INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume 4, Issue 2)

Available online at: www.ijariit.com

All Access V Card

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ABSTRACT

In this paper, we demonstrate an RFID tag is used for multiple purposes in a college or office premises. Here, we focus on two applications, access control, and monetary transactions. The basic details of the user of the card and a fixed amount deposited by him/her will be stored in a database. The user can be granted or denied access to any desired place with the help of this card. Also, the same card can be used instead of cash where monetary transactions are involved, where the amount spent gets deducted from the balance associated with the RFID card of the user. We achieve this by using a Wi-Fi module ESP8266 for communicating the required details to the server over the internet. The goal of this project is to provide easy access control and a cashless environment in any workplace.

Keywords: *RFID, Database, Server, WIFI Module ESP8266.*

1. INTRODUCTION

Automation in many fields has replaced the old school techniques and at the same time proved to be more efficient, correct and less cumbersome making our life much easier. This automation process when applied to an integral part of any organization, helps reduce the service time, eliminates queues, provides security, etc. Here we try to achieve automation by introducing RFID tags used as identity cards in any workplace. The focus lies on college environment, but the same technology can be implemented in any office premises as well. An RFID card can be issued for everyone and it can be used for basically two purposes- access control and monetary transactions. Educational institutions have well-equipped laboratories with delicate and expensive instruments to help students perform various experiments to understand the subject better. Although, a small barrier in this process is that the instruments in the laboratories being expensive and delicate, students are not given the permission to use them in the absence of a faculty member. In our system, we plan to register the details of the student using the equipment and the time duration for which he/she uses it. This enables the students to access the equipment at and point in time as well as track the culprit in case of damage. Another increasing trend observed is cashless transactions which are growing because of its ease and advantages. In order to give students a feel of this environment, our system issues an RFID card for each student along with some cash balance associated with each card which can be used by student for purchase in college canteen, stationary or any other place where monetary transactions are involved so that the commotion caused at counter can be avoided and students would not have to carry cash inside the campus.

2. OVERVIEW OF RFID TECHNOLOGY

RFID system consists of three components namely transponder (tag), interrogator (reader) and a computer containing the database, as shown in Fig. 1. The interrogator reads the tag data and transmits it to the computer for authentication. The information is processed and upon verification, access is granted. The system offers diverse frequency band ranging from low frequencies to microwave frequencies [1]:

- Low Frequency: 125-134 KHz
- High Frequency: 13.56 MHz
- Ultra High Frequency: 902-928 MHz
- Microwave Frequency: 2.4 GHz

Depending upon the source of electrical energy, RFID tags are classified as either active or passive. The active tags use a battery for powering the circuit on the tag and transmit the tag information upon the reader request. However, these tags are very expensive and seldom used. On the other hands, passive tags get energy from the reader to power their circuit. These tags are very cost-effective and hence most of the applications use them.

In the present work, passive RFID tags have been used. A passive RFID tag transmits information to the reader when it comes in the vicinity of the electromagnetic field generated by the reader. The phenomenon is based on Faraday's law of electromagnetic induction. The current flowing through the coil of interrogator produces a magnetic field which links to the transponder coil thereby producing a current in the transponder coil. The transponder coil then varies this current by changing the load on its antenna. This variation is actually the modulated signal (scheme is known as load modulation) which is received by the interrogator coil through mutual induction between the coils. The interrogator coil decodes this signal and passes to the Arduino for further processing.

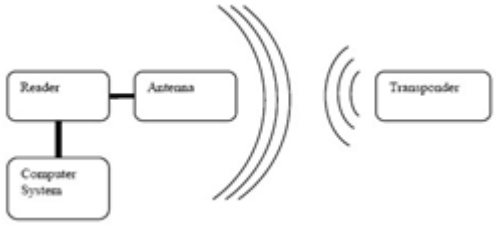

Figure 1: Basic RFID

3. PROPOSED SYSTEM

3.1 Problem Statement

To develop a system which can be used by students to gain access to places where the presence of staff member is generally required for security reasons as well as to allow them to carry out routine activities inside the campus without using cash for transactions.

3.2 Components

i) RFID reader:

The EM-18 RFID Reader module operating at 125 kHz is used to read the RFID tags. It can be powered up with a 5V power supply and has a range of 10 cm.

ii) 4x4 Matrix keypad

A 4x4 Matrix keypad is used to obtain the product code of the product which the user wants to purchase.

iii) ESP8266 12e (NodeMCU)

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Espressif Systems. The NodeMCU includes firmware which runs on the ESP8266 Wi-Fi SoC and hardware which is based on the ESP-12 module.[2] This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections. It is used to communicate the obtained information to the server.

iv) Arduino Uno

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc.[3] Here it is used to collect entered data from the 4x4 matrix keypad and send it to NodeMCU via the I2C protocol.

v) 16x2 LCD screen

A 16x2 LCD is connected to the NodeMCU over the I2C protocol. It is used to display instructions and notifications while the process is being executed.

3.3 Working

As mentioned earlier, two systems are focused upon-

access control system using RFID for students to be allowed access to laboratories wherein their details and time for which they use the lab will be registered and transactions using RFID where students can use RFID cards wherever there is need to pay money inside the campus and required amount will be deducted from the balance associated with the card which can be refilled from time to time by paying cash only once.

A) ACCESS CONTROL

For this, we use the RFID reader, Node MCU, a locking system and 16x2 LCD screen. We use the on-board microcontroller of Node MCU for processing. The LCD is controlled by Node MCU using I2C protocol.

- The user scans the RFID tag against the RFID reader so that the unique code associated with it gets scanned.
- This code is sent to the server by the ESP 12e module and the validity of the RFID card is checked.
- If the RFID is valid, access is granted to the user and the enclosure or door gets unlocked. Also, the time at which the RFID was scanned gets noted in the database. If the RFID is invalid, access is denied.

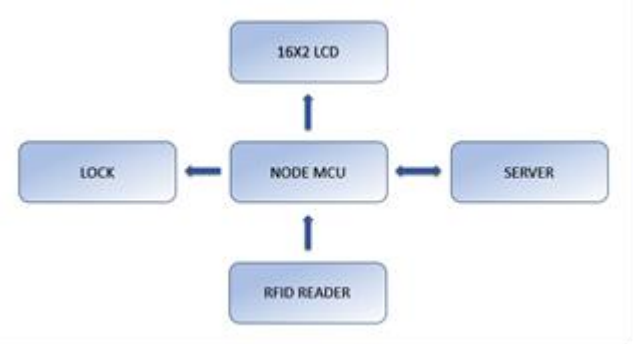

Figure 2: Access control system block diagram

- When the user is done with using the instrument, he scans it again. The ESP 12e module again sends the unique ID to the server, which finds the user using the ID and registers the time at which user stopped working and the enclosure gets locked.

This procedure is illustrated in Figure 3.

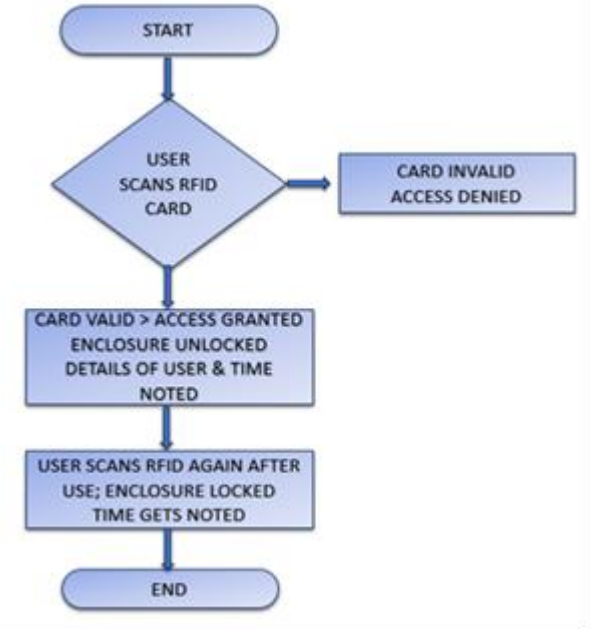

Figure 3: Access control system flowchart

B) TRANSACTIONS

For this, we use the RFID reader, Node MCU, Arduino, 4x4 matrix keypad to enter product codes and 16x2 LCD screen. We use the on-board microcontroller of Node MCU as well as the controller on Arduino. As the number of pins on Node MCU is less, the Arduino is used as a slave for passing the keys pressed on the keypad. The Node MCU uses I2C communication protocol to speak to the Arduino and LCD and connects to Wi-Fi to pass information to the server. This can be shown in Figure 4.

- When the user scans the RFID against the reader, the unique code is sent by the reader to Node MCU.
- It then sends this code to the server to verify the user. When the user is verified it asks for the product code.

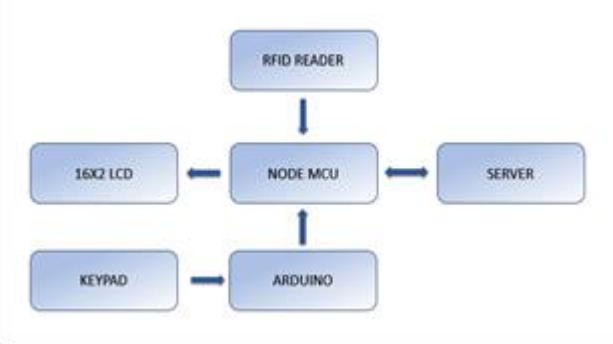

Figure 4: Transaction system block diagram

- The product code entered on the keypad is fetched by Arduino. When Node MCU requests, Arduino sends this code and Node MCU further sends this code to the server.
- If this code is correct, the price of the product gets deducted from the user's account and the remaining balance is updated on the database and is also reflected back on the LCD screen.
- If the code is incorrect, the request is canceled, and the entire process should be repeated again. This process can be understood with the help of flowchart in Figure 5

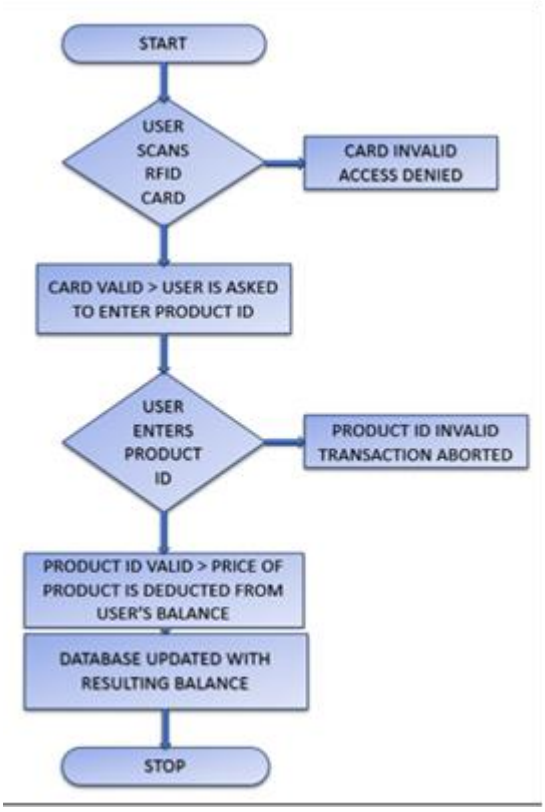

Figure 5: Transaction system flowchart

4. RESULTS AND DISCUSSIONS

The test results can be observed on the server in the database. As the operations are performed by the hardware, the database gets updated accordingly.

For access control, the database is dynamic. When the user scans the RFID, his name and login time will get updated. When he scans it again, the logout time will get updated after hardware operation. This can be observed in Figure 6.

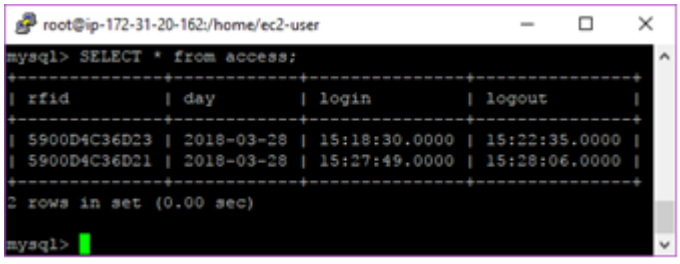

Figure 6: Database for access control

For evaluating transactions, we need to observe the changes in the balance which take place before and after hardware operation. The initial database consists of a list of all valid users and the amount associated with each user which is as shown in Figure 7 and also a list of the product code and the price of the product. This table is shown in Figure 8.

Figure 7: Initial user database for transactions

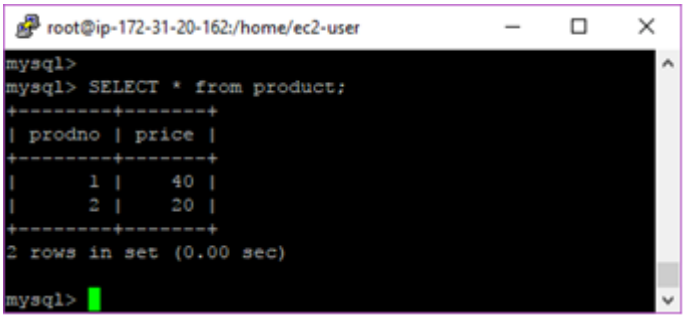

Figure 8: Initial product database for transactions

Assuming the first user is trying to purchase a product and the product code entered is '1', the price of the product related to this code gets deducted from her balance and the database is updated with this new amount. This can be observed in Figure 10.

Figure 9: Updated user database for transactions

5. CONCLUSION

We have established a system that can meet our objective. The access control system allows students to access the laboratories and its instruments even in absence of staff. However as the details of the students are maintained, the staff can actually keep a track of who used which instrument at what time, so as to avoid malpractices. Hence, this system allows students to access many places like laboratories, the library at any point in time. The transaction system using RFID gives the students the freedom of carrying out their daily activities on the campus without using their wallet. The RFID card can be used instead of cash in many places like canteen, stationary, library etc.

Thus students enjoy a cashless environment on the campus. This system focuses on implementation on a college campus but the same system can be used in any workplace as well for same purposes.

6. REFERENCES

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