A SMART LOCKER USING SOLAR ENERGY

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Amit Chakraborty Chhoton, lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree.

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ABSTRACT

We have made a smart locker by using RFID sensor where user can use the locker by scanning the ID card. This smart locker is used to charge smart devices of the user like mobile phone. The smart locker is powered by a smart solar system. In the solar system we have used a single axis motorized solar panel to detect the luminous intensity of solar so that it can charge itself very efficiently. And we are also using a charge controller to safely manage all the power distributions.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Load shedding is one of the common problem in our country. One day when I entered on university and I hear that electricity will not came whole day, and that moment on my mobile phone's battery was low. Also there is no option to charge my phone. Then a thought came to my mind. That is how I can charge my phone without A/C current. Then a technology named Solar System technology came to my mind. Then I decide that I will charge my phone using solar energy and after that no one not to face this types of problem. For safety I want to create a smart locker in my university. For that in my university everyone can use our smart device. Teachers, students and admin can use this device. We add security system in this device that users smart device can charge free and safely. It's a smart locker. For security user can use their DIU smart card. Our system is user friendly so that everyone can use our device easily.

1.1 Motivation

Teachers, students and admin can use our locker easily. We add security system on the locker that they can put their smart device under the locker safely. For security lock we use DIU smart card that use of this locker easy and tension free. We also use one default smart card to open the lock any time that if user lost his/her smart card.

1.2 Necessity of the Project

- Teachers, students and admin can charge their smart device without having electricity in area.
- It's a secure smart locker.
- It has 0 amount of electric bill.

1.3 Drawback of the smart locker

- If the smart card is lost then the lock cannot be open.
- It is useless if the battery is damaged.
- It has no confirmation message for user and admin.

CHAPTER 2

PROBLEM STATEMENT

2.0 Problem Definition

As we know that in our project has some system that is very sensitive. Some connection are very sensitive. Solar tracking system is sensitive case because if LDR is damage then the solar tracking system will not work properly. Again if the smart card is lost then the lock will not open. If the battery is damage the system will not work. If the solar panel is damage then the battery cannot be charge anymore and the system will not work properly.

2.1 Finding solution

In the project, it's a good idea to develop the system that will help people (teacher, student, admin) to charge the smart device with securely. The security system is also smart.

2.2 Why an approach of A Smart Locker Using Solar Energy?

In my country load shedding is one of the common problem and also in my university. Sometime it's very tough to charge the smart device. Then this types of issues are encourage us to develop the project.

CHAPTER 3

METHODOLOGY

3.0 Methodology

This project has been developed for teachers, students and admin in DIU. It helps them to charge their smart device without local current. In this project we use Arduino board, it's a physical programmable circuit board for upload the code from computer. Then we use breadboard to test that circuit which one we ensure as final circuit design. We use RFID sensor and solenoid lock for security purpose. We also LCD (16x2) for confirmation message. It's user friendly.

Besides, here we have used single axis solar panel which will go from east to west receiving solar energy. It can revolve 0°-180° using sg90 servo motor and this energy will be stored in the controller.

Therefore, we use jumper wires to make all the connections and also use breadboard, Arduino and some equipment for finalize the smart locker.

3.1 Users of the smart locker

As this smart locker has been made for teachers, students and admin of DIU. For helping them who want to charge their smart device safely.

CHAPTER 4

Hardware Requirements

4.0 Used hardware

- Arduino Uno
- Bread Board
- solar Panel
- Servo Motor
- Buzzer
- LCD Display
- RFID
- Solenoid Lock
- Connecting wires
- Solenoid Lock

4.0.1 Arduino UNO

We know Arduino is a hardware. Generally arduino is a micro-controller based open source electronic prototyping board which can be programmed with an easy to use Arduino IDE. The arduino platform has become quite popular with just staring out with electronics and for good reason. The Arduino is one of the more popular boards in the arduino family and great choice for Beginners. The major components of the Arduino UNO board are USB, power port, microcontroller, analog input, pins digital pins, reset switch, crystal oscillator.

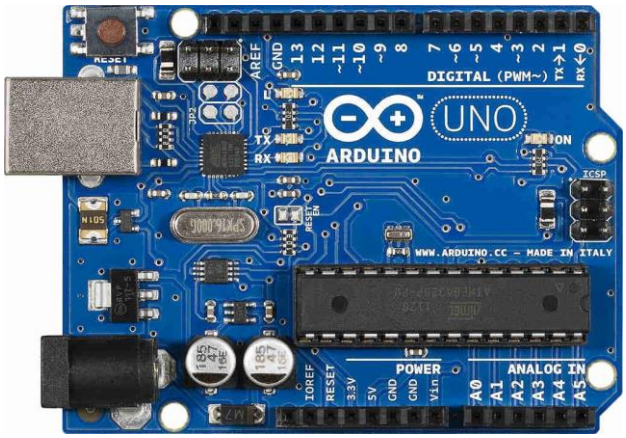

Figure 4.0.1: Arduino UNO

In this project we have to connect some of the major components in this arduino UNO board. We use two Arduino UNO. One for solar tracking and another for LCD, RFID, etc.

4.0.2 Bread Board

A Bread Board is a solder less device for temporary prototype with electronics and test circuit designs. We using Bread Board for connecting wires to Arduino UNO.

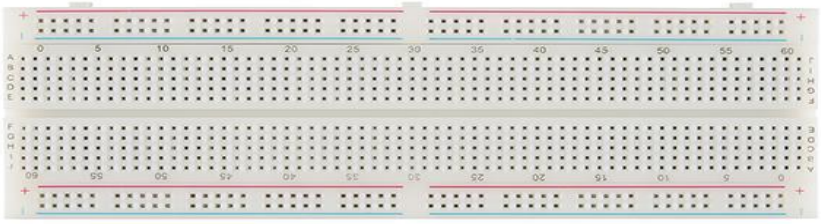

Figure 4.0.2: Bread Board

4.0.3 Solar Panel:

Solar Panel are made up of smaller units called solar cells. The most common solar cells are made from silicon, a semiconductor that is the second most abundant element on earth.in solar cell crystalline silicon conductive layers. Each silicon atom is connected to its neighbors by four strong bonds, which keep the electrons in place so no current can flow. We use 12 volts solar panel for charge a Cellphone. It is enough for charging a Cellphone.

Figure 4.0.3: Solar Panel

4.0.4 Servo Motor

We use servo motor for solar tracking. Servo motor are part of a closed-loop system and are comprised namely a control circuit, servo motor, shaft, amplifier and either and encoder or resolver. A Servo motor is a self-contained electrical device, which rotate of a machine with high efficiency and with great perfection.

Figure 4.0.4: Servo Motor

4.0.5 Buzzer

We know buzzer is a sound generator. It is a small electronic component which is consists of piezoelectric material. It has two terminal where one is positive and another is negative. We use buzzer for security purpose. When anyone do anything wrong then the buzzer start sound.it is very important for security.

Figure 4.0.5: Buzzer

When the buzzer gets any kind of signal from the Arduino board then it buzz and give notification to the user about the obstacle.

4.0.6 LCD Display:

An LCD (Liquid Crystal Display) is an electronic display module which uses liquid crystal to produce a visible image. It has sixteen columns and two rows. We use 16×2 LCD display for showing message.

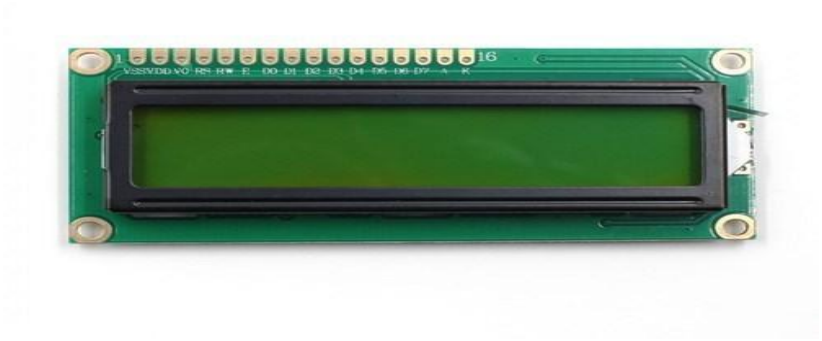

Figure 4.0.6: 16×2 LCD Display

4.0.7 RFID

A RFID (Radio-Frequency identification) is a technology that allows almost any object to be wirelessly identified using data transmitted via radio waves. RFID technology is similar to barcodes, but with a few major advantages which can do hundreds of tags can be read in seconds, RFID tags can be very durable. WE use RFID for secure the system.

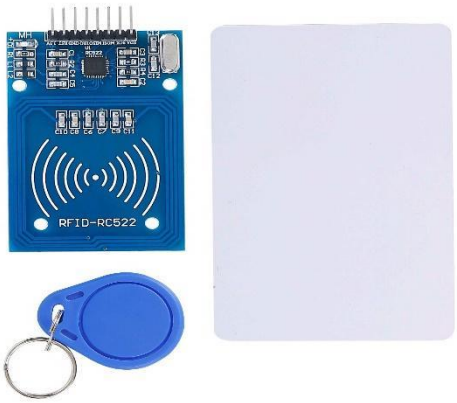

Figure 4.0.7: RFID

4.0.8 Solenoid Lock

The solenoid lock denotes a latch for electrical locking and unlocking. It is available in unlocking in the power-on mode type, and locking and keeping in the power-on mode type, which can be used selectively for situations. The power-on unlocking type enables unlocking only while the solenoid is powered on.

Figure 4.0.8: Solenoid Lock

4.0.9 Wires:

Necessary wires.

Figure 4.0.9: Wires

CHAPTER 5

MODEL OF THE PROJECT

5.0 MODEL OF THE PROJECT

It will be helpful to select a specific model for our project. We selected Waterfall model for our project. We choose waterfall model because the requirements and conditions are mostly matching with this model.

5.1 Waterfall model

In waterfall model it has six steps.

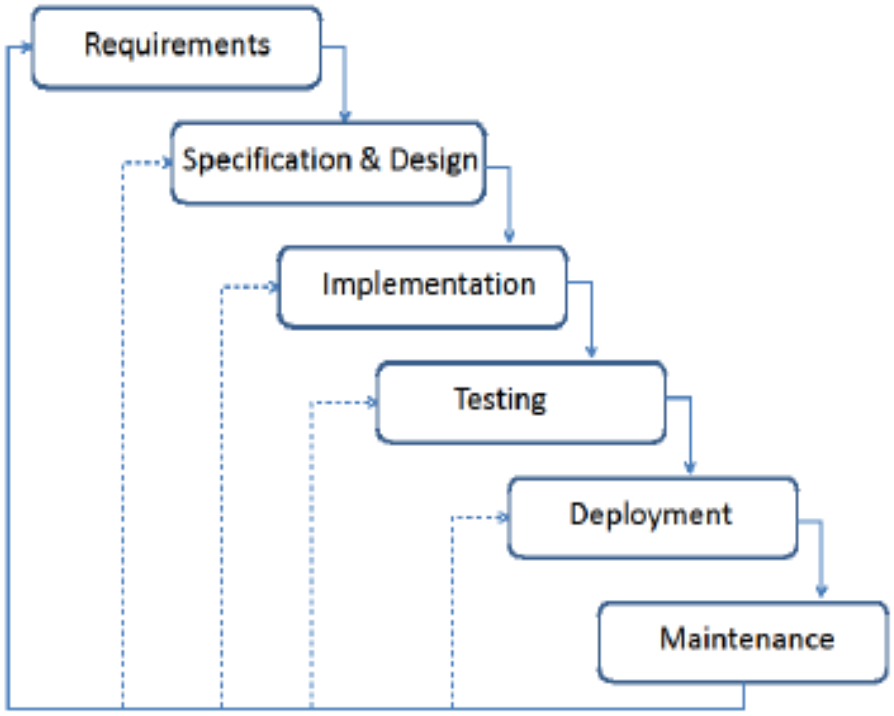

Figure 5.1.1: Waterfall Model

These are the 6 sequential phase to follow the waterfall model. Which are-

5.1.0 Requirement analysis

First of all, we find out the requirements of our project and we gather it to analyze it perfect for this hardware based project or not? As per the rules of waterfall model.

5.1.1 System design

In 1st step we find the requirement and analyzed on requirements. In system design we draw architecture design of our following project. Because of this design will help for specifying hardware.

5.1.2 Implementation

From the basic design we need to part the project into some units. The each and every unit we tested and find the limitation. We also checked each unit's functionality.

5.1.3 Testing

In this phase we checked the non-functionality and integration the units to move on the next phase.

5.1.4 Deployment

In previous phases we checked all the things including function and non-function. So this is the time to distribute the device among our selected user.

5.1.5 Maintenance

User can make issue about our device, that's why we need to update day by day as per demand of user and distribute the updated version.

5.2 Why waterfall model?

- It is suitable for our project.
- It has fulfill our requirement.
- Technology is familiar and easy to complete

5.3 Advantage

- It is quite simple of visualizing and understanding
- It works well with the small project where requirements are well understood before hand

- Time spent early in the software development cycle can reduce cost at later stages.

5.4 Disadvantage

- Not change friendly.
- Poor resource allocation.
- Communication gap can result in disaster
- Need crystal clear requirements.

5.5 Why we choose waterfall model though it has some limitation?

- Though it has some limitation like measure phases and longtime ongoing. We also found the solution of this problems which are:
- We clearly documented our requirements on each and every step.
- We will update the device day by day to go long and ongoing.

5.6 Why other model is not suitable for this project?

We choose waterfall model instead of other models. Here are elaboration of other models that why we hasn't been picked those models:

5.6.0 Spiral model:

This model is so complex every processes has more complexity. The project will go to the finish line it is unknown to know until complete the project. It requires a large number of intermediate stage.

5.6.1 Agile model:

It has more risks on sustainability and maintainability of project. This model has been suitable for small project but for big project it is better to avoid this model. This model has been depending on user interaction, if user is not clear than it can be out off the track at any time.

5.6.2 V-model:

V-model is highly risk and uncertainty model. Once we found any problem on testing than we need to go back of previous steps and we have to check all the functionality. Although this model is so rigid and less flexible.

5.6.3 Iterative model:

In this model we need more resources. At the end of the project it is very hard to determine that what the actual risks is. It is not suitable for big projects. Highly skilled risk analyzer required to analyze on risks.

CHAPTER 6
SYSTEM ANALYSIS

6.0 Project Functionality

- RFID sensor for receiving smart.
- Solenoid lock for lock the locker door.
- 16*2 LCD will show the condition of the locker that is the locker.
- Solar panel for charging and store electricity on battery.

- Servo motor and LDR for sun-light tracking.
- Buzzer for something wrong happening with locker.
- Default smart card for open the lock in anytime.

6.1 Design requirement

- Solar controller
- Buzzer
- RFID sensor
- Smart card
- 16*2 LCD display
- Solenoid lock

6.2 System Development

6.2.0 RFID sensor Circuit Diagram

In the smart locker, there has an RFID sensor to detect a smart card for open the lock. This sensor works with radio frequency wave. This sensor wait for new card

and when it detect the card and then it give message to the Arduino board.

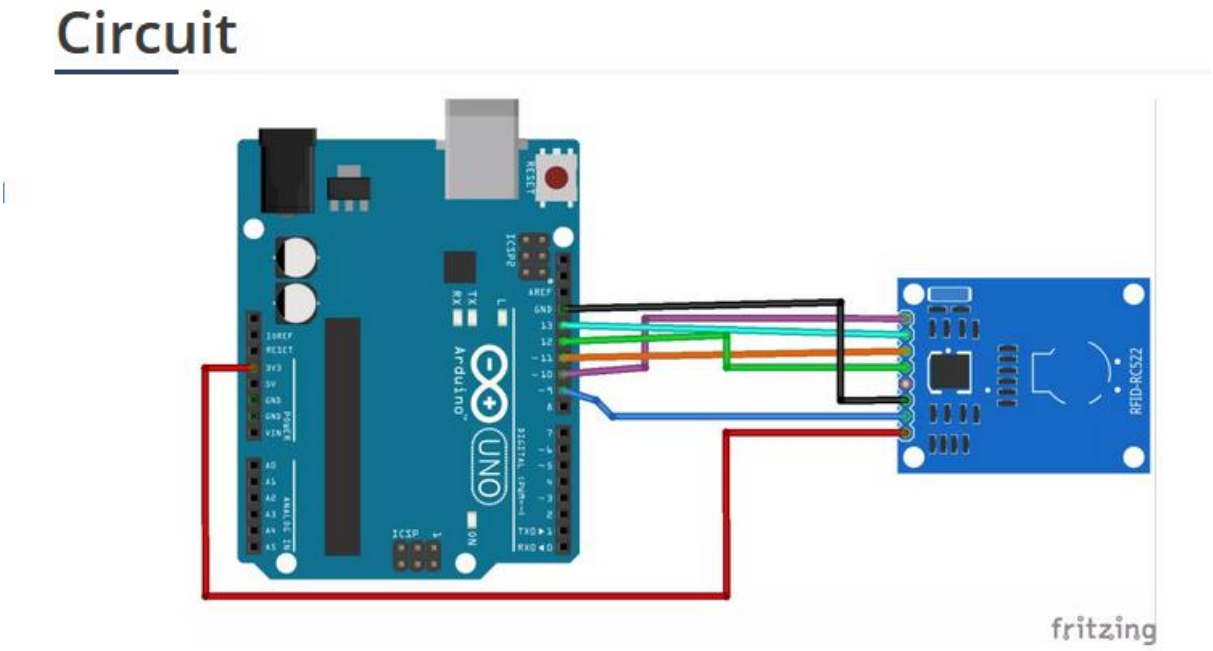

Figure 6.2.1: Circuit Diagram of RFID

6.2.1 Buzzer

The buzzer has been connected with the Arduino through the bread board and jumper wires. When the wrong card came near to the RFID sensor then it will ring and alert him that the card is wrong.

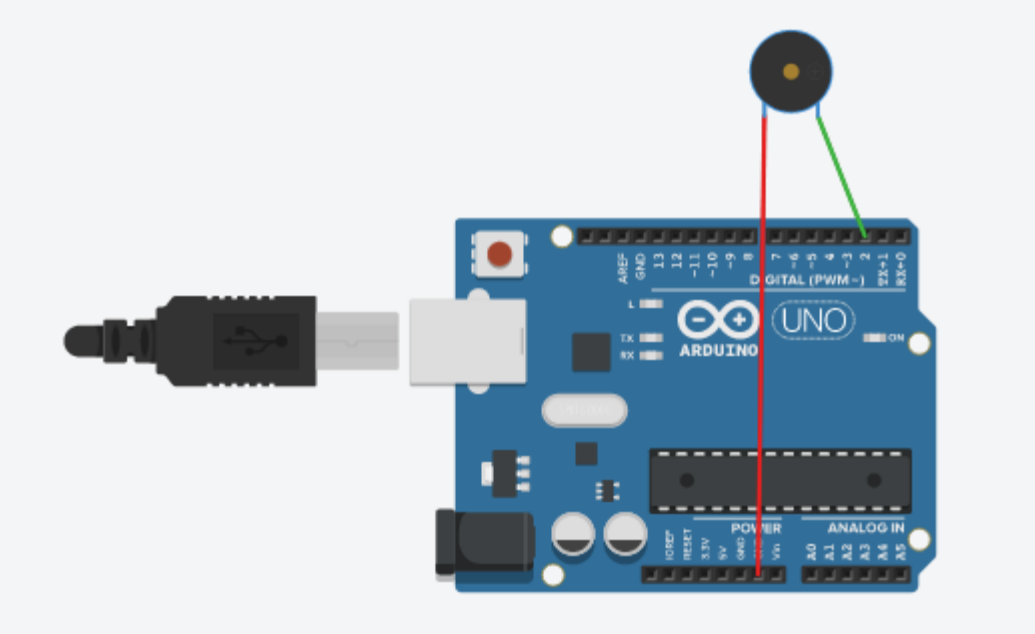

Figure 6.2.2: Circuit Diagram of Buzzer

6.2.2 Solenoid lock and Relay

It works with RFID sensor and arduino board. When RFID sensor detect a card and if the card is right for open the lock then arduino give a signal to the relay and it helps to open the lock.

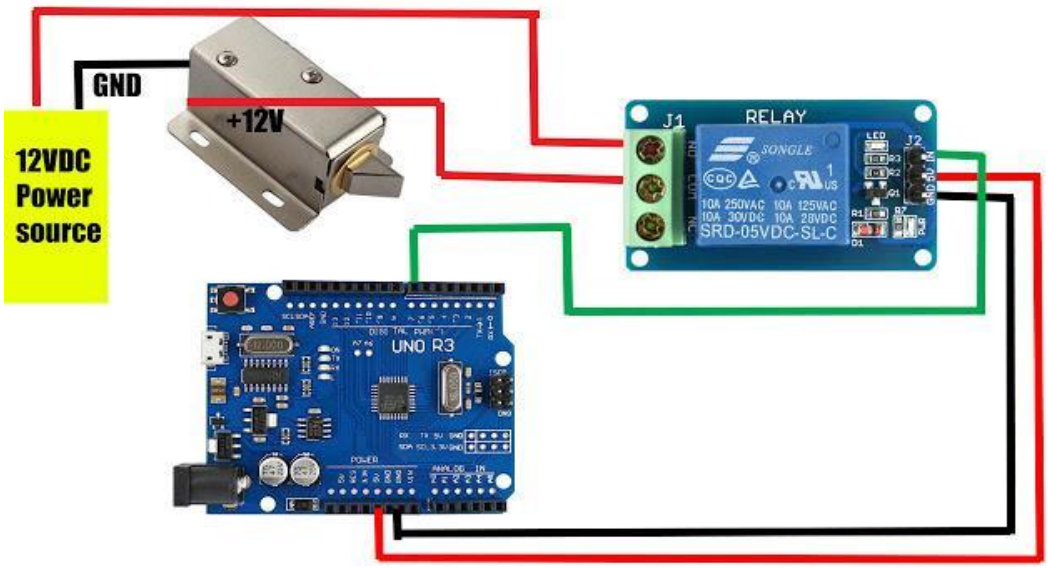

Figure 6.2.3: Circuit Diagram of Solenoid lock and Relay

6.2.3 Solar Panel and LDR

Solar for charge the battery and LDR for tracking the sun. Here we use 2 LDR that the solar can detect East to West axis where the sun light is maximum. From East to West axis SERVO motor help to move and it take signal from LDR.

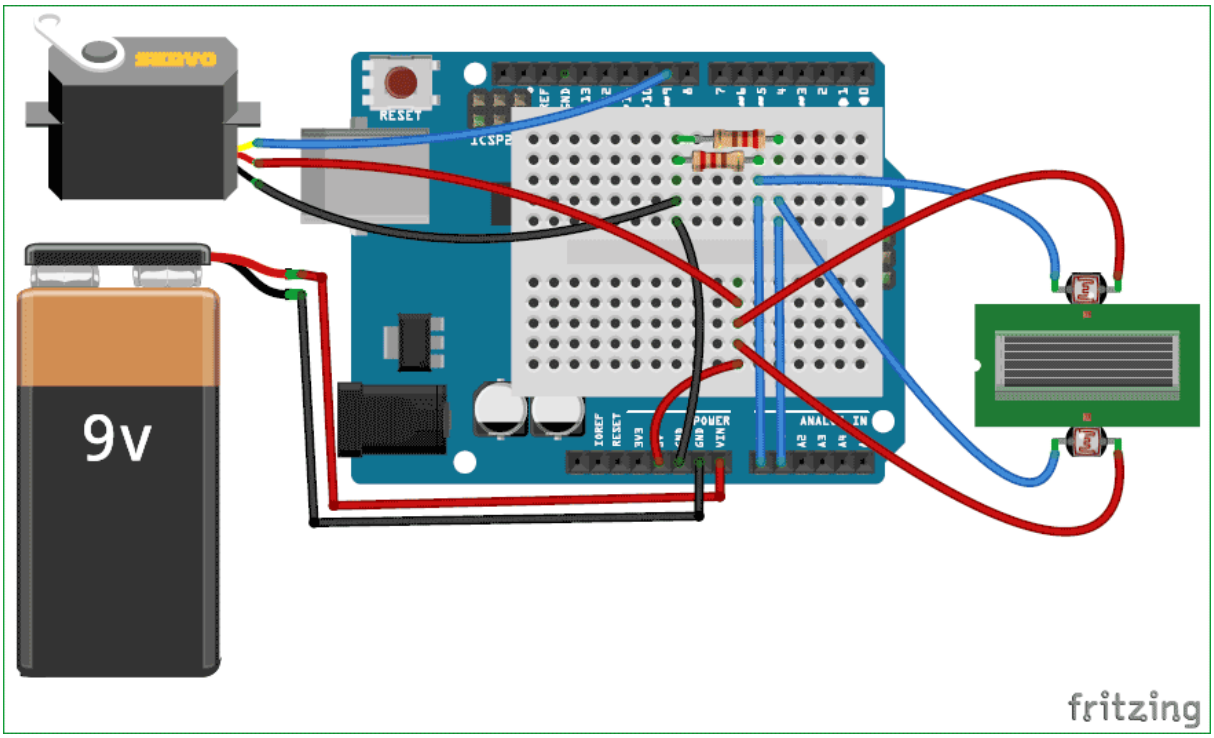

Figure 6.2.4: Circuit Diagram of LDR and Servo motor

CHAPTER 7
DESIGN REQUIREMENT

7.0 Activity Diagram

Activity diagram is basically a flowchart or UML which describes all the activity that happens in the system by a flow. We can get the idea about the whole system that how it works and how does it make us benefited. The activity diagram of this system has been given below.

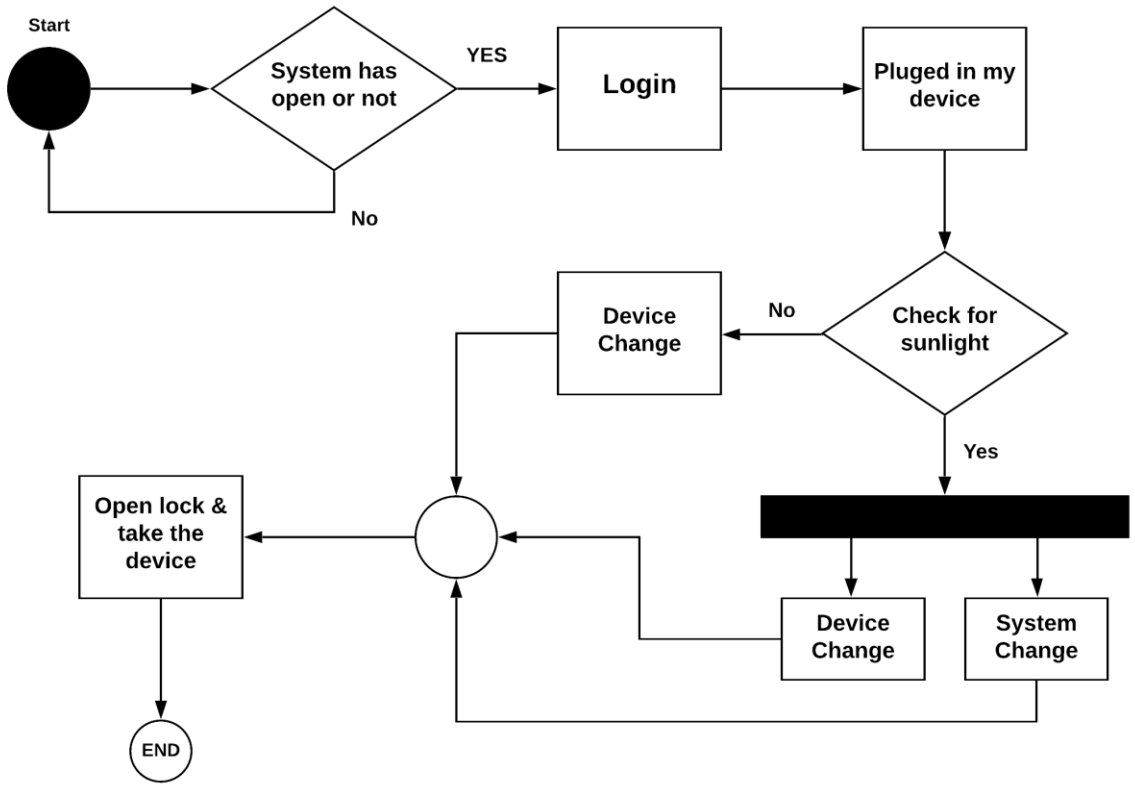

Figure 7.0.1: Activity Diagram

7.1 Use case Diagram

The use case diagram shows the activities between two actuators who are related with the system here.

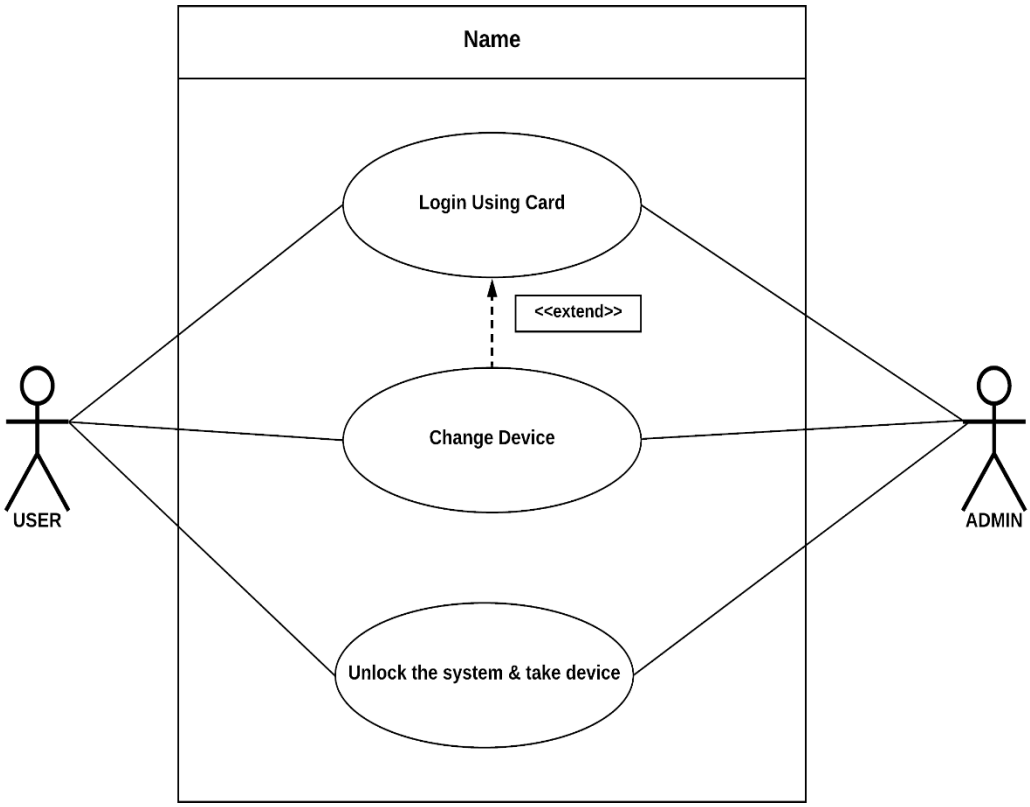

Figure 7.1.1: Use Case Diagram

Chapter 8

IMPLEMENTATION & TESTING

8.0 Implementation

In this part, we have discussed about how we have implemented our system. Although we have explained it before again and again. According to the design diagram, we have implemented all the components using Arduino UNO, RFID, Solenoid lock, Relay module, Solar Panel, LDR, Servo motor and Buzzer.

8.0.1 RFID card scanning code:

```
void loop(){

  //look for first card
  if ( ! mfrc522.PICC_IsNewCardPresent()){
    return;
  }
  if ( ! mfrc522.PICC_ReadCardSerial()){
    return;
  }
```

8.0.2 Solenoid Lock open and closing code:

```
  //lock open and lock
  digitalWrite(RELAY, LOW);
  delay(2000);
  Serial.print("It's open.");
  digitalWrite(RELAY, HIGH);
  delay(1000);
```

8.0.3 Buzzer code:

```
//Wrong Card and Buzzer Alert the person
Serial.println("Access Denied");
digitalWrite(BUZZER, HIGH);
delay(2000);
digitalWrite(BUZZER, LOW);
delay(1000);
return myFunction();
```

8.0.4 LDR code:

```
void loop()
{
  int R1 = analogRead(LDR1); // reading value from LDR 1
  int R2 = analogRead(LDR2); // reading value from LDR 2
  int diff1= abs(R1 - R2);   // Calculating the difference between the LDR's
  int diff2= abs(R2 - R1);

  if((diff1 <= error) || (diff2 <= error)) {
    //if the difference is under the error then do nothing
  } else {
    if(R1 > R2)
    {
      initial_position = --initial_position;  //Move the servo towards 0 degree
    }
    if(R1 < R2)
    {
      initial_position = ++initial_position; //Move the servo towards 180 degree
    }
  }
  sg90.write(initial_position); // write the position to servo
  delay(100);
}
```

8.1 Testing

Testing is the most important part of any system. Testing is being using for to check whether actual results match with expected result. Without testing none can determine the actual problem or error on a system. There are a lot of test in testing phase. We choose Unit test and System test during testing phase of our system. Testing is mainly used for identify errors, gaps or missing requirements. Testing is compare as overall approach of a system. Therefor without fixing bugs and deliver a good quality product, no mean to create a system for mankind. And our project has been tested through this testing and it passed this across.

8.1.0 Unit testing

Unit testing test all the individual units of a system. It test every parts with a small enough data. The strong thing of this testing is it finds problems early in the development cycle, and the weak thing is it cannot setup realistic and tough to set the conditions and logics.

8.1.1 Black box testing

Black box testing is a method of examines functionality of an application or system. This method is using for testing integrations, system and testing acceptance without looking internal side.

8.1.2 White box testing

White box testing is a testing method where internal structure/design of the system has been known by the tester. It focuses on improving design and usability of a system. It is also known as clear box testing, open box testing, and Glass box testing, transparent box testing, Structural box testing.

8.1.3 Grey box testing

Basically this is the combination of black box and white box testing combination. This testing performs with limited knowledge of an application or system, In case of testing system some of the part contains clear knowledge content some of are not on this case grey box testing has performed.

8.1.4 System testing

System testing is a testing where a complete system are integrated and tested. This is the way to find any bugs or incomplete things of a system.

8.1.5 Alpha testing

This is the initial phase of validating of a product to release in market. It is performing with developers by acceptance test, integration test and system test these three test get together with a meaning of alpha test.

8.1.6 Beta testing

After alpha test, beta test has been come it is considering as second phase of system testing. This is prerelease test, this is the type of testing period for a product to release commercially or officially. This is a real world exposure and it’s provide the preview of releasing the product.

CHAPTER 9
CONCLUSION AND FUTURE PLAN

9.0 Conclusion

This system is made for the general people who can charge their phones battery without worrying about any security issues. This system has been made with simple instruments and parts which is available at any city's market. It will be upgraded time to time by user demand. The main thing of this system is it is so easy to use and it is cost efficient product. There are no complexity and no extra knowledge need to use this project. Therefore, we made this project with time and give effort, this will be really helpful for general peoples. In further update we will try to keep remain the system as simple as it is.

9.1 Future work

Most of the usable things is costly in this earth. In future for solving all cost limitations and to develop our project, we will include some new features which are given below.

- Face lock for security.
- Wireless Charging.
- Fast Charging system.

References

[1] Altas, I. H., and A. M. Sharaf. "A novel maximum power fuzzy logic controller for photovoltaic solar energy systems." *Renewable Energy* 33.3 (2008): 388-399.

[2] Rai, A. K., Kaushika, N. D., Singh, B., & Agarwal, N. (2011). Simulation model of ANN based maximum power point tracking controller for solar PV system. *Solar Energy Materials and Solar Cells*, *95*(2), 773-778.

[3] Messai, A., Mellit, A., Guessoum, A. and Kalogirou, S.A., 2011. Maximum power point tracking using a GA optimized fuzzy logic controller and its FPGA implementation. *Solar energy*, *85*(2), pp.265-277.

[4] Want, R., 2006. An introduction to RFID technology. *IEEE pervasive computing*, *5*(1), pp.25-33.

[5] Paret, Dominique, and Roderick Riesco. *RFID and contactless smart card applications*. New York: Wiley, 2005.

[6] Kfir, Ziv, and Avishai Wool. "Picking virtual pockets using relay attacks on contactless smartcard." In *First International Conference on Security and Privacy for Emerging Areas in Communications Networks (SECURECOMM'05)*, pp. 47-58. IEEE, 2005.

[7] Hendri, H., 2017. SISTEM KUNCI PINTU OTOMATIS MENGGUNAKAN RFID (RADIO FREQUENCY IDENTIFICATION) BERBASIS MIKROKONTROLER ARDUINO UNO R3. *Komputer Teknologi Informasi*, *4*(1).

[8] Arifatno, Deny Rochman, and Sirojuddin Munawir. "RANCANG BANGUN SISTEM KEAMANAN KUNCI PINTU DENGAN RFID (RADIO FREQUENSI IDENTIFICATION) BERBASIS MIKROKONTROLLER ARDUINO UNO 328P." *Jurnal Multimedia* 8, no. 1 (2017): 33-40.

[9] PRADINI, YOGI S. "Rancang Bangun Pemanfaatan E-Ktp Sebagai Pembuka Kunci Pintu Ruangan Pada Laboratorium Teknik Elektro Menggunakan Rfid Berbasis Arduino Uno." (2019).