# Chapter-01

## Introduction

## 1.1 Radio-frequency identification (RFID)[1]

**RFID** uses Electromagnetic Field to automatically identify and track tags attached to objects. The tags contain electronically-stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source (such as a battery) and may operate hundreds of meters from the RFID reader. Unlike a Barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for AIDC (Automatic Identification and Data Capture


Figure.1.1: A user is trying to open the door by placing an RFID tag near the RFID reader

[1] atlasrfidstore.com/rfid-beginners-guide/

## 1.2 RFID Advantages over Barcodes[2]

- ✓ For a barcode to be read, the scanner must be placed directly in front of each label, RFID tags on the other hand, don't need to be directly in sight of an RFID reader
- ✓ A barcode can only be read, and the data can never be changed once it has been printed onto a label. RFID tags can be read, and the data on the tag can be rewritten or modified as needed.
- ✓ Barcodes are typically printed on paper labels or other unprotected surfaces, they are easily damaged
- ✓ Barcodes are easily counterfeited, and the data itself is always readable. With RFID tags, your data is much more secure as the information has the ability to be encrypted.
- ✓ Standard barcodes are limited in the amount of information they are capable of representing. An RFID tag actually stores data in non-volatile memory and is capable of storing up to 8 kilobytes of data in certain tags.

## 1.3 How do RFIDs work[3]

Shown below is a typical RFID system. In every RFID system the transponder Tags contain information. This information can be as little as a single binary bit , or be a large array of bits representing such things as an identity code, personal medical information, or literally any type of information that can be stored in digital binary format

[2] aalhysterforklifts.com.au/index.php/about/blog-post/rfid_vs_barcodes_advantages_and_disadvantages_comparison
[3] https://electronics.howstuffworks.com/gadgets/high-tech-gadgets/rfid.htm

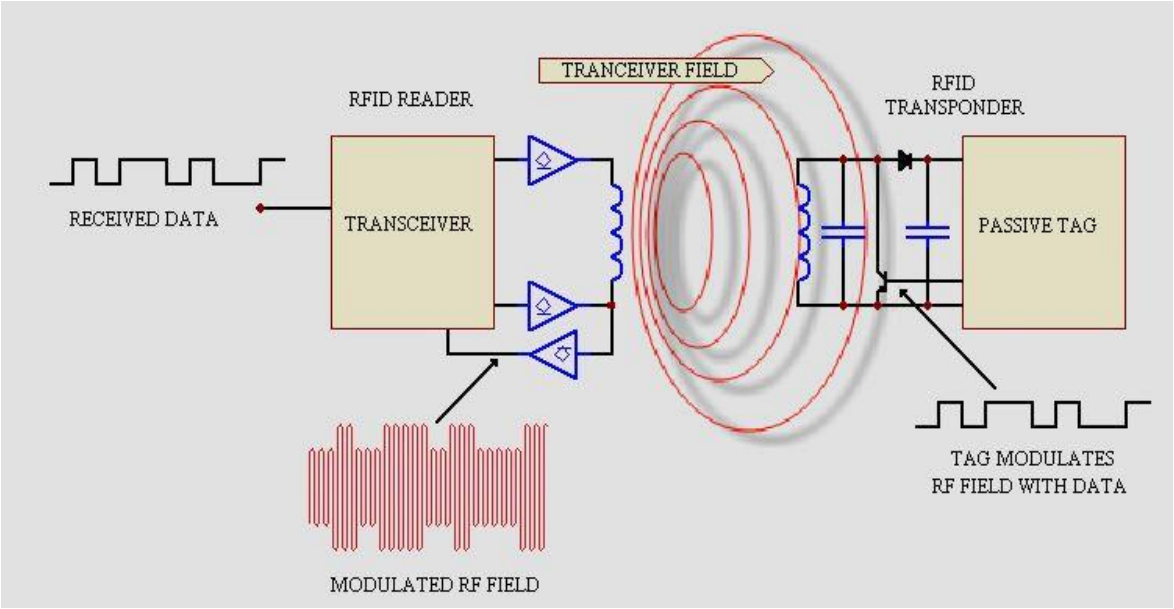


Figure 1.2: Working mechanism of RFID

Shown is a RFID transceiver that communicates with a passive Tag. Passive tags have no power source of their own and instead derive power from the incident electromagnetic field.Commonly the heart of each tag is a microchip. When the Tag enters the generated RF field it is able to draw enough power from the field to access its internal memory and transmit its stored information.

When the transponder Tag draws power in this way the resultant interaction of the RF fields causes the voltage at the transceiver antenna to drop in value. This effect is utilized by the Tag to communicate its information to the reader. The Tag is able to control the amount of power drawn from the field and by doing so it can modulate the voltage sensed at the Transceiver according to the bit pattern it wishes to transmit.

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## 1.4 Components of RFID[4]

A basic RFID system consist of three components:

- An antenna or coil
- A transceiver (with decoder)
- A transponder (RF tag) electronically programmed with unique information

**Transceiver** — Also known as the reader or the interrogator, transceivers send the electronic signal to the transponder that provides the power for the transponder to send the signal back to the transceiver with the information contained in the transponder's electronic circuit. Transceivers can be powered by batteries or plugged into a traditional power supply.

The transceiver is either tethered (physically attached to the data accumulator such as laptop or scale head) or it transmits data to the accumulator wirelessly. Transceiver units are usually comprised of a transmitter/receiver, antennae, control unit, power unit, coupling element and an electronic interface enabling it to communicate with the data accumulator.

**Transponder** — this is the electronic identification (EID) tag itself, often serving as the female button attachment for a traditional visual identification tag. Transponders for radio-frequency identification (RFID) in the beef industry are passive responders. This means they possess no power source of their own. Instead, it's the charge provided by the transceiver (reader) that enables the transponder to emit a signal back to the transceiver.

[4] .researchgate.net/figure/Components-of-RFID-technology_fig1_286418905

# CHAPTER-02

# Proposed Methodology

## 2.1 Objectives

In order to automate the evaluation of security in commercial RFID systems, so a methodology has been devised. It consists of the following main steps:

1. Visual inspection of the tag. Many tags include the name of manufacturer, the model and sometimes, the RFID standard. With such data, it is usually easy to get more specific information on the way the tags behave and how to perform security tests.
2. Radio frequency detection.
3. Standard Identification
4. Sniff and emulate communications to perform security task.
5. To construct a simple and cheap security system using RFID reader.
6. To uniquely identify and make security for a person.
7. To maintain the security of an important work place.
8. To use for protection.

## 2.2 Apparatus required

I. Microcontroller
II. 125KHz RFID module
III. 125KHz RFID tags
IV. 16*2 LCD display
V. 8 MHz crystal oscillator
VI. Capacitors
VII. Resistors
VIII. Vero board
IX. LED
X. Transistor
XI. Power supply

# CHAPTER-03

## Description of major components

### 3.1 Microcontroller (PIC16F877A)[4]

A **microcontroller** is a small computer on a single integrated circuit. A microcontroller contains one or more CPUS (processor cores) along with memory and programmable input/output peripherals. A microcontroller's processor will vary by application. Options range from the simple 4-bit, 8-bit or 16-bit processors to more complex 32-bit or 64-bit processors. In terms of memory, microcontrollers can use random access memory (RAM), flash memory, EPROM or EEPROM. Generally, microcontrollers are designed to be readily usable without additional computing components because they are designed with sufficient onboard memory as well as offering pins for general I/O operations, so they can directly interface with sensors and other components.

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output.

PIC16F877a is a 40-pin PIC Microcontroller and is used mostly in embedded projects and Applications. Few of its features are as follows:[5]

- It has five Ports on it starting from **Port A to Port E**.
- It has **three Timers** in it, two of which are 8 bit Timers while 1 is 16 Bit.
- It supports many communication protocols like:
    - Serial Protocol.
    - Parallel Protocol.
    - I2C Protocol.

[4] https://microcontrollerslab.com/pic16f877a-introduction-features/
[5] https://www.microchip.com/wwwproducts/en/PIC16F877A

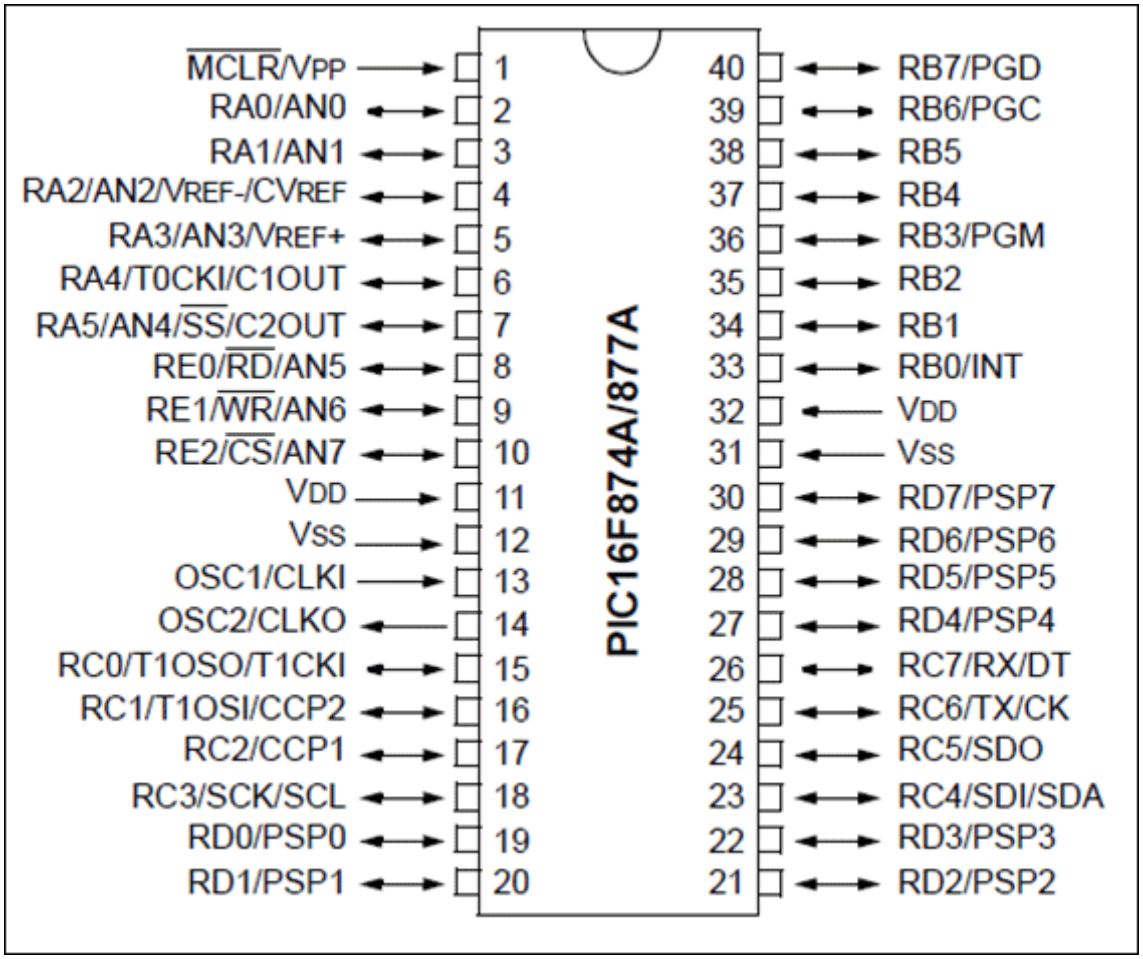


Figure 3.1:- Microcontroller (PIC16F877A)

## 3.2 125 KHz RFID module – UART[6]

RDM 125 KHz card mini-module is designed for reading code from 125 KHz card compatible read-only tags and read/write card. It can be applied in office/home security, personal identification, access control, anti-forgery, interactive toy and production control systems etc.

[6] http://wiki.seeedstudio.com/125Khz_RFID_module-UART/

**Features:**

- Support external antenna
- Maximum effective distance up to 50mm
- Less than 100ms decoding time
- Support EM4100 compatible read only or read/write tags

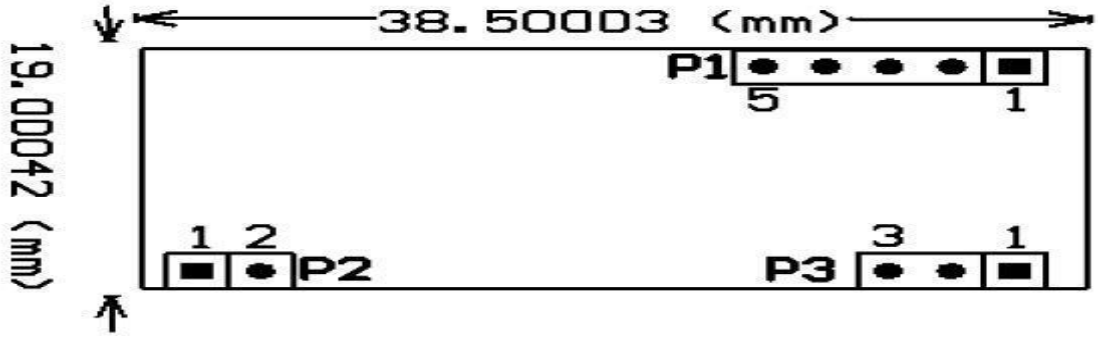


Figure 3.2:- RFID Module

## Pin definition

Pin definition list here:

```
Pin Definition:
P1:
  PIN1    TX
  PIN2    RX
  PIN3
  PIN4    GND
  PIN5    +5V (DC)
P2:
  PIN1    ANT1
  PIN2    ANT2
P3:
  PIN1    LED
  PIN2    +5V (DC)
  PIN3    GND
```

## 3.3 RFID Tag (125 KHz)

This is a basic RFID tag used for presence sensing, etc. Works in the 125 KHz RF range. These tags come with a unique 32-bit ID and are not re-programmable. Card is blank on one side, smooth, and mildly flexible.[7]

[7] https://www.camcode.com/asset-tags/what-are-rfid-tags/

Figure 3.3:- RFID Tag

## 3.4 CRYSTAL OSCILLATOR[8]

8 MHz Crystal Crystals are commonly used to provide a stable clock source for micro-controllers. This has a freq. tolerance of +-50ppm, temperature stability of +-50ppm, and load capacitance of 18pF. It's slightly more than 1/8" tall. The crystal oscillator circuit sustains oscillation by taking a voltage signal from the quartz resonator, amplifying it, and feeding it back to the resonator.

Figure 3.4:- Crystal Oscillator

## 3.5 16*2 LCD DISPLAY[9]

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments

[8] https://www.watelectronics.com/crystal-oscillator-circuit-working-applications/
[9] https://circuitdigest.com/article/16x2-lcd-display-module-pinout-datasheet

and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom character (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

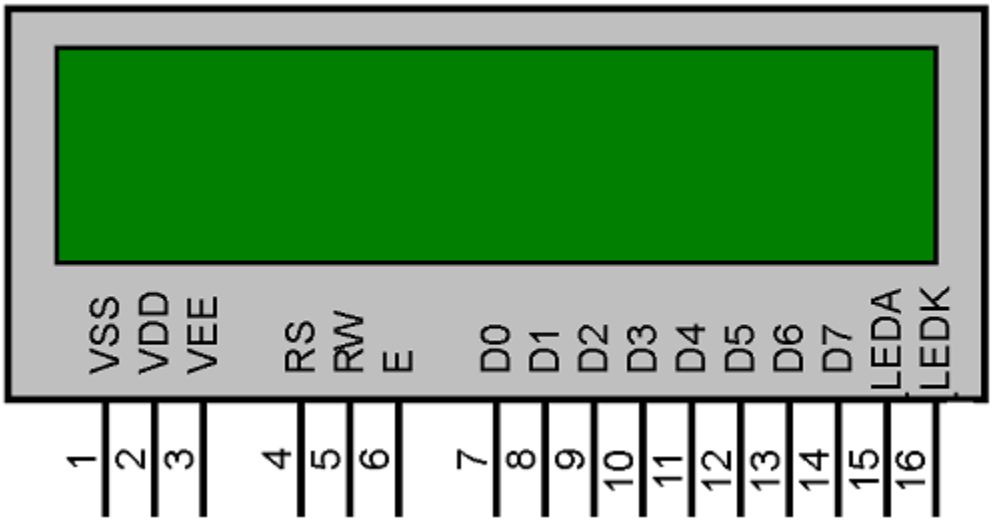


Figure 3.5:- LCD Display

## 3.6 TRANSISTOR[10]

A transistor is a semiconductor device used to amplify and switch electronic signals and power. It is composed of a semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the

[10] .explainthatstuff.com/howtransistorswork.html

transistor's terminals changes the current flowing through another pair of terminals. Because the controlled (output) power can be much more than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits.

Transistors rely on semiconductors to work their magic. A semiconductor is a material that's not quite a pure conductor (like copper wire) but also not an insulator (like air). The conductivity of a semiconductor – how easily it allows electrons to flow – depends on variables like temperature or the presence of more or less electrons. Let's look briefly under the hood of a transistor. Don't worry, we won't dig too deeply into quantum physics.

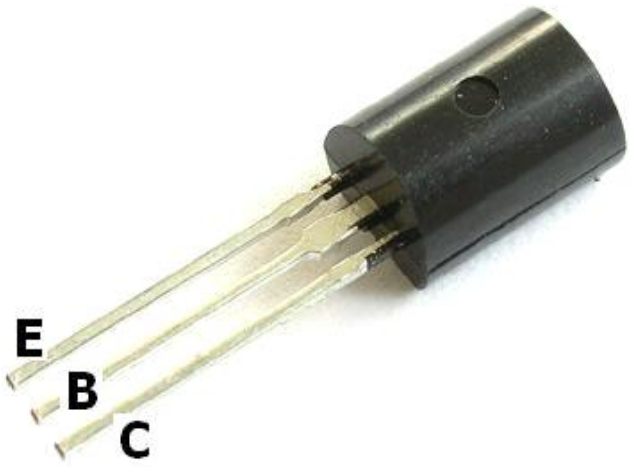


Figure 3.6: Transistor

# CHAPTER-04

## Architectural model and processing

### 4.1. Simulation diagram

The Proteus Design Suite is widely used across various industry sectors as a cost effective solution for professional PCB design and as a rapid prototyping tool for R&D.

- Virtual Prototyping enables system testing before the first physical PCB is ordered.
- Shape based auto routing as standard saves time with non-critical routing.
- Direct access to over 15 million parts means never building a component or footprint again[11].

In following circuit, Port 0, pins (1-8) are connected to LCD data Pins, Pin 12 to RS(4) 13 RW(5), 14 to E(6) of LCD Module respectively. LCD is configured in 8bit Mode. Pin 10(Rx) of 16F877A is connected to the tx pin of LCD module. You can directly Connect led to output pins with small resistor for testing

[11] https://www.labcenter.com/

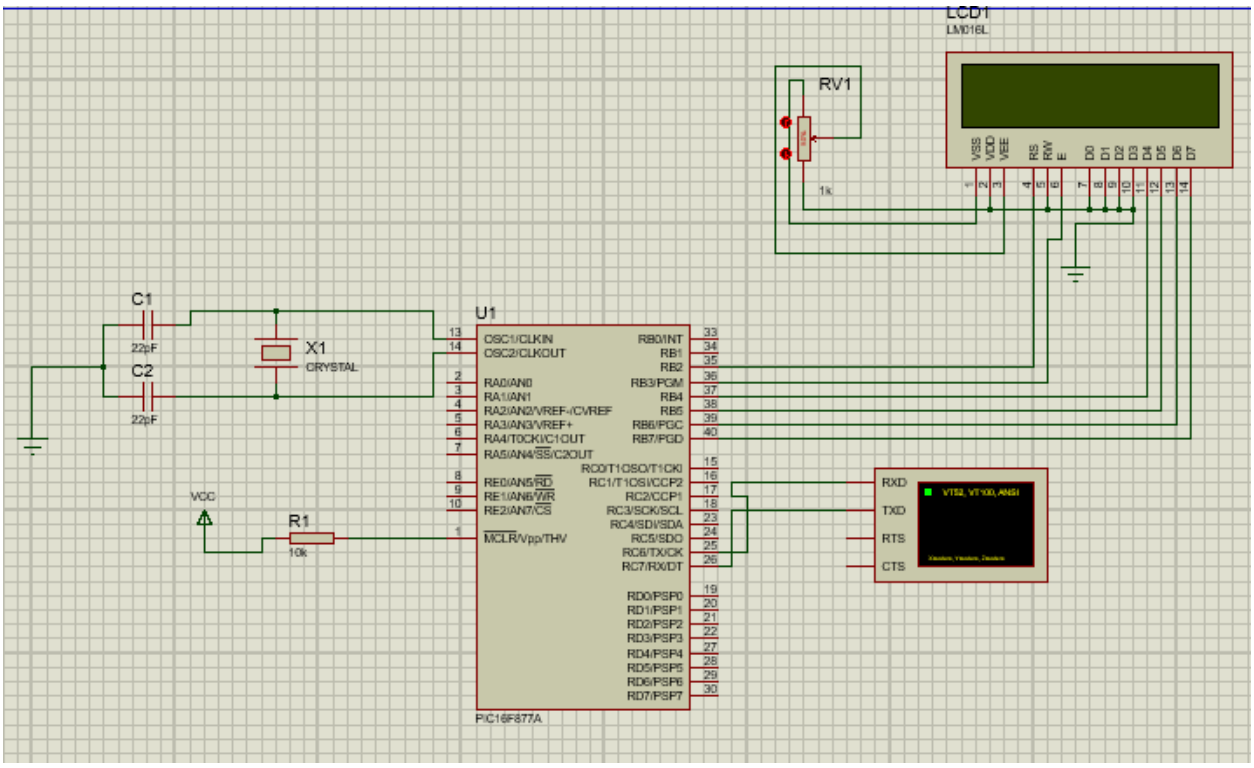


Figure-4.1: Simulation diagram on proteus software

## 4.2. Architectural model

The main components of our project are Microcontroller, RFID Reader, RFID Cards or Tags, an LCD display, antenna coil.

For the microcontroller to function properly, we need to connect an 125 KHz oscillator along with two ceramic capacitors of capacitance 33pF to the microcontroller.

Pin 31 of the microcontroller i.e. EA Pin is connected to 5V using a current limiting resistor of resistance 10KΩ.
In order to reset the microcontroller, the RST pin (Pin 9) must be momentarily connected to 5V. Hence, a combination of push button, 10KΩ resistor and 10µF capacitor is used in the reset circuit.

An LCD Display is used in this project to display the details of the card. The data pins of the LCD are connected to PORT1.

The control pins are connected to P3.6, GND and P3.7 and a 10KΩ potentiometer is connected to adjust the contrast.

The next component we need to connect to the microcontroller is the RFID reader module. The communication between the Reader and the microcontroller is using UART protocol.

Hence, we need to use the TX and RX pins for communication. Connect the RXD pin (Pin 3.0) of the microcontroller to the TX pin of the RFID Reader module.

Similarly, connect the TXD pin (P3.1) of the microcontroller to the RX pin of the RFID Reader module.
Finally, we need to connect the motor driver IC to the PORT0 of the microcontroller.

An important note is that Port 0 pins must be externally pulled high in order to use them as input / output pins.

Connect the two input pins of the motor driver i.e. IN1 and IN2 (Pins 2 and 7) to Port 0 pins i.e. P0.0 and P0.1 of the microcontroller. A motor is connected to output pins of the motor driver

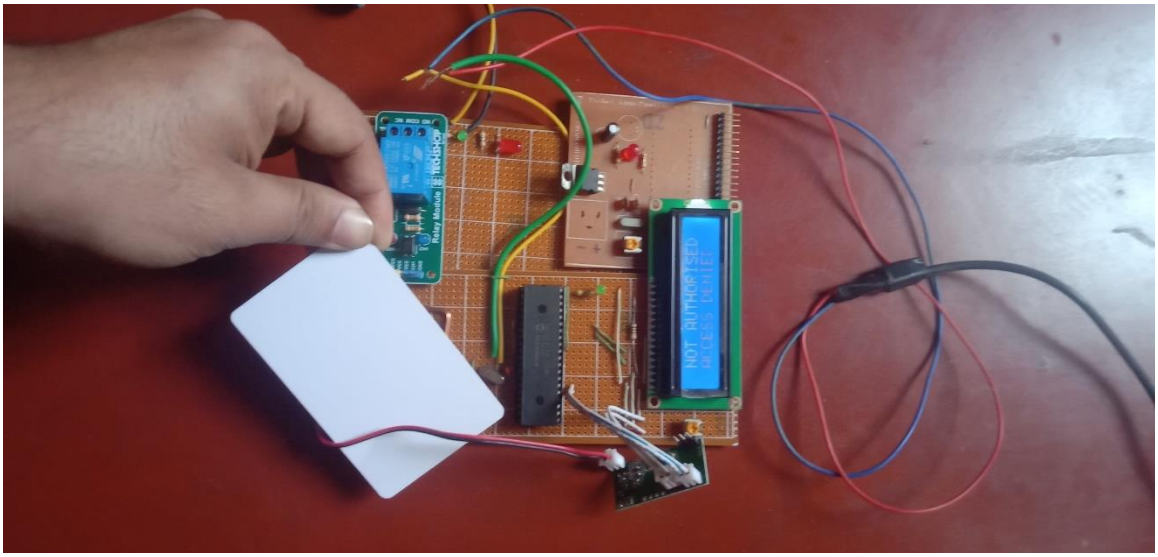


Figure-4.2 Architectural design

## 4.3 .MICRO C CODE

```
// LCD module connections
sbit LCD_RS at RB2_bit;
sbit LCD_EN at RB3_bit;
sbit LCD_D4 at RB4_bit;
sbit LCD_D5 at RB5_bit;
sbit LCD_D6 at RB6_bit;
sbit LCD_D7 at RB7_bit;
sbit LCD_RS_Direction at TRISB2_bit;
sbit LCD_EN_Direction at TRISB3_bit;
sbit LCD_D4_Direction at TRISB4_bit;
sbit LCD_D5_Direction at TRISB5_bit;
sbit LCD_D6_Direction at TRISB6_bit;
sbit LCD_D7_Direction at TRISB7_bit;
```

```
// End LCD module connections
void main()
{
  char i,rfid[13] = "123456781212";
 Lcd_Init();                    // Initialize LCD
  Lcd_Cmd(_LCD_CLEAR);              // Clear display
  Lcd_Cmd(_LCD_CURSOR_OFF);          // Cursor off
  Lcd_Out(1,1,"ICE RFID PROJECT");     // Write text in first row
  Lcd_Out(2,1,"SCAN YOUR CARD");     // Write text in first row
  UART1_Init(9600);
  rfid[12] = '\0';
  while(1)
  {
    if(UART1_Data_Ready())
    {
      for(i=0;i<12;)
      {
        if(UART1_Data_Ready())
        {
          rfid[i] = UART1_Read();
          i++;
        }
      }
 if((rfid[0] ^ rfid[2] ^ rfid[4] ^ rfid[6] ^ rfid[8] == rfid[10]) && (rfid[1] ^ rfid[3] ^ rfid[5]
^ rfid[7] ^ rfid[9] == rfid[11]))
```

```
{
    if(((rfid[10]=='1') && (rfid[11]=='2')) ^ ((rfid[10]=='3') && (rfid[11]=='4')) )
    {
   Lcd_Out(2,1,rfid);
   }
else {
  Lcd_Out(2,1,"Error          ")}
```

# CHAPTER-05

# Result and Discussion

## 5.1 How RFID Security Access Control System Works?

The aim of this project is to design an RFID based security access control system using PIC 16F877A microcontroller, in which only authorized personnel are allowed access to a secure area. The working of the project is explained here.

When the circuit is powered ON, the microcontroller will initially display a message as "Swipe the Card" on the LCD display.

When the RFID Card or Tag is swiped against the RFID reader, it will detect the ID card and sends the unique card no. to the microcontroller via serial terminal.

With the help of suitable programming, we need to compare the received card no. with the numbers that are already stored in the microcontroller or any database like external memory unit.

If the received number is matched with the already stored number, then the microcontroller will display the name of the card holder on the LCD and activates the motor driver IC. As a result, the door is opened for a predefined duration after which the door is automatically closed.

If there is no match for the received numbers with the stored numbers, then the microcontroller will not open the door and displays a message as "Access Denied" on the LCD display.

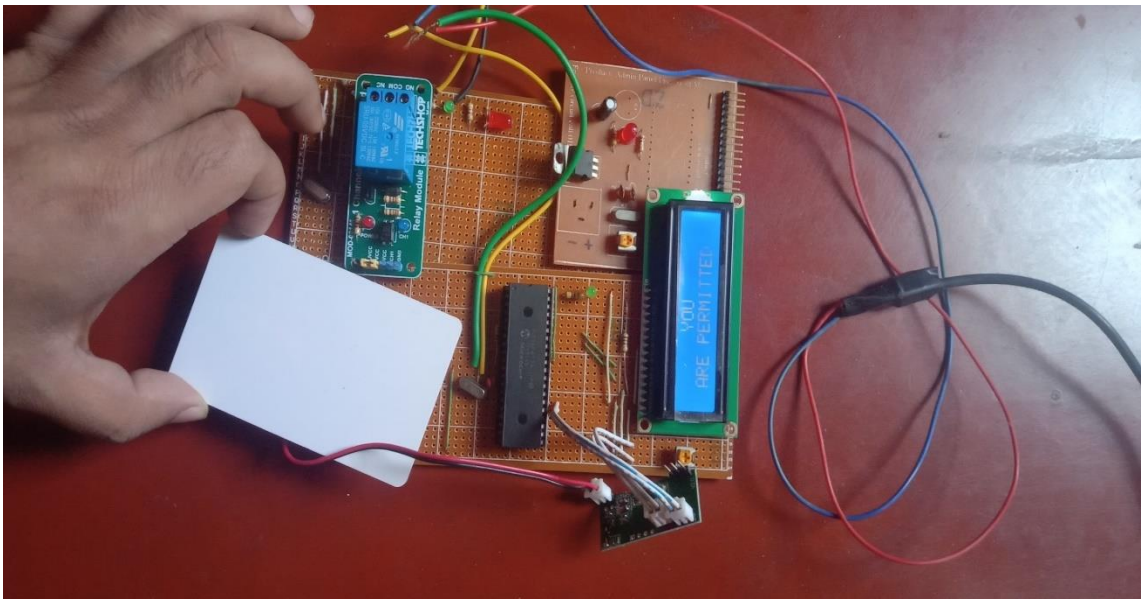


Figure-4.3: RFID tag show on antenna

# CHAPTER-06

## Conclusion and future aspect

### 6.1. Applications[11]

1. Securing and access control system is very convenient use at home.
2. Used in office and commercial building.
3. RFID based Security Access System is designed in this project. As the system uses RFID Technology based identification, it can be used to access secured areas like research centers, defense sites etc.
4. It is a low power system and also the RFID Cards or Tags used are of passive type.

## 6.2. Limitation[12]

If the card is lost by the right person and another wrong person get it then the security reduce.

- Even though RFID Technology is secure, the security can be increased by integrating other security measures like facial detection, finger print scanner etc.

[11] .electronicshub.org/rfid-security-access-control-system/
[12] https://www.electronicshub.org/rfid-security-access-control-system/

- As the card details are stored in the microcontroller, only a limited number of card details can be stored. This can be increased by implementing a memory unit like EEPROM

## 6.3. *Conclusion*

Thus, there are various applications of this project at different-different places. This project is also cheap and can be used on large scale. One more is by adding different types of controllers like ATMEL(AT89C51/52) etc. and also replacing latest RFID module and some compatible component we can use some different applications at low cost.

## 6.4. **Future development of the project**

1. We can add voice alert system to this project.
2. We can update this project as student attendance system for schools and colleges.
3. We can send data to a remote location using mobile phone or internet.

**END**