby restricting their access to areas where they are not authorized. There are several automatic access control technologies including barcode, magnetic stripe and Radio Frequency Identification (RFID) applied in security system. Radio-Frequency Identification (RFID) is an emerging technology and one of the most rapidly growing segments of today's access control.

RFID technology, offers superior performance over other automatic identification systems and is used in many areas such as public transport, ticketing, animal identification, electronic immobilization, industrial automation, access control, asset tracking, people tracking, inventory detection and many more. Figure 1 show two different ways access control system can be accomplished. Use of keys which is old method and by use of RFID technology. This paper discusses the design of an automatic access control system using Arduino microcontroller and RFID system.

The aim is granting access to authorized personnel and denying access to unauthorized personnel by using RFID technology instead of keys as shown in figure 1. Each person is issued an authorized tag, which can be used for swiping in front of the RFID reader to have access to a secured environment.

2. Literature Survey

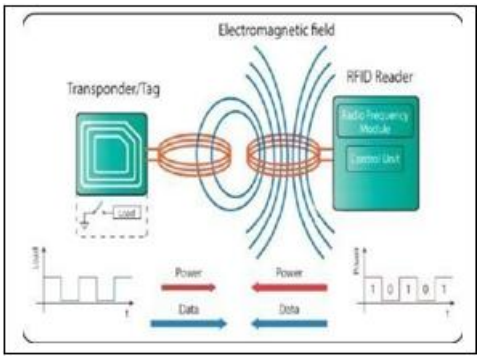
Umar et al proposed an RFID based security and access control system. It is the design of RFID based security and access control system for use in hostels inside Punjab University promises. The system combines RFID technology and biometrics to accomplish the required task. When the RFID reader installed at the entrance of the hostel detects tag UID, the system captures the user's image and scans the database for a match. If both card UID and captured image matches a registered user, access is granted; otherwise, access is denied and the system turns on alarm to alert the security personals. The advantage of the system is that it successfully accomplished security and control task by processing information from sub-controllers like; entrance monitoring controller, exit monitoring controller and mess monitoring controller installed at entrance gate, exit gate and mess gate respectively. Although the developed system is useful in reducing security threats to the hostels, there is a room for improvement in the response time of the system. The response time can be improved by using dedicated processors instead of computer systems capable of processing the images in real time. RFID based access control security system with GSM technology was proposed by Peter et al. The work was archived through the use of RFID system operating on 125 KHz frequency, microcontroller programmed to send control signals, DC motor, relay, buzzer, liquid crystal display (LCD), and GSM/GPRS modem. Once the RFID tag which contains the user's unique information is scan by the RFID reader and confirmed match with the information stored in the microcontroller, the microcontroller is instructed to turn on the DC motor, display user number and card number on the LCD and activates the GSM/GPRS modem to send an SMS

alert about authorized user card to the security personnel. Else, the DC motor remained off, LCD displays invalid card, buzzer turns on for about 5seconds, and GSM/GPRS modem activated to send unauthorized user card to the security personnel.

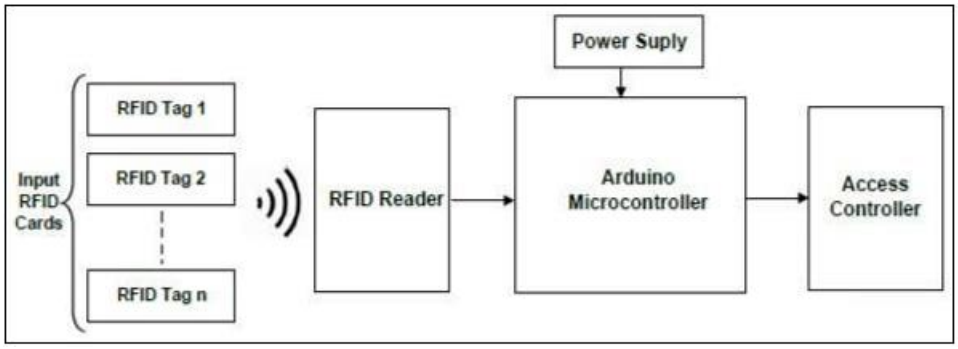
3. Scheme of the Project

In this proposed work, the RFID reader reads the data from tag and sends the card UID number to Arduino microcontroller for comparison, if the card is valid then Arduino microcontroller display access granted else, access denied on the screen. 3.1. Hardware Overview RFID Technology - RFID stands for Radio Frequency Identification and it's a non-contact technology that's broadly used in many industries for tasks such as personnel tracking, access control, supply chain management, books tracking in libraries, tollgate systems and so on. Our RFID system consists of two main components, a tag which is located on the RFID card one want to be identified, and a transceiver or a reader which is installed at the secured entrance.

Our system RFID reader consists of a radio frequency module, a control unit and an antenna coil which generates high frequency electromagnetic field as shown in figure 2. On the other hand, the tag used in this work is a passive component, which consists of just an antenna and an electronic microchip, so when it gets near the electromagnetic field of the transceiver installed at the secured entrance (2 to 5 inches), due to induction, a voltage is generated in the tags' antenna coil and this voltage serves as power for the microchip of our system tag. Now as the tag is powered, it can extract the transmitted message from the reader, and for sending message (UID) back to the reader, it uses a technique called load manipulation. Switching on and off a load at the antenna of our tag will affect the power consumption of the reader's antenna which can be measured as voltage drop. These changes in the voltage will be captured as ones and zeros and that's the way the data is transferred from the tag to the reader.

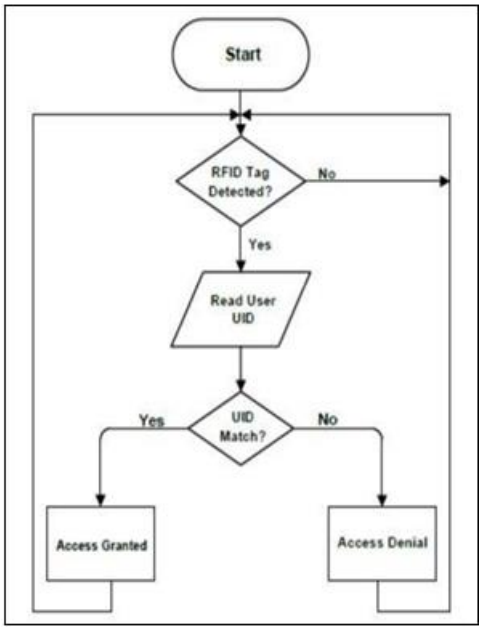


4. Diagram of The Project



5. Flow chart

All necessary information about all users is stored in the system. In other to add a new user, we must first register the user with the system then, corresponding user information is burn in RFID tag. The new tag will now be accessible through the system.



When a user comes to the entry point where the RFID reader is installed and places the RFID tag close (contactless) to the reader, the system checks whether it is a registered user or not. If the user is registered, the tag information is matched with the user information stored in system as shown in the flowchart. Access is granted to such user while access is denied to unauthorized user.

6. Working Principle

We have one RFID tag with UID (B0 A5 8D 7C) and for RFID reader to get such information from the tag it needs to be converted from hexadecimal value to binary. (As Shown Bellow)

Table 1: UID- B0 A5 8D 7C Conversion

Hexadecimal value	Binary
B	1011
0	0000
A	1010
5	0101
8	1000
D	1101
7	0111
C	1100

32 bit worth of data is transferred from the tag to the reader in binary form (1011 0000 1010 0101 1000 1101 0111 1100). This data is transferred using high frequency (HF) 13.56MHz, which is the frequency that our RFID system operates on.

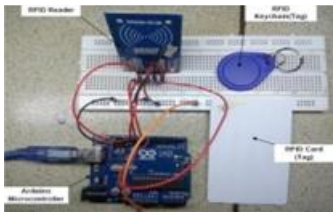
Arduino UNO Board:
The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM (pulse width modulation) outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB (universal serial box) connection, a power jack, an ICSP (in-circuit serial programming) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Software overview: Arduino IDE
The IDE (Integrated Development Environment) is a special program running on computer that allows one to write sketches for the Arduino board in a simple language model after the Processing language. To program the Arduino microcontroller Arduino coding language was used. The Arduino language is based on C/C++ and the most basic executable program only needs two functions as shown in figure 4, a setup() and a loop(), to run. In the setup() function variables, pin modes, serial communication, etc are initialized. This function only runs once. The loop() function is where one write the actual code. As the name implies, the loop() function loops continuously until the device is powered off. Simple as it may sound; it is possible to write complex programs using the above described structure.

7. Outcomes

When the RFID tag is placed close to the RFID reader, access is granted or denied. The right tag stored on the microcontroller grants access to the secure environment while the wrong tag not stored on the microcontroller will deny access to the card holder. Access granted or denied is displayed on the serial monitor.

8. Results

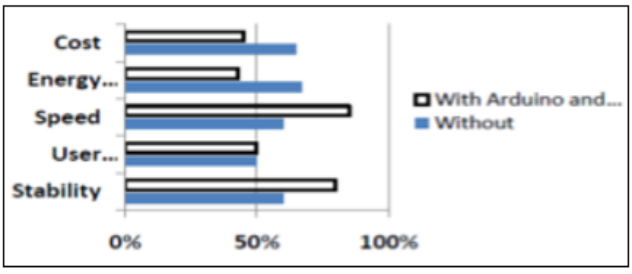


The project has the following here the access control is installed, one is asked to approximate their RFID tag to the reader as show on the output window. The reader reads the tag and the microcontroller compare the tag's UID for match and grant access if there is a match and deny access if there is no match.

An RFID tag can be added or removed through the Arduino IDE or any other programming language that Arduino understands. For changes made on the sketch (i.e. adding or removing a tag) to be effective on our system, the sketch must be re-uploaded to the Arduino board to override previous sketch.

9. Cost estimation of this project

Access control system was analyzed using the following criteria: cost, energy consumption, speed, user satisfaction, and stability. The bar chart (figure 10) shows that there are significant enhancements in access control system using Arduino and RFID technology. The enhancements come in the area of cost, energy consumption, speed, and stability. Other access control systems have high energy consumption rate which is a great problem in Nigeria where energy is very expensive, while the users of the system have equal satisfaction in both systems.



So, as we can see by the charts, this can be done very easily with a cost cutting moments, and also with Arduino it can be done very easily and can be bought very easily by some local Stores in a cheap price

10. Conclusion

In this paper, a prototype of automatic access control system for use in an environment is presented. The system uses radio frequency identification (RFID) with Arduino

technology to differentiate between authorized and unauthorized users. The RFID reader reads RFID tag issued to the user and matches it with stored UID on the Microcontroller. On a successful match, the microcontroller grants access or deny access if no match was found. An automatic access control system using Arduino and RFID has been prototyped and functioned as desired. The system can be installed at the entrance of a secured environment to prevent an unauthorized individual access to the environment.

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