Mini Project 1B Report

On

Security Access Using Arduino and RFID Reader

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CERTIFICATE

This is to certify that the Mini Project stage 1B entitled "**Security Access Using Arduino and RFID Reader**" is a bonafide work of

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Project Report Approval

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ABSTRACT

RFID tagging is an ID system that uses small radio frequency identification devices for identification and tracking purposes. An RFID tagging system includes the tag itself, a read/write device, and a host system application for data collection, processing, and transmission.

In simple words an RFID uses electromagnetic fields to transfer data over short distances. RFID is useful to identify people, to make transactions, etc..

You can use an RFID system to open a door. For example, only the person with the right information on his card is allowed to enter. 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.

Whereas it can also be commonly found in hotels, offices, banks, stores, etc. RFID chips are even implanted in pets to make sure that they can be identified and returned home if lost. It is often compared to a barcode. But even if it has the same use as a barcode, the two differ in a few ways.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

RFID technology was solely **Invented by Charlie Walton** in the 1970's and patented in 1973 and 1983.Although patented many years ago, RFID technology only came to be used more recently in the 2000s.

Recently, there have been numerous explorations of the fundamental characterizations of passive radio frequency identification (RFID) systems in electromagnetic structures. These studies have concentrated on various topics not limited to the holy grails of passive RFID systems, i.e. metallic and moist environments. Because of the nature of passive systems, attenuation in these environments is relatively high and often causes an RFID tag to hover towards the no-read zones. This is typically propelled by the lack of power being harvested by the tag or attenuation of the tag reply signals. An area of research that has garnered interest is the use of passive RFID systems in and around human tissues, but this interest has not previously resulted in significant research. UHF RFID reader systems operating under FCC regulations may create RF energy absorption that could represent a significant impact to the human body, when present in high densities and/or close proximities

1.1. EXPLORING ARDUINO:-

Arduino is an open source platform that is used to program hardware using software. Arduino boards consist of a micro-controller and other electronic components that can be programmed using Arduino programming language to do different tasks.

Micro-controller is a type of IC (integrated circuit) and it includes processor, memory and input/output peripherals on a single chip. The micro-controllers used by Arduino are mostly from ATMEL.

Arduino was born at the Ivrea Interaction Design and since then it is used in thousands of projects and applications. Unlike other microcontrollers, the code is easy to upload in it. It doesn't require a separate hardware to upload the code in it. The code can be uploaded by just using a USB cable. The code will be saved on the Arduino and will run until you upload a new code.

Top 6 Different Types of Arduino

Arduino **UNO**. The development of the Arduino UNO board is considered as new compared to other Arduino boards. ...

- Arduino **LilyPad.**
- Arduino **Mega.**
- Arduino **Leonardo.**
- Arduino **Red Board.**
- Arduino **Shields.**

1.1.1 ARDUINO BENEFITS:-

1) It is an Open source project and you can easily customize and extend it by using sensors and modules. The software is also free to download.
2) It is Cross platform and can run on Windows, Linux and Mac operating systems.
3) It is Inexpensive and the most commonly used Arduino board (Arduino Uno) costs less than ₹450 .
4) It is very Easy to use, you just need to connect it to the computer via USB cable and it will automatically install the drivers and will be ready to use.
5) It has a Large support community and you can find an extensive number of libraries and shields.
6) It can do simple as well as complex tasks like you can program it to blink an LED as well as you can program it to build a CNC machine using it.

1.1.2 ARDUINO BOARD PIN CONFIGURATION
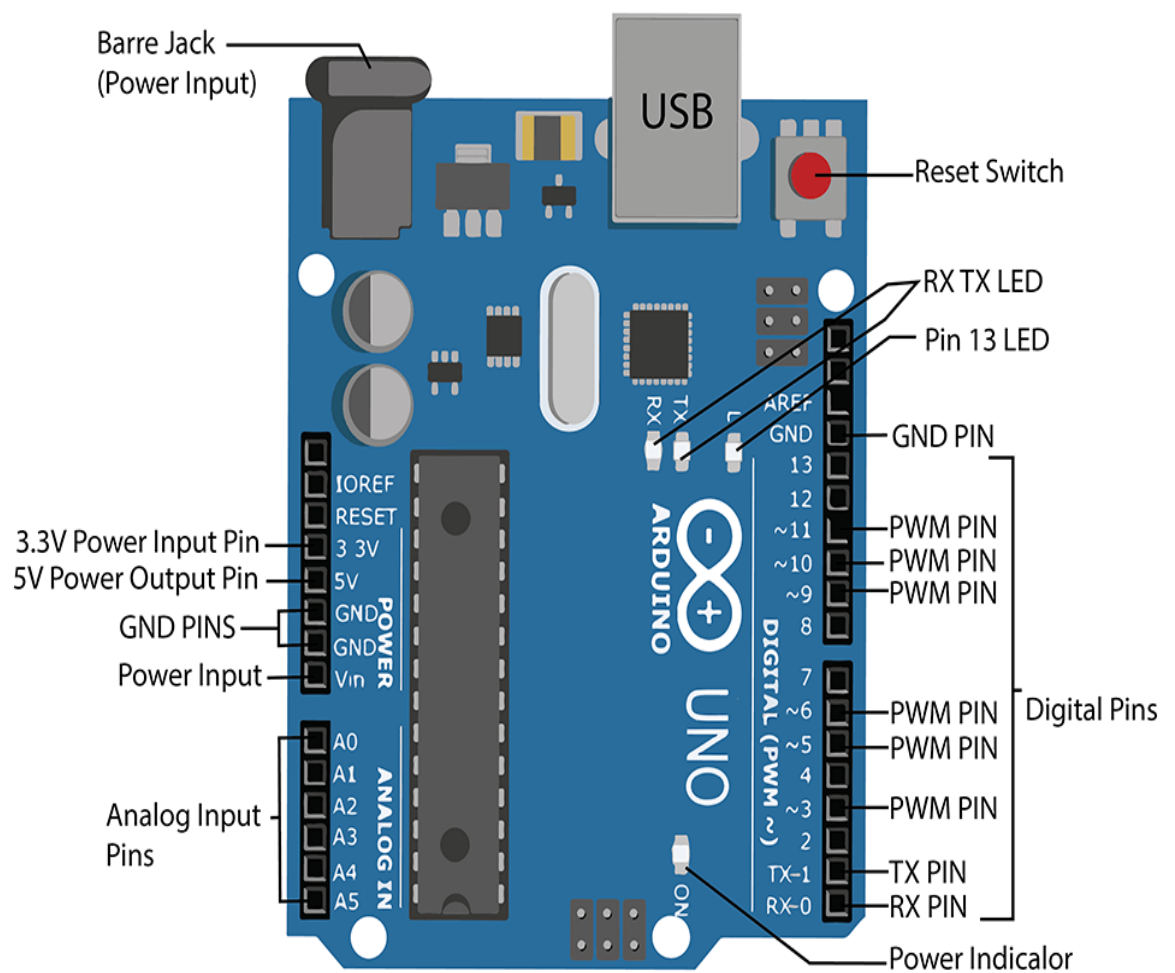
Fig 1.1.2 Arduino Board Pin Configuration

There are different Arduino's available that are used for different purposes and they have most of the components in common.The most commonly used Arduino is the Arduino Uno so let's see what is on the Arduino Uno board.

1- USB Plug:

The Arduino Board can be powered by a USB cable coming from your computer. Using this USB connection, we will upload our codes in the Arduino.

2- Barrel Jack:

Arduino Board can also be powered from wall power supply by connecting it to the barrel jack. For power supply users, the recommended voltage for mostly Arduino boards is between 6 to 12 Volts. The maximum voltage to use is 20 Volts.

3- Voltage Regulator:

It controls the amount of voltage going into the Arduino Board to sustain the voltage used by the microcontroller and other components. It will cut off the extra voltage that might harm any component on the board. It has limitations and cannot control voltages greater than 20 Volts.

4- Crystal Oscillator:

It provides a clock signal to the microcontroller which helps the microcontroller to calculate time. The frequency of this crystal oscillator is 16 MHz which means that it can make 16 million cycles per second.

5- Reset Button:

It will restart your Arduino program.

6- Digital I/O Pins:

These pins are either used as input pins or as output pins. Arduino Uno has 14 digital pins from 0 to 13. Out of these 14 digital pins, 6 pins can also provide PWM (Pulse Width Modulation) output. The PWM pins have tilde sign (~) before the pin numbers. The PWM pins on the Arduino Uno are 3, 5, 6, 9, 10, and 11. The pins 0, 1 are RX and TX pins and these are used to receive and transmit the TTL serial data.

7- ICSP (In Circuit Serial Programming) Pins:

It is one of the several ways to program an Arduino board. Normally, a boot-loader is used to program an Arduino but if it is missing or damaged, ICSP can be used instead.

8- Microcontroller:

You can say it is the brain of the Arduino. Micro controller is a type of IC (integrated circuit) and it includes processor, memory and input/output peripherals on a single chip. Different Arduino Boards have different microcontrollers. The Arduino Uno has an ATmega328P microcontroller.

9- Analog Pins:

These pins can read the signals from analog sensors such as LDR and convert them into digital. There are 6 analog pins on Arduino from A0 to A6.

10- Power Pins:

- Vin: This pin is sometimes also labelled as "9V". It can be used to power the Arduino and if you are giving power to the Arduino through the barrel jack, this can be used to access voltage.

- GND: Ground pins are used to ground the circuit. There are 3 ground pins on the Arduino Uno.
- 5V: It supplies output of 5V.
- 3V: It supplies output of 5V.
- Reset Pin: You can also use this pin to restart the Arduino by connecting a button at this pin.
- IOREF: This pin gives the output voltage corresponding to the I/O of that board. In the case of Arduino Uno, this pin gives 5V.

11- ATmega16U2 Chip:

This chip on your Arduino act as a bridge between the computer's USB port and the main processor's serial port. This helps us to upload the code from the computer into the Arduino.

12- AREF:

This is the external analog reference pin and we can use this to use it instead of the standard 5V reference as the upper limit for the analog input pins. For example, if you are getting a signal of 0-3.3 volt then you can get the full scale of ADC by connecting AREF to 3.3V signal.

13- TX RX LEDs:

These are transmitter and receiver LED's. They will blink whenever we will upload a program or the Arduino will receive or transmit data.

14- Power LED:

This should light up whenever you will give power to your Arduino.

1.2 RFID READER

In our everyday life, everybody uses RFID technology, most of the times without knowing it. Today, in this article, we are going to see some examples of where we find it. Maybe you will be surprised about how many times you use RFID technology in your everyday life.

As you may know, the initials RFID mean Radio Frequency Identification. The basic concept of operation is:

- An antenna sends out and receives radio signals.

- These signals are received and returned by an RFID tag with information added.

- A reader which is integrated with a system accepts and stores these data called events and finally, they trigger actions.

The RC522 is a 13.56MHz RFID module that is based on the MFRC522 controller from NXP semiconductors. The module can supports I2C, SPI and UART and normally is shipped with a RFID card and key fob. It is commonly used in attendance systems and other person/object identification applications.

1.2.1 RC522 PIN CONFIGURATION

PIN NUMBER	PIN NAME	DESCRIPTION
1	Vcc	Used to Power the module, typically 3.3V is used
2	RST	Reset pin – used to reset or power down the module
3	Ground	Connected to Ground of system
4	IRQ	Interrupt pin – used to wake up the module when a device comes into range
5	MISO/SCL/Tx	MISO pin, when used for SPI communication, acts as SCL for I2c and Tx for UART.
6	MOSI	Master out slave in pin for SPI communication
7	SCK	Serial Clock pin – used to provide clock source
8	SS/SDA/Rx	Acts as Serial input (SS) for SPI communication, SDA for IIC and Rx during UART

2. REQUIREMENTS

2.1 HARDWARE COMPONENTS:-

(i) ARDUINO UNO:-

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc.The word "uno" means "one" in Italian and was chosen to mark the initial release arduino software.
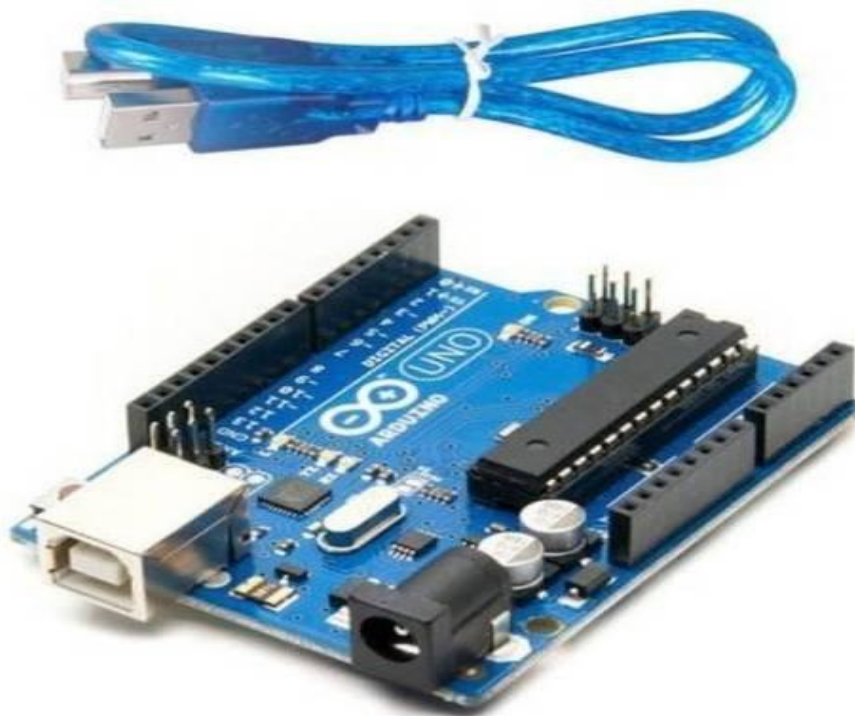
Fig 2.1.1 Arduino Uno

(ii) RFID:-

Radio Frequency Identification (RFID) is a technology that uses radio waves to passively identify a tagged object.

Fig 2.1.2 RFID

(iii) RFID/NFC TAG:-

RFID (radio frequency identification) and NFC (near field communication) are both wireless communication technologies that power the Internet of Things (IoT). The technologies can be used in everything from access control to asset tracking.

Fig 2.1.3 RFID/NFC Tag

(iv) MALE TO FEMALE JUMPER:-

Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into.

Fig 2.1.4 Male To Female Jumper

(v) 9V CELL:-

The nine-volt battery, or 9-volt battery, is a common size of battery that was introduced for the early transistor radios . It has a rectangular prism shape with rounded edges and a polarized snap connector at the top.

Fig 2.1.5 9V Cell

(vi) LED:-

Light emitting diode a device that produces a light on electrical and electronic equipment


Fig 2.1.6 LED

(vii) BUZZER:-

A buzzer or beeper is an audio signalling device,which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Fig 2.1.7 Buzzer

(viii) BREADBOARD:-

A breadboard, or protoboard, is a construction base for prototyping electronics. In the 1970s the solderless breadboard (a.k.a. plugboard, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these.
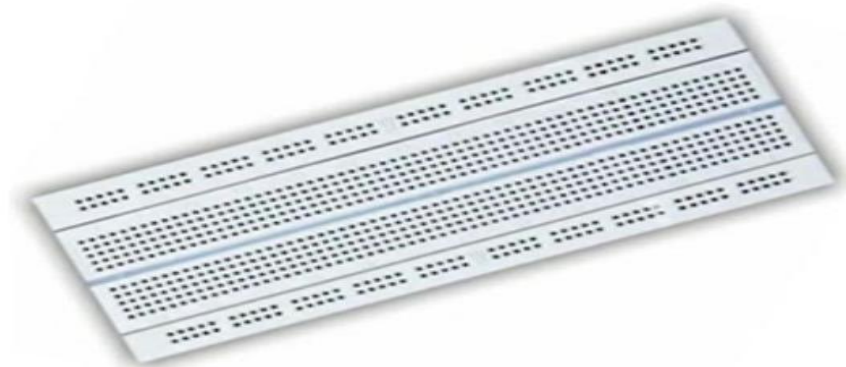

Fig 2.1.8 Breadboard

2.2 SOFTWARE APPLICATION

(i) ARDUINO IDE:-

Arduino IDE where IDE stands for Integrated Development Environment An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is open source and is readily available to install and start compiling the code. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.
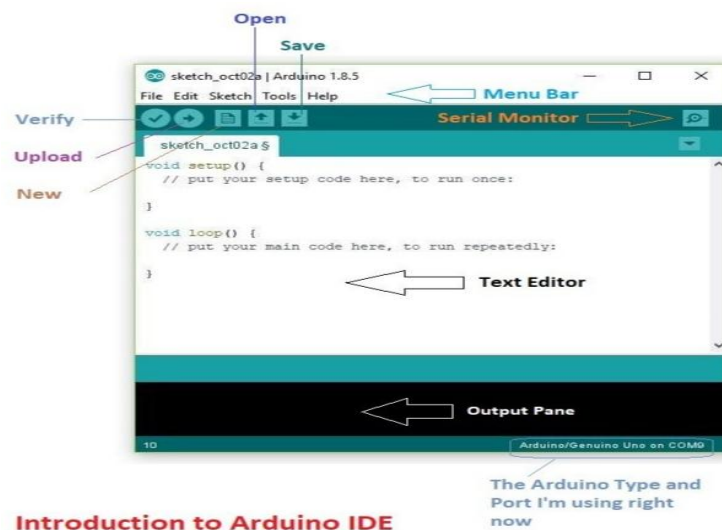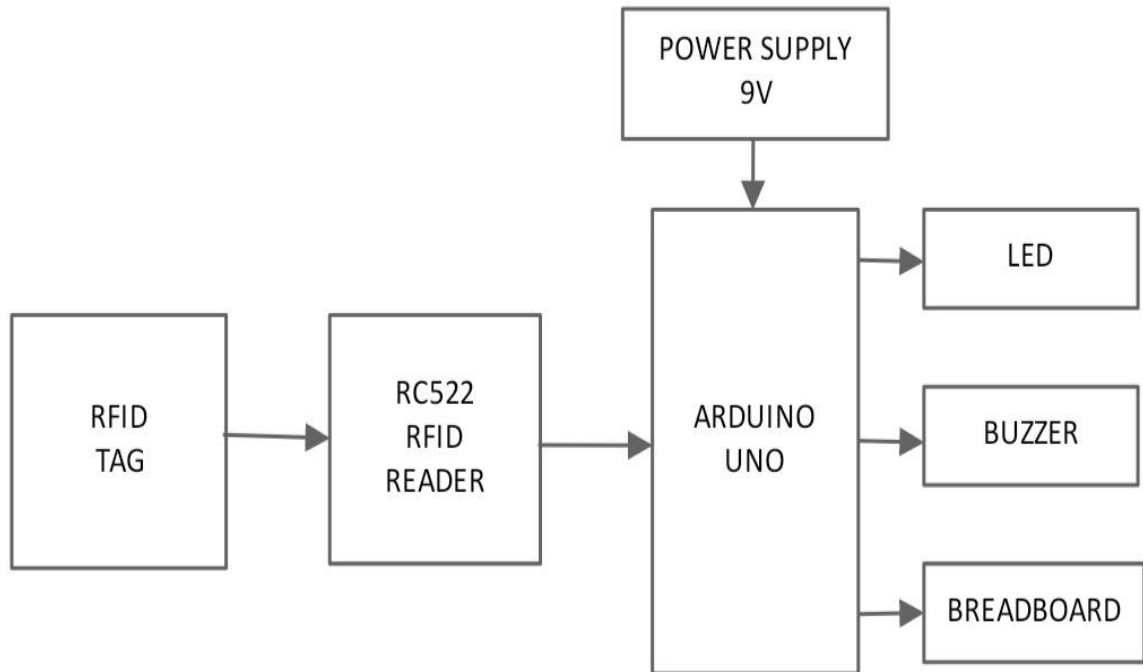
Fig 2.2 Introduction To Arduino IDE

2.3 DIAGRAM/LAYOUT

2.3.1 BLOCK DIAGRAM

Fig2.3.1 Block Diagram

Security access using the Arduino and RFID reader project has an RFID reader attached to it. RFID reader reads the unique alphanumeric code of RFID tags and sends it to Arduino. Then Arduino detects whether an RFID card is valid or invalid. The system will only give access on scanning the right tag and on scanning the wrong tag, the system will deny access and buzzer will make a beep sound
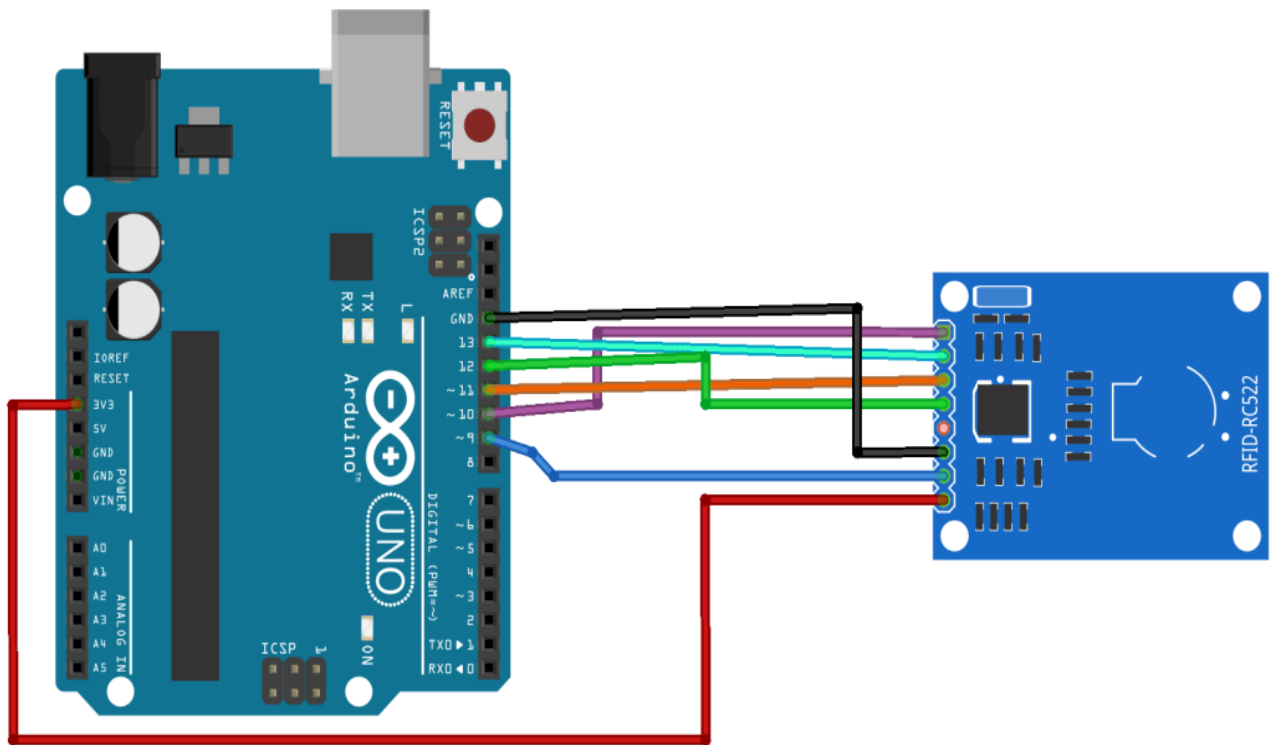
2.3.2 CIRCUIT DIAGRAM

RFID reader is a wireless technique used for wireless communication where it is used to read or write data over a RFID tag.

Now, it's time to connect our Arduino with the RFID reader. Refer to the PIN Wiring below, as well as the connection schematic diagram for easy reference:-

PIN WIRING

| PIN	WIRING TO ARDUINO UNO
SDA	DIGITAL 10
SCK	DIGITAL 13
MOSI	DIGITAL 11
MISO	DIGITAL 12
IRQ	UNCONNECTED
GND	GND
RST	DIGITAL 9
3.3V	3.3V(DO NOT CONNECT TO 5V)

**Fig 2.3.2 Circuit Diagram**

2.4 OUTPUT/RESULTS:-

RFID is an emerging technology and one of the most rapidly growing segments of today's access control. RFID can now generally be regarded as the best Security solution for Schools, Colleges etc. In the following steps we will see how our project is going to work. At first when we connect our battery, the user will have to wait for 3 seconds for the system to get ready. After 3 seconds our project is ready to scan and hence you can take a look on how the following steps are taken:-
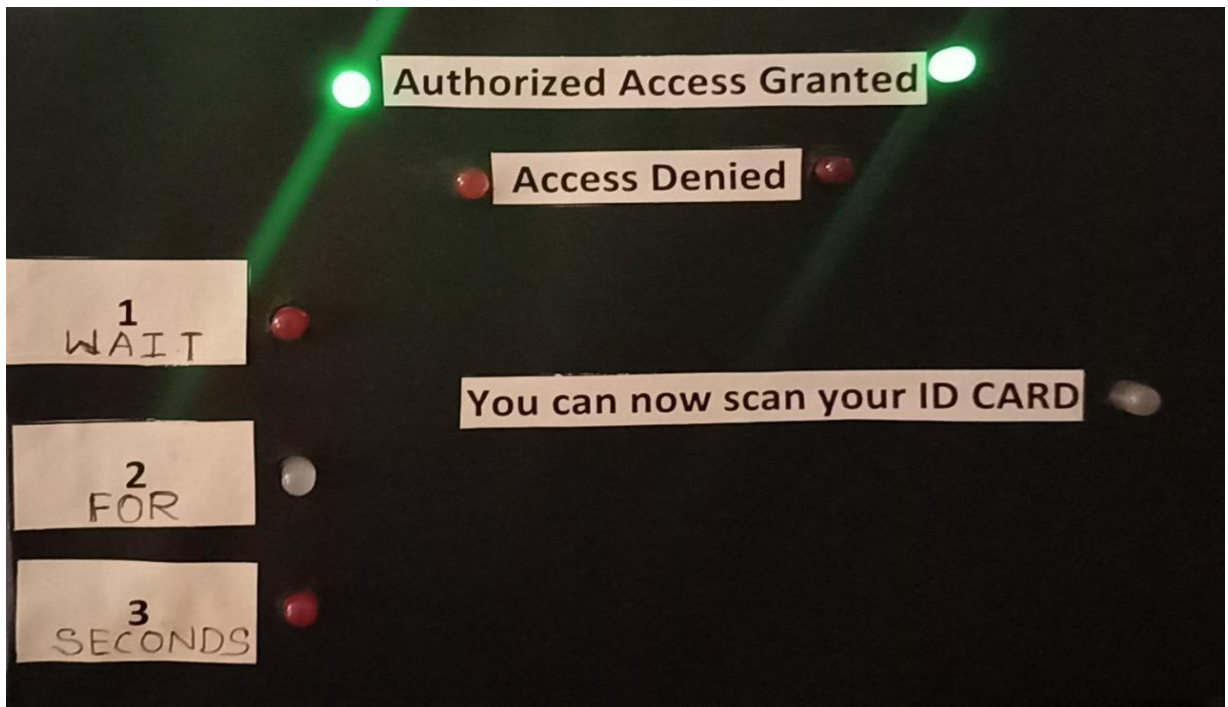
(i)System Ready To Scan Tag:
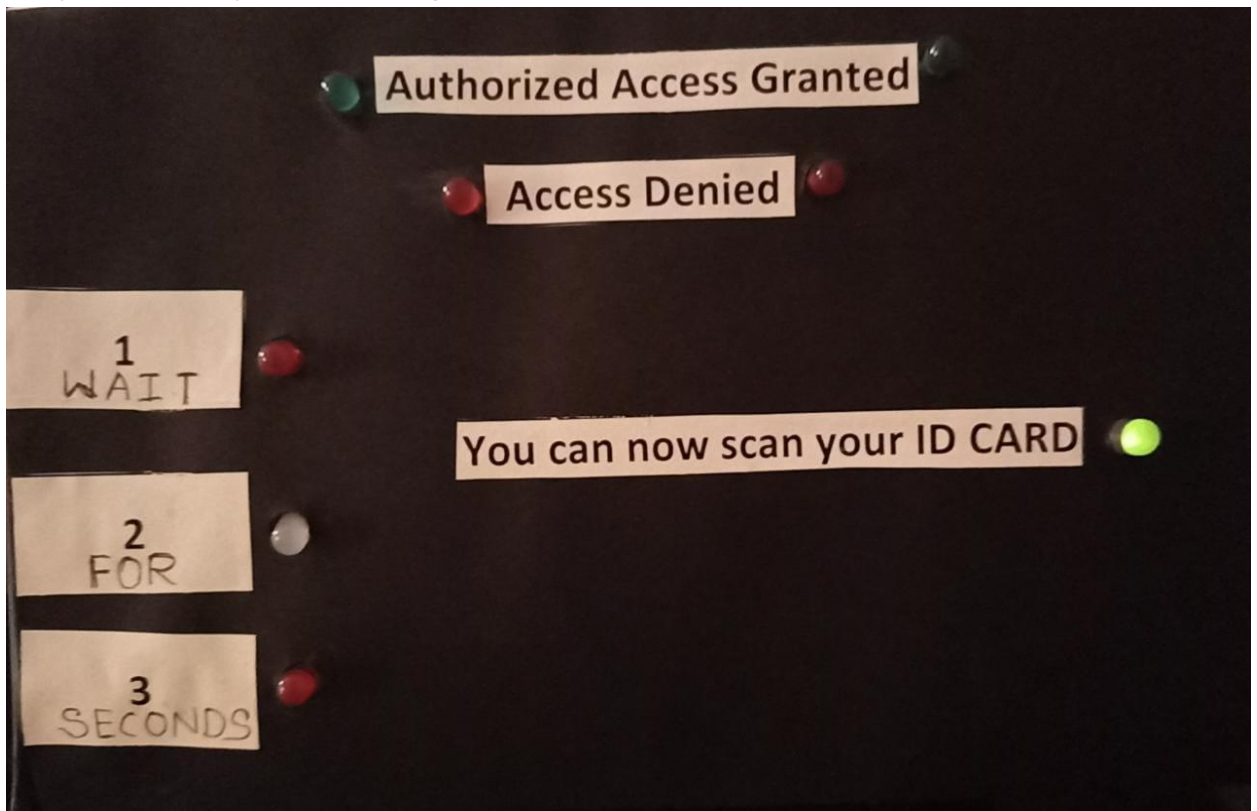
Fig 2.4.1 Ready to Scan Tag
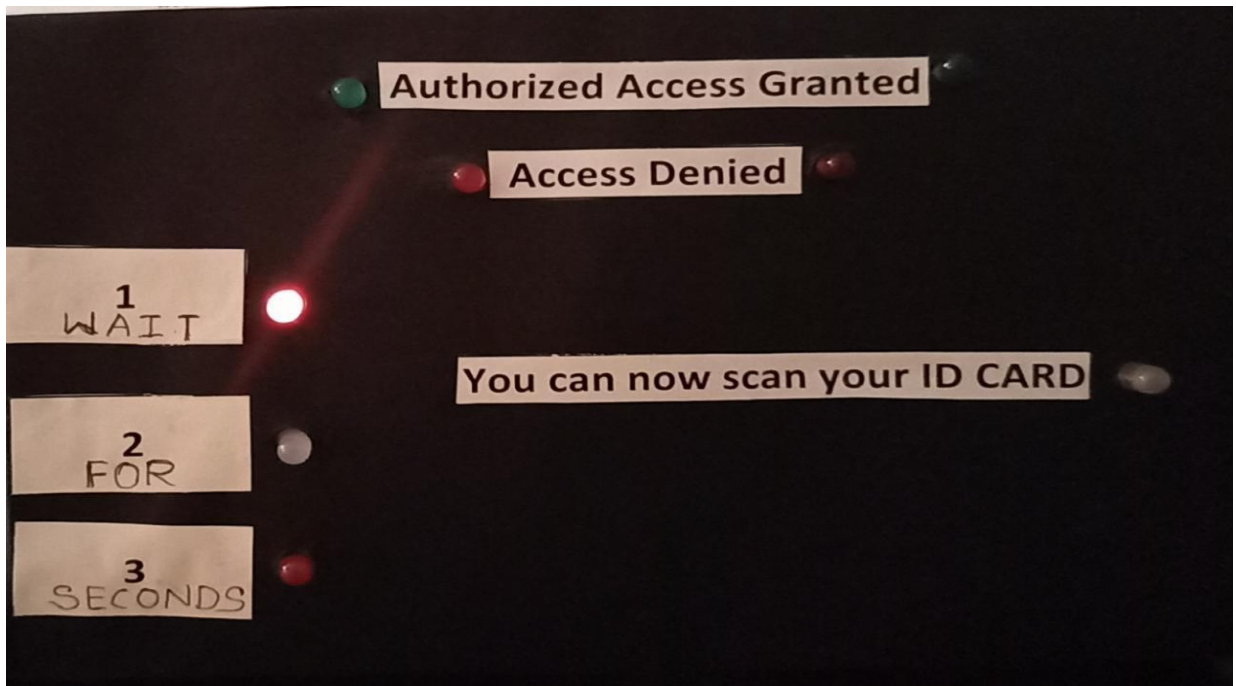
(ii) Authorized Tag Being Scanned:
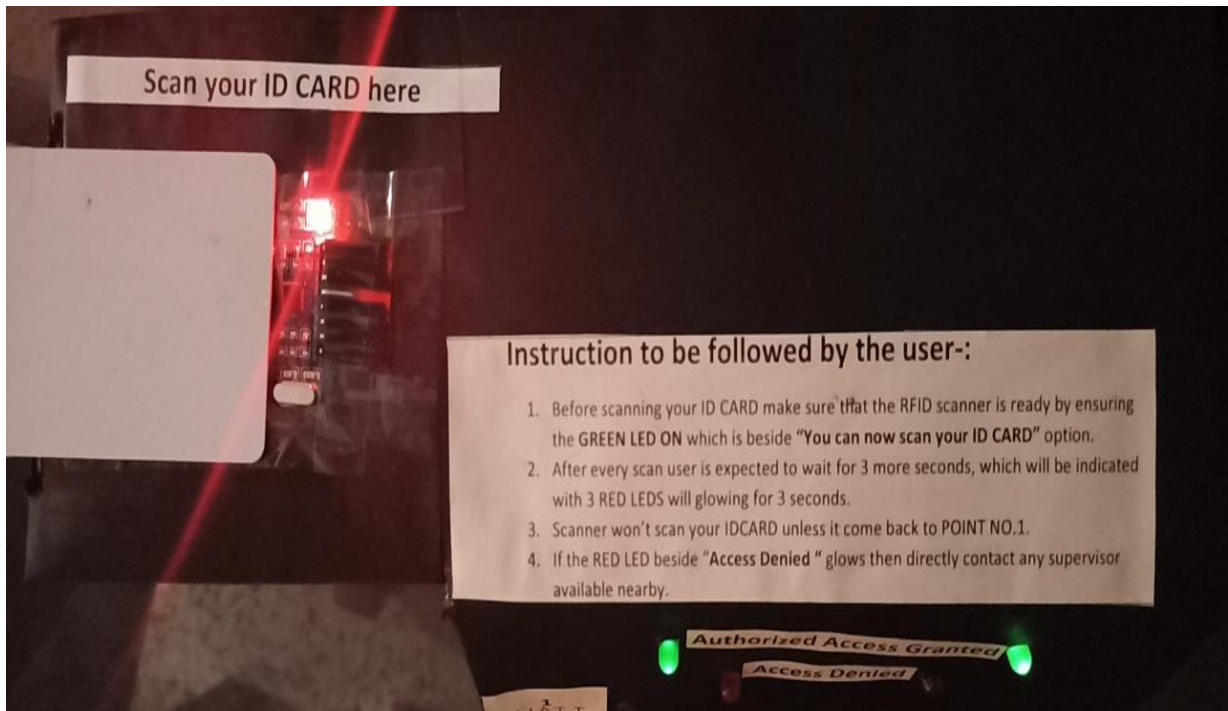
Fig 2.4.2 Authorized Tag

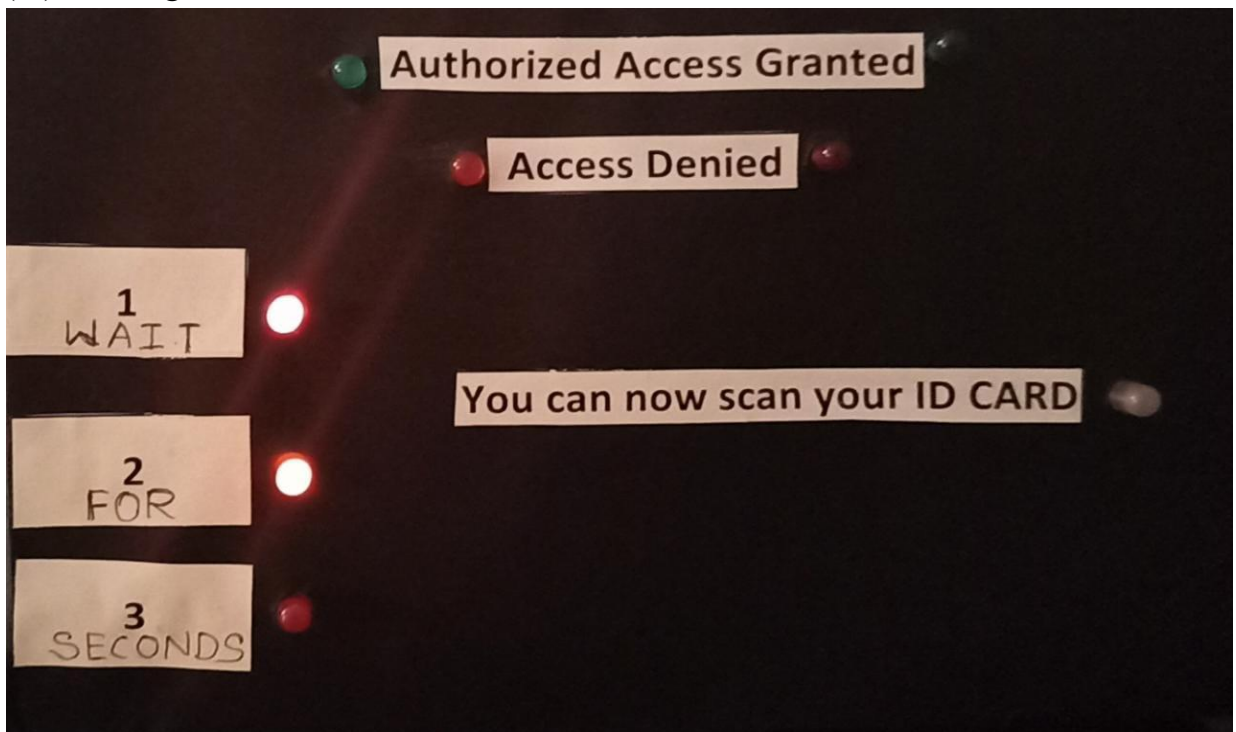(iii) Scanned Successfully and Granted Access:-

Fig 2.4.3 Granted Access

(iii) Waiting Limit 1/3 sec:-

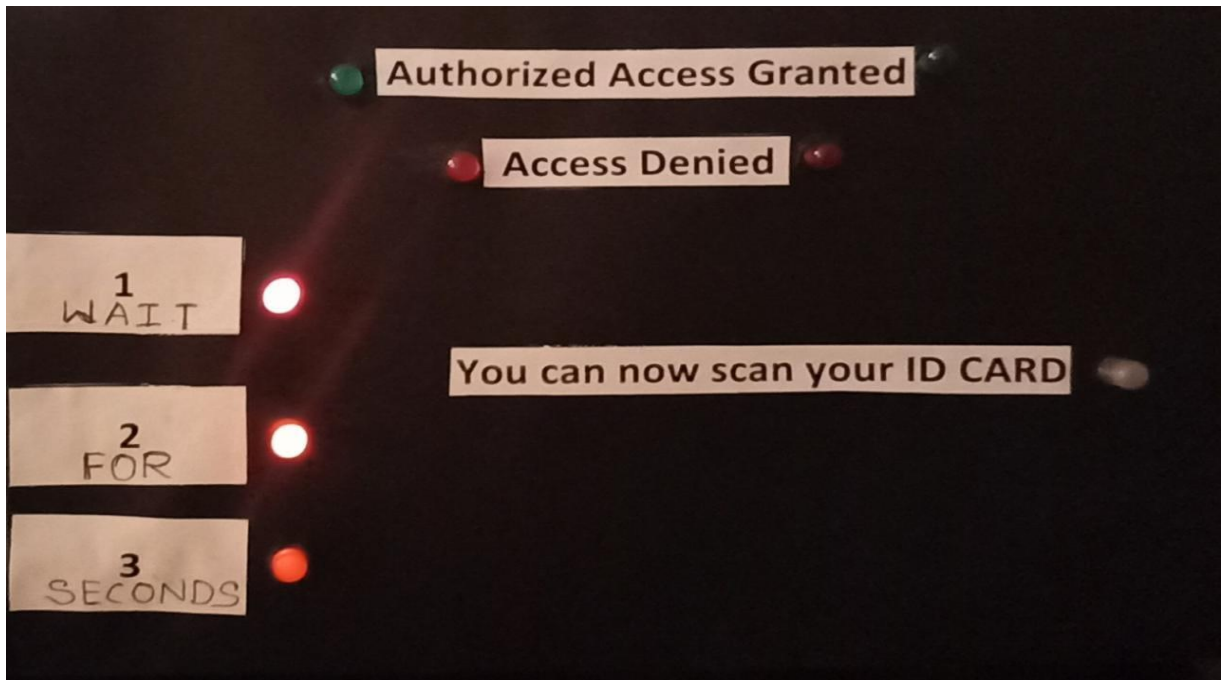**Fig 2.4.4 Wait for 1/3 sec**

(iv) Waiting Limit 2/3 sec:-

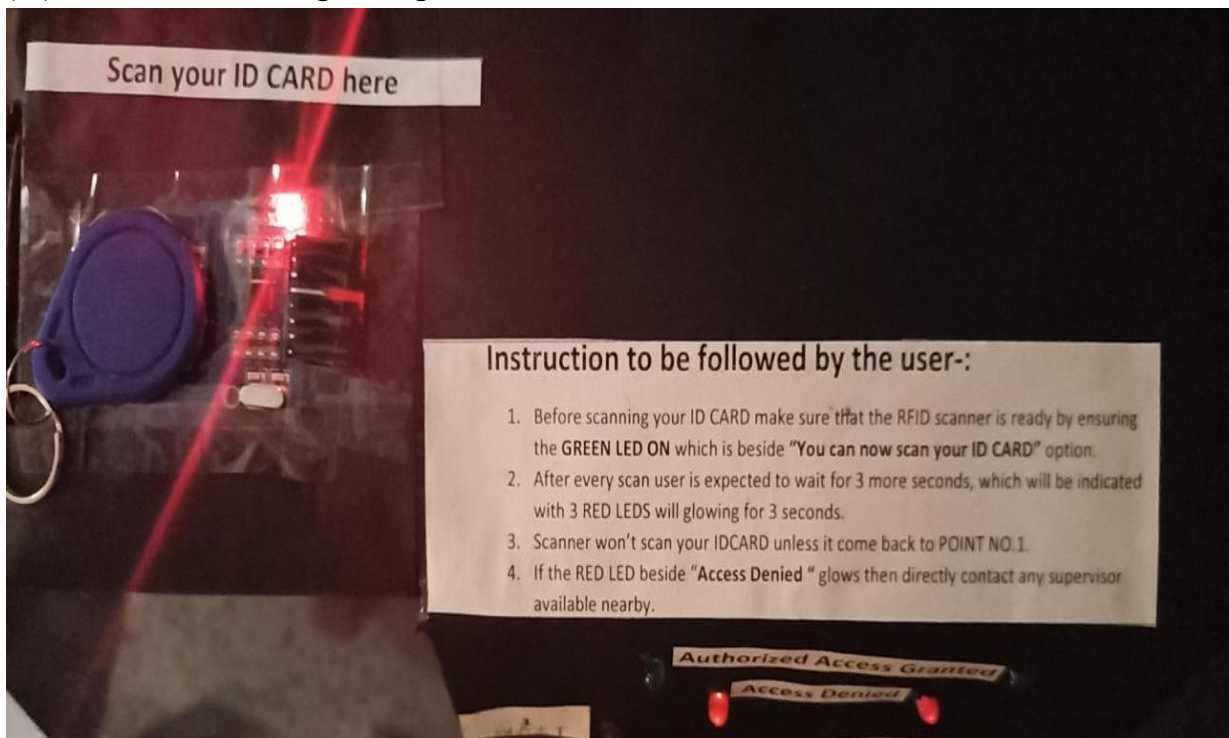

Fig 2.4.5 Wait for 2/3 sec
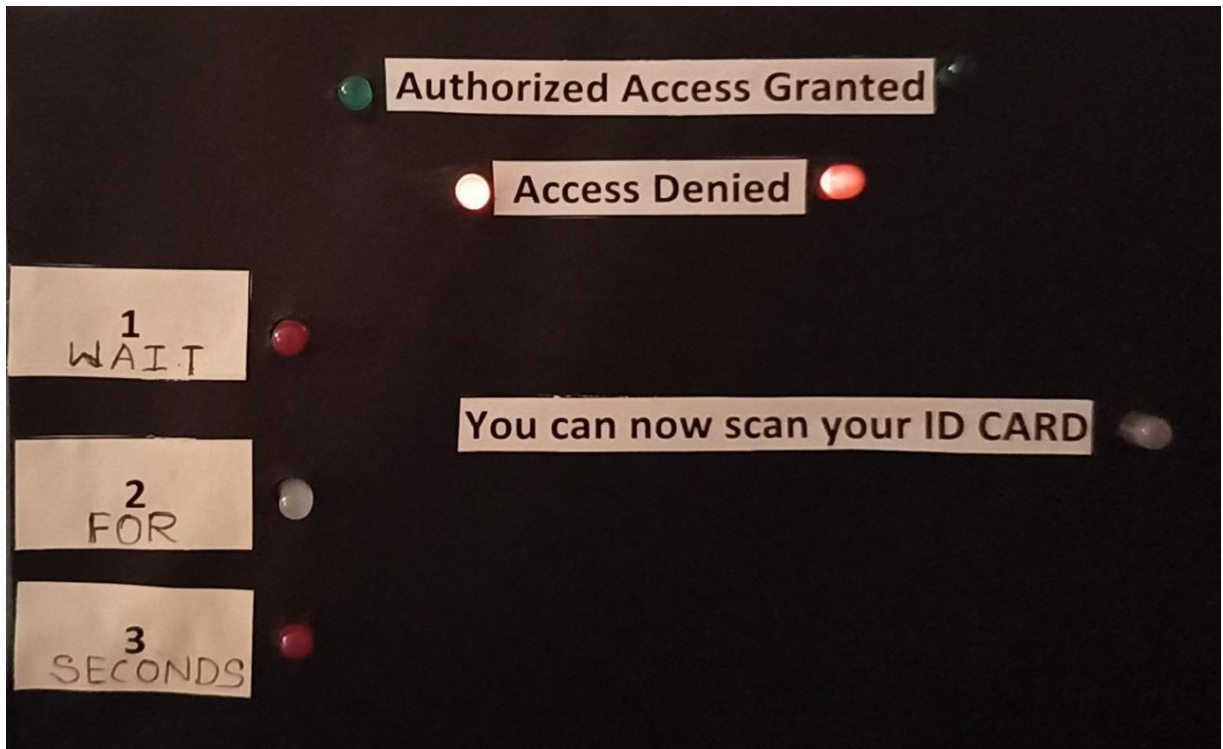
(v) Waiting Limit 3/3 sec:-

Fig 2.4.6 Wait for 3/3 sec

(vi) Unauthorized Tag Being Scanned:-

Fig 2.4.7 Unauthorized Tag

(vii) Scanned Successfully But Access Denied:-

Fig 2.4.8 Access Denied

3. PROBLEM STATEMENT

RFID is a technology with applications throughout business from controlling manufacturing processes to maintenance and inspection of equipment, managing assets and tracking goods through to distribution.

RFID systems offer benefits for businesses of all sizes, allowing them to rapidly improve efficiency and improve utilisation of assets and quality. RFID can form the basis of an effective asset management system The simultaneous scanning of products with an RFID reader also drastically lowers the time spent on inventories which brings a rise in productivity and less manual work for your staff

In this project we shall see When an RFID tag is placed on the RFID reader as it reads the data and through the reader its code is sent to the Arduino which then accesses and sees whether an RFID Tag is valid or invalid.

After every Successful Scan User needs to wait for a time interval of 3 seconds to place a RFID Tag as the system gets ready for the next scan. If the tag is valid, you will be granted access and if the tag is invalid, your access will be denied

4. METHODOLOGY

- Research articles collection.

- Familiarization with ARDUINO UNO R3 Microcontroller with complete understanding of internal structure of Microcontroller.

- Start-up process of microcontroller, how entities and hardware,software initialization are done by microcontroller when it's turned on.

- The developed methodology utilizes passive RFIDs and localization methods integrated in a two-step algorithm supported by a specially designed relational database to identify locations of user who are equipped with RFID readers and materials onsite.

- In the first step of the algorithm, the user location is identified making use of the captured signals from a set of passive reference tags deployed on site and processing them using the triangulation or proximity method.

- In the second step of the algorithm, material location is identified making use of the mobile user locations, which were identified in the first step, and the captured signals from material tags; similarly processed as in the first step using the triangulation or proximity method.

- RFID reference tags are used as a reference point with a known location (landmark) within a predefined zone. In this approach, passive RFID tags are distributed on the jobsite, and mobile users are equipped with RFID readers.

- The known locations of the reference tags are used to estimate the location of the user, based on the RSSI received from these tags. Locations of reference tags are identified with subscript.

- In this proposed work, the RFID reader reads the data from the tag and sends the card UID number to Arduino microcontroller for comparison, if the card is valid then Arduino microcontroller displays access granted else,access denied.

5. LITERATURE REVIEW

The paper presents a systematic literature review of supply chain management, focusing in particular on RFIDs vital role in managing a supply chain. This has been achieved by reviewing a total of 68 journal articles from 37 leading supply chain and technologies journal articles between the years 2006 and 2018. The aim of this research is to understand the key benefit-drivers and the ways in which they enhance competitive advantage. The study found six major benefit-drivers for RFID implementation in the supply chain which are categorized as customer-driven and corporate-driven benefit-drivers. The customer-driven element focuses on the ways in which traceability helps in adhering to and meeting customer requirements while the corporate-driven element focuses on the ways in which traceability can lead to supply chain profitability. Further, the study developed a framework for better understanding the ways in which benefit-drivers associated with RFID implementation can lead to different competitive advantages. The study findings and the framework provide a good starting point for academics and practitioners to further explore the opportunities in the supply chain afforded by RFID implementation.

RFID based security and access control system for use in hostels.The system combines RFID technology and biometrics to accomplish the required task. When the RFID reader installed at the entrance of the hostel detects the 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 the alarm to alert the security

personnel. The advantage of the system is that it successfully accomplished security and control tasks 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 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.

6. CONCLUSION

RFID based security and access control systems are more secure and fast response as compared to the other systems like biometric. The advantage of the RFID system is that it is contactless and works without line-of-sight. By using Arduino it is easy to access and works very quickly. It is easier to use and accurate also.

The tag can trigger security alarm systems if removed from its correct location.Automatic scanning and data logging is possible without human intervention.Each tag can have a unique product code like standardized.Each item can be individually labeled.

The use of RFID technology is seeing increasing use in all areas of industry. Companies and government agencies have implemented RFID solutions to make their inventory control systems more efficient. Because of the advances in security protocols for RFID, it is becoming viable as technology for use for everyday applications

FUTURE SCOPE:-

It depends upon how original one could be to enhance the use of this project. But for us this project is practical for future uses such as Smart cart can be interfaced with wireless technologies to make it completely portable in the near future. Payment of bills using mobile can be implemented. A low cost RFID scanner can be manufactured and used which can scan multiple tags (products) simultaneously for faster processing and lesser resources. Automatic scanning & availability of products can be introduced. Pay preparation feature will be the latest trend in upcoming years due to the boost in the ecommerce industry.

1. In malls for generating bills

2. Gaming zone

3. Environmental problems to control and make nature friendly.

4. Uses in ATM machines

Hence this project can be useful for implementation of access control applications for tracking systems as well as providing the security benefits. This project can improve by raising the range of reader in which the tag read

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