A SYSTEM TO SENSE LOCKED DOOR AND TURN OFF POWER TO HOME APPLIANCES

A Project Report

submitted by

K.HEMANTH

EE14B030

in partial fulfilment of the requirements

for the award of the degree of

BACHELOR OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY MADRAS.

MAY 2018

THESIS CERTIFICATE

This is to certify that the thesis titled **A system to sense locked door and turn off power to home appliances**, submitted by **K.Hemanth**(EE14B030), to the Indian Institute of Technology, Madras, for the award of the degree of **Bachelor of Technology in Electrical Engineering**, is a bona fide record of the research work done by him under our supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Dr.Boby George
Research Guide
Associate Professor
Dept. of Electrical Engineering
IIT-Madras, 600 036

Place: Chennai

Date: 15th May 2018

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my guide Dr.Boby Geroge for guiding me thoughtfully and efficiently through this project, giving me an opportunity to work at my own pace along my own lines, while providing me with very useful directions whenever necessary.

I would also like to thank my friends Ashok Reddy,Subham,Harsha,Srikanth,Bhadra for being great sources of motivation and for providing encouragement throughout the length of this project.

I offer my sincere thanks to all other persons who knowingly or unknowingly helped me complete this project.

ABSTRACT

Electricity is the most important thing in human life.It has now become a part of our daily life and one cannot think of a world without electricity. Most people won't switch off lights,fans and electrical devices in their living rooms even though they are not using.Students living in hostels won't switch off the power inside their room when they are going out. Through this a lot of electricity is being wasted every year.So,we need to conserve it.We can conserve electricity by automatically turning on or turning off the main power supply.

The aim of the project was to design a wireless device which automatically switches off the power inside a room when its door latch is closed and switches on when the door latch is open. Hall effect principle, amplifier and rf transmitter-receiver module were used in designing the device. Using a hall effect sensor and a magnet, we are detecting the closing and opening of the door. This change is used to close or open a relay which is connected to main power supply.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS **i**

ABSTRACT **ii**

LIST OF FIGURES **iv**

1 INTRODUCTION **1**

2 IMPLEMENTATION **2**

2.1 Hall Effect Sensor 3

2.1.1 Hall Effect: 3

2.2 Differential Amplifier 4

2.3 Comparator and Switch 5

2.4 Transmitter and Receiver 6

2.5 Working 7

3 CONCLUSION **9**

LIST OF FIGURES

2.1 Circuit 2

2.2 Block Diagram of the Circuit 2

2.3 Variation of Voltage of hall effect sensor output with distance from magnet 3

2.4 Differential Amplifier 4

2.5 Comparator 5

2.6 Comparator Output 6

2.7 Transmitter 6

2.8 Output of the Receiver 7

2.9 Circuit with Wooden Setup 7

2.10 Flow Chart 8

CHAPTER 1

INTRODUCTION

Electricity is generated using natural resources like coal, natural gas, wind, water,solar energy etc. But day by day the natural resources are depleting.Because of global warming,there is huge water shortage. Over last 4 years,water shortages cost india's thermal power plants 30TWh in potential electricity generation.Since the natural resources are depleting at faster rate, we need to minimize the usage of electricity.But people are wasting electricity. Over 3 billion units of electricity is being wasted every year, which is a day's consumption of entire nation.Using fossil fuels to generate electricity increases the pollution levels which causes global warming.So conserving electrical energy reduces the usage of fossil fuels which means reduction in the emission of green house gases.Thus by conserving electricity, we can reduce global warming as well.So it is important to conserve electrical energy.

The aim of this project is to reduce the wastage of electricity.So,we came up with an idea and made into a device which automatically turn on/off the main power supply to a room.One can install this device on their doors.Whenever the door is closed,the device turns off the power supply in the room and turns on when door is opened.The device consists of a Hall Effect Sensor, a differential amplifier, a comparator and switch and transmitter-receiver module.By using this, one can not only conserve electrical energy, but can reduce their electrical bills.

CHAPTER 2

IMPLEMENTATION

The proposed device consists of simple circuit which is implemented as shown in the below block diagram.It consists of a hall effect sensor which is used to detect the movement of door latch,a differential amplifier,a comparator and a switch and transmitter-receiver.The connections between them are shown in below diagram.

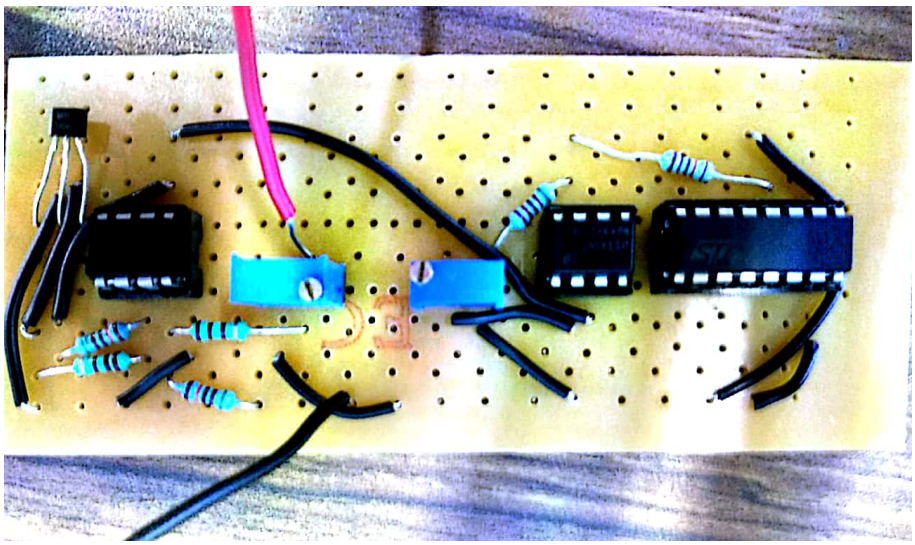

Figure 2.1: Circuit

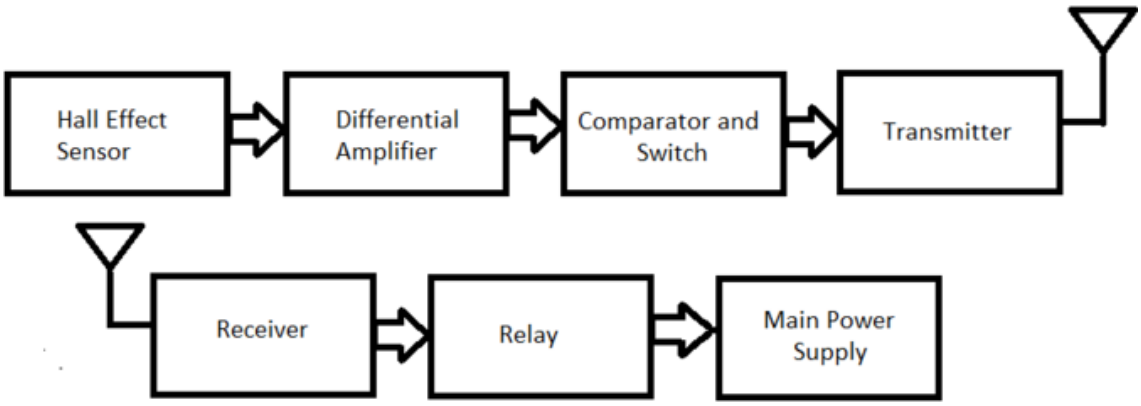

Figure 2.2: Block Diagram of the Circuit

Each block is explained below in detail. The circuit is connected as shown in figure.Hall ic output goes to differential amplifier.The difference between output voltage of hall effect sensor and reference voltage is amplified and given to comparator.The

comparator compares the output of differential amplifier with fixed voltage.The output of the comparator goes to switch and turns on/off the transmitter.

2.1 Hall Effect Sensor

2.1.1 Hall Effect:

The Hall effect is the production of a voltage difference across an electrical conductor, transverse to an electric current in the conductor and to an applied magnetic field perpendicular to the current.

Hall Effect Sensor is a transducer whose output changes with magnetic field across it.It can be used to detect speed and can be used as a proximity sensor. In this project we used it to detect the position of the door latch as follows:

A magnet is attached at the tip of the door latch. The hall effect sensor is placed on the other side of the door such that it is perpendicular to the magnetic field of magnet.So,while closing the door latch, the voltage drop across the hall effect sensor increases. While opening the door latch, the voltage drop decreases. The change in voltage drop of hall effect sensor with distance is shown in below figure.

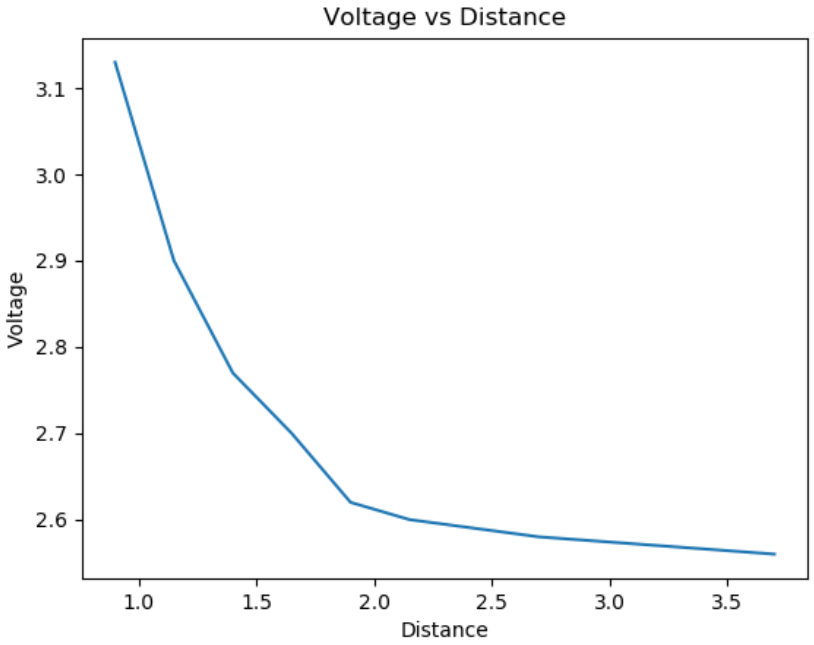

Figure 2.3: Variation of Voltage of hall effect sensor output with distance from magnet

The voltage at the output of hall effect sensor is 2.48V when there is no external magnetic field applied. As the magnetic field is applied, the voltage increases.Thus from the voltage of hall effect sensor output,we can determine whether the door latch is closed or not.

2.2 Differential Amplifier

The distance between the door latch and the outer part of wood in which we put the latch is nearly 4cm.As we can see from the graph, when the distance between magnet and hall effect sensor is 4cm, the change in the voltage at the output of hall effect sensor is very small and it will be in millivolts. So, a differential amplifier is used to amplify the change.In this project, LM741 opamp is used as differential amplifier.

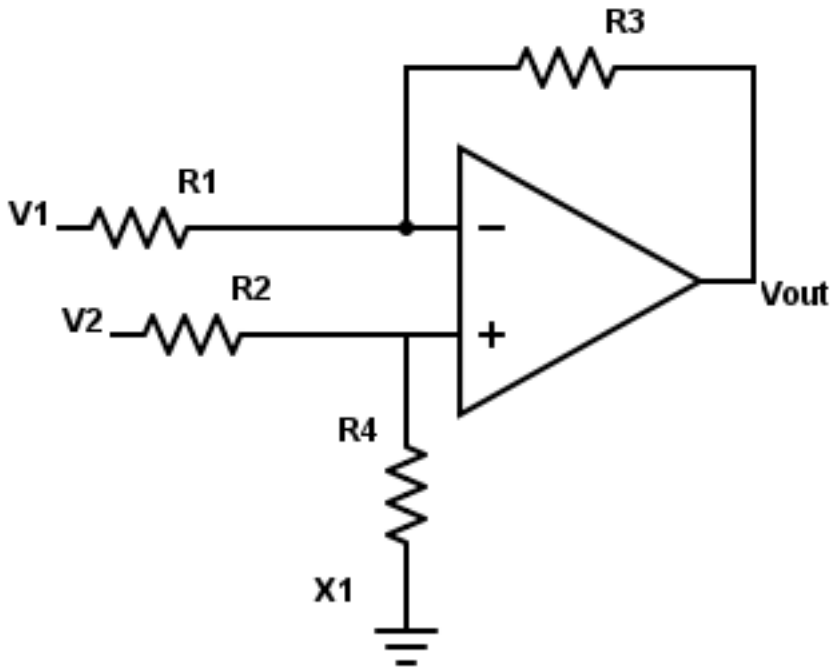

Figure 2.4: Differential Amplifier

$$Vout = -V1(\frac{R3}{R1}) + V2(\frac{R4}{R4+R2})(\frac{R1+R3}{R1})$$

$$When\ R1 = R2\ and\ R3 = R4\ in\ above\ equation, we\ get$$

$$Vout = \frac{R3}{R1}(V2 - V1), Gain = \frac{R3}{R1}$$

Input V2 is reference voltage of value 2.48V. A potentiometer is used to generate

this voltage.Input V1 is the output of hall effect sensor. Any change in the output of hall effect sensor from reference voltage is amplified.In this project,

$$R1 = R2 = 100\Omega \; and \; R3 = R4 = 510k\Omega \; . \; So \; Gain = 5100$$

2.3 Comparator and Switch

A comparator is used to compare the output voltage of differential amplifier with a reference voltage.Differential amplifier output is given to negative terminal of comparator and reference voltage is given to positive terminal of comparator.If the output voltage of differential amplifier is less than reference voltage, the output of the comparator will be HIGH(5V). If the output voltage of differential amplifier is more than reference voltage, the output of the comparator will be LOW(0V).

The reference voltage used in this project is 2.5V.It is generated using potentiometer.

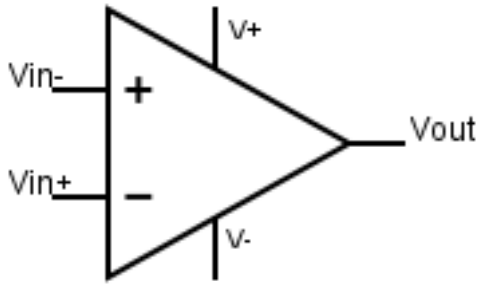

Figure 2.5: Comparator

$$If \; Vin+ \geq Vin- \; , Vout = 5V \; , else \; Vout = 0V.$$

The output of the comparator is used to control the switch.CD4053 ic is used as switch in this project.Since CD4053 is a mux, it will have a control, two inputs and an output. The output of comparator is given to control of CD4053.The two inputs are connected to 5V and 0V. When control is HIGH, output connects to 5V input and when control is LOW, output connects to 0V input.The output of switch is used to turn on/off the transmitter.

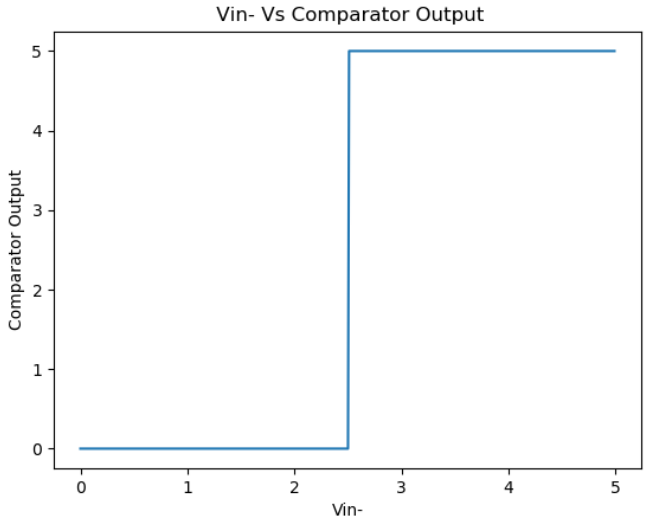

Figure 2.6: Comparator Output

2.4 Transmitter and Receiver

A transmitter-receiver is used to transmit the signal at the output of the switch.The output of switch goes to transmitter and a relay is connected between receiver and main power supply.When the output of switch is HIGH, the transmitter transmits the signal and receiver opens the relay.When the output of switch is LOW, transmitter won't transmits any signal and relay will be closed.

A wireless door-bell transmitter-receiver module is being used in this project.So,instead of push button of the door-bell,we are using CD4053 as switch.The push button was removed and it's terminals were shorted.The CD4053 switch output is connected to the shorted terminals. The transmitter is shown in below figure.

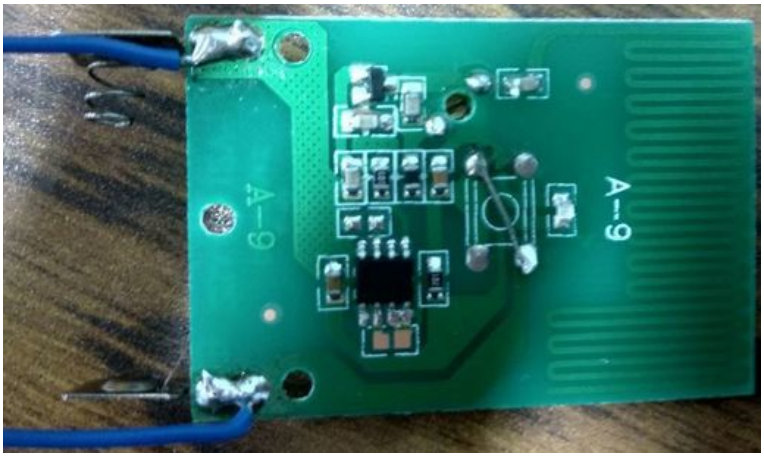

Figure 2.7: Transmitter

The signal received at the receiver is as shown in the below figure.

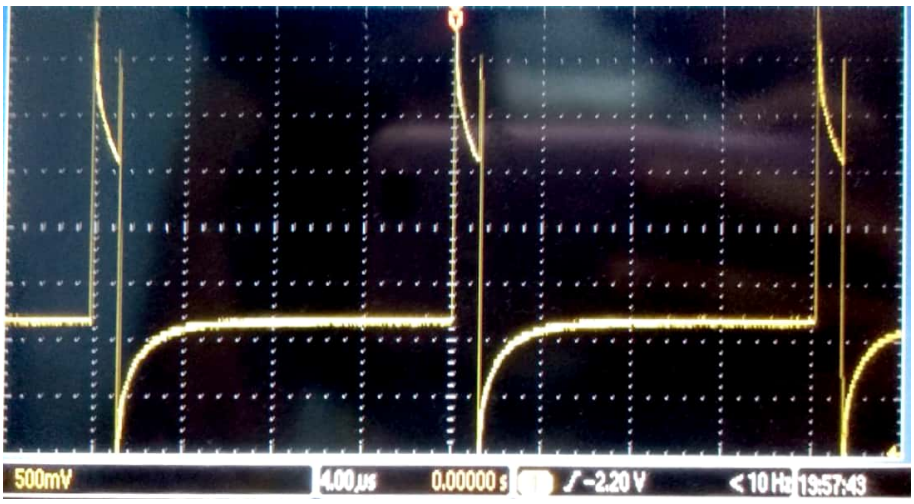

Figure 2.8: Output of the Receiver

As we can see from the above figure, the signal received at receiver is AC. So,we need to rectify the AC signal and convert to DC.The DC signal is used to close or open the relay which is connected to main power supply.

2.5 Working

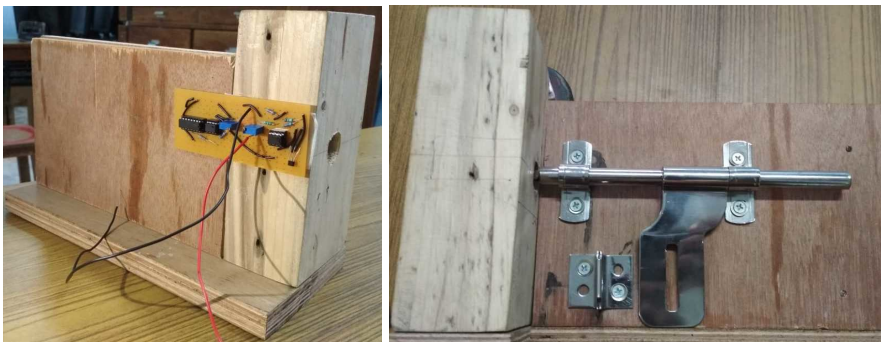

Figure 2.9: Circuit with Wooden Setup

When the door latch is open, the output of differential amplifier is high.It is compared with reference voltage of 2.5V.Since the output of differential amplifier is high, the output of comparaotor will be low.Switch output will be low and transmitter won't transmit any signal and relay will be closed.

When the door latch is closed, the output of differential amplifier is low.It is compared with reference voltage of 2.5V.Since the output of differential amplifier is less

than reference voltage, the output of comparaotor will be high. Switch output will be high and transmitter transmit the signal and relay will be opened.

The working of the circuit drawn in a flow chart is shown below.

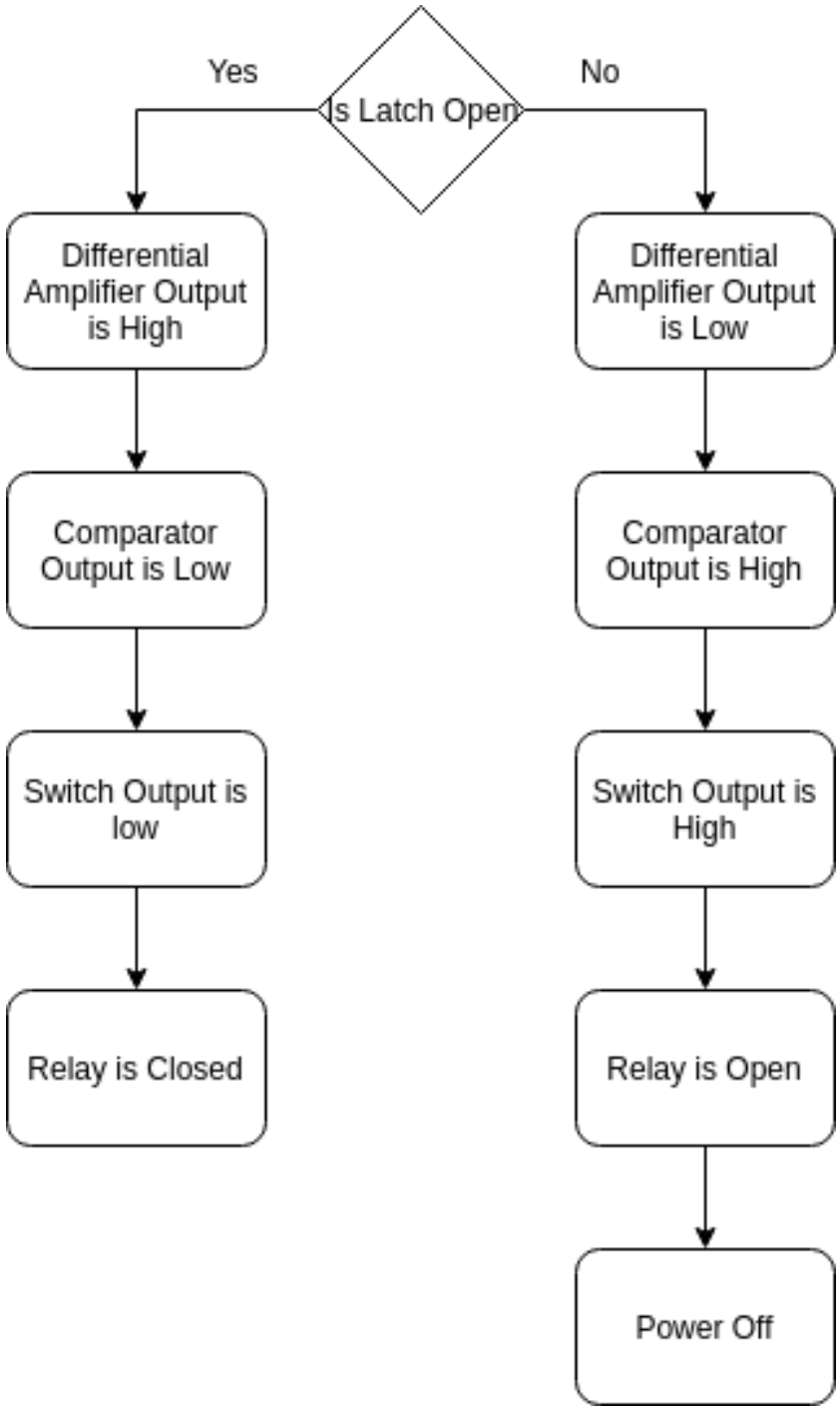

Figure 2.10: Flow Chart

CHAPTER 3

CONCLUSION

We proposed to build a product which turns off the power supply when the latch is closed and turns on the power supply when the latch is opened.This is being done by using a differential amplifier, comparator, switch.Our product is mainly designed to conserve electricity.This product is reliable, cost-effective and simple.It brings benefits to home users and contribute to building a better world through technology.

When someone closes the door latch from outside even though people are there inside the room,it will be a problem to use this device.In that case some sensors can be used to detect persons inside the room and switch off/on the power accordingly. When the door latch is closed, the hall effect sensor should be able to detect the magnetic filed.When opened, hall effect sensor should not detect the magnetic field strength.

REFERENCES

[1] http://www.wri.org/blog/2018/01/40-indias-thermal-power-plants-are-water-scarce-areas-threatening-shutdowns

[2] https://en.wikipedia.org/wiki/Hall_effect

[3] https://en.wikipedia.org/wiki/Hall_effect_sensor

[4] Differential Amplifier
https://www.electronics-tutorials.ws/opamp/opamp_5.html

[5] Comparator
http://www.scullcom.uk/operational-amplifier-op-amp/