Over Voltage and Under Voltage Protection System

Project Exhibition -2
Submitted in partial fulfilment for the award of the degree of

Bachelor of Technology
In
ELECTRICAL AND ELECTRONICS ENGINEERING

Submitted to

VIT BHOPAL UNIVERSITY (M.P.)

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December– 2021 DEC – 2021

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CANDIDATE'S DECLARATION

I hereby declare that the Dissertation entitled "**Over Voltage and Under Voltage Protection System**" is my own work conducted under the supervision of Dr. Om Prakash Pahari, Assistant Professor, Electrical and electronics department at VIT University, Bhopal.

I further declare that to the best of my knowledge this report does not contain any part of work that has been submitted for the award of any degree either in this university or in other university / Deemed University without proper citation.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date: 27 December 2021

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CERTIFICATE

This is to certify that the work embodied in this Project Exhibition -1 report entitled "**OVERVOLTAGE AND UNDERVOLTAGE PROTECTION SYSTEM"**has been satisfactorily completed by **Ms. PRASHASTI SINGH GAUTAM** Registration no: **19BEE10028** in the School of Electrical & Electronics Engineering of at Electrical & Electronics Engineering VIT University, Bhopal. This work is a Bonafide piece of work, carried out under my/our guidance in the School of Electrical and Electronics Engineering for the partial fulfilment of the degree of Bachelor of Technology.

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Acknowledgement

First and foremost, I would like to express my deep and sincere gratitude to my guide, Prof. Om Prakash Pahari, Assistant professor, SEEE, VIT Bhopal University, and our program chair Dr.PallabiSarkar Asst. Professor, SEEE, VIT Bhopal University for offering me the opportunity execute this project. Under their guidance and experience, I learned a lot about the various aspects in and around the project. They supported whenever needed, even during their busy schedule. It was indeed a privilege to work under these qualified visionaries.

I would like the extend my heartfelt thanks to the panel members Prof.Dr.NellaAnveshkumar, Prof.Dr.Baladevswamy, Prof.Dr.omprakashpahari, prof. Dr.Abhayvidharthi VIT Bhopal University, for his timely suggestions and ideas to direct us into the right path towards success and to the completion of the project.

I am overwhelmed and grateful for the support and competition given by my fellow classmates.

I would like to give credit to my teammates Tekumalla Lakshmi Sowjanya (19BEE10023) and samiksha dash (19BEE10009). It is because of their cooperation for the project, stimulation in the discussions, contribution with each of our ideas and effort, we were able to bring forth our project to reality.

EXECUTIVE SUMMARY

The importance of using electronic and electrical appliances is increasing day by day .but in the type of under voltage and over voltage conditions those appliances get damage. It causes economic losses. So this protection system helps to recognise the under , normal and over voltages conditions and protect the load which is appliances. When especially in industrial purpose, it protects heavy load from damage till 500v.

LIST OF FIGURES

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CHAPTER- 1

INTRODUCTION

The fluctuation in voltage is the major issue facing industry and home today, it is the cause which is responsible for damaging valuable equipment. If any unexpected fluctuation in the power supply may cause many problems in the industries, homes, offices. Voltage fluctuations in the electric power supply have a very poor effect on connected load.These fluctuations of over voltage and under voltage protection system are produced by many reasons which are like voltage surges, limiting, overload and etc. Protection system from the voltage fluctuation is needed for both equipment and user. Due to irregularity in voltages electrical appliances are not allowed to use without any protective device installed.

Technically speaking, an over/under voltage condition is reached when the voltage exceeds/lags the nominal voltage by10% for more than 1 minute. Short duration voltage events can also occur such as transients (both impulsive and oscillatory). Short duration intermittent supply failures can last anywhere from 0.5 cycles up to 1 minute and can be caused by a number of occurrences such as supply system faults, equipment failures, or malfunctions in control equipment. Under-voltage might result into brownout, distortion or permanent damage while overvoltage in the form of spikes and surges could cause distortion, burn-out, meltdown, fire and permanent damages. In this paper, the conditions of voltage are calculated and the normal condition of this protection system which is 230 volts as the undervoltage condition is recognized in between 200 to 230 volts and the overvoltage condition is recognized in between 230 to 250 volts. To protect the load, a relay is implemented with load, under these conditions the relay functions accordingly like it will switch OFF if the voltage is observed under and over and it will switch ON if the condition is observed normal. Here, as a voltage sensor, LV25P is used, which can sense voltage of higher ranges also, with this specification this project can also be used for industrial purposes.

OBJECTIVE

The objective of this system is to provide protection to the equipment's and avoid their failure due to abnormal conditions. This system provides protection for industrial, commercial and residential equipment's.

The process of this system is whenever there an overvoltage or under voltage the relay sense the input from operational amplifier and gets trip and the load is off. Thus, it protects the electrical appliance.

PROPOSED METHODOLOGY

- In this project under voltage, normal and over voltage conditions recognized accurately.
- The value of the voltage displayed on LCD.
- The relay protects the load accurately by functioning OFF at under and over voltage conditions and ON at normal conditions.
- The peak value from the voltage source is accurately given to the Arduino to recognise the conditions.
- In this system detection of voltage conditions effectively not frequency and phase.

BLOCK DIAGRAM

The block diagram for undervoltage and overvoltage protection system is shown in the fig.1. The input supply of the public utility is fed directly into voltage sensor circuitry (LV25P) which senses the voltage and at the output voltage in between the range of 1.9 to 2.9 is obtained. The value of this voltage varies as the input voltage changes. This output voltage is given to the signal conditioning circuit which is used to give the peak value of voltage. This peak value is the input to the Arduino. For powering up all the components of protection system a separate power supply is used which first stepped down, rectified, and smoothened. Regulators are used for regulating the voltage. The LM705 gives the 5 volts at output that is used for powering the Arduino and LCD, and LM712 gives 12 volts at output that is used for powering the relay.For driving the relay, a relay driver is used which is nothing but a NPN transistor with a resistance in series. This relay driver is directly connected from the Arduino. The load which is needed to protect is connect to the relay so that is any abnormal condition as the relay swich OFF, the power supply to the load is disconnected.

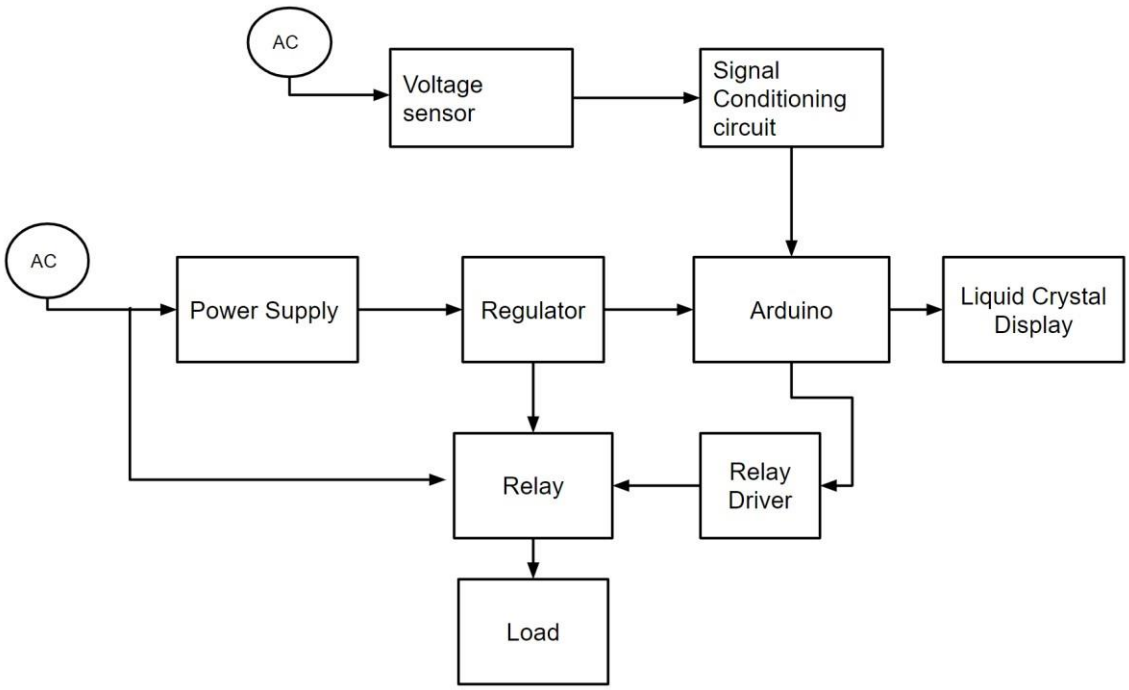

Fig. 1

CHAPTER-2

LITERATURE REVIEW

The research paper which we have used are:

- Under voltage and over voltage protection is a system, that offer the protection to load. The two voltage sources are used to power up the system and recognise the conditions. One voltage is step down by using the transformer and after converting into dc by using rectifier. Capacitors is used to reduce the ripples and get smooth voltage and after regulating the voltage by using regulators of 7805 and 7812.one is connect with the Arduino and LCD to power up and other is connected to relay to controlling purpose. And one signal conditioning circuit is used which is connected with LV25P and sending the input of peak voltage to Arduino to detect the conditions.

1st paper

This paper raises the design of under voltage and over voltage protection system. The outcome of this paper which helps us to design the system and we were able to collect the ideas and information which is the base for building our desired system.

2nd paper

This paper helped us in planning the framework of our desired system and we get the details of the components.It helped us designing our half of the circuit and we get know the connections of the circuit .

3rd paper

This paper helped us in designing in the signal conditioning circuit and the to get know about the connection to get the desired value as output.

4th paper

This paper helped us to know the connections of LV25P and to make the connections to signal conditioning circuit .And we get an idea about the threshold range about the voltage conditions of our desired system.

5th paper

This paper helped us to know the some functions to complete the Arduino code and it helps us in running our system and to check whether it is giving desired results or not.

Chapter – 3

LIST OF COMPONENTS

1. TRANSFORMER
2. BRIDGE RECTIFIER
3. CAPACITORS
4. VOLTAGE REGULATORS

4.1. 7805

4.2. 7812

5. ARDUINO UNO R3
6. RELAY
7. RELAY DRIVER
8. DIODES
9. OPAMP
10. LCD DISPLAY
11. VOLTAGE TRANSDUCER
12. RESISTERS

KEY PARTS

1. **Transformer:** Steps down the 220V ac into 18V ac on the principle of mutual induction.

2. **Bridge rectifier**: Full wave bridge rectifier converts the ac to dc for supplying the power to whole components of the system.

3. **Regulator:** Two voltage regulators LM7805 and LM7812 are used to give the regulated output voltage of 5V and 12V respectively.

4.Op-Amps: LM741 is used in signal conditioning circuit, to provide peak value of voltage.

5.Arduino UNO R3: It is used to make this project intelligent and smart. It can control actions automatically in case of under and over voltage.

6.LCD:it is used to display the input mains voltage level. It is 16 pin LCD powered up with 5V DC supply. It is interfaced with Arduino.

7. Relay driver: To give proper voltage or current to a relay driver is used. It is made by using one transistor with a resistance.

8. Relay: Relays are electrically operated switches that open and close the circuits by receiving electrical signals from outside sources.

9. LV25P: It is a voltage transducer which is used to observe the input voltage and at output it gives the voltage in between the range of ±5 volts.

CHAPTER – 4

PRACTICAL IMPLEMENTATION

Under voltage and over voltage protection system is used to protect the loads from damage. In practical, voltage source is connected to the transformer. Here 230v is step down to 18v ac. And to get the dc supply , full wave bridge rectifier is used where the output of transformer is given as input and getting 18v dc supply as output. But the dc supply has ripples, to smoothing the supply, a capacitor is connected in the shunt. The output of the capacitor is given to the voltage regulators 7805 and 7812 where we get 5v and 12 v as output. The 5v supply is connected to the Arduino and LCD display to power up. And 12v supply is connected to the relay which is needed for the functioning.
Another voltage source is added and connected to the LV25P. Here the output of the LV25P is in between the range from 2 to 2.7 and the threshold value is needed to be taken as the range of 10 percent. And this connected to the signal conditioning circuit as input. Here peak detector circuit is used as signal conditioning circuit which issued to determine the peak (maximum)value of the input signal until it comes to the reset condition. The peak detector circuit utilizes its property of following the highest value of an input and storing it. Here in between 3 to 4v getting as out in the different voltage conditions respectively.

The out is given to the ARDUINO. The Arduino code is needed to be convert into the hex. File and connect with circuit. After run the circuit the condition of the voltage and the value of voltage is display on the LCD display.

SIMULATION DIAGRAMS

For simulation, PROTEUS 8 software is used. The circuit was implemented in Proteus 8 professional software environment. The designed circuit was then simulated with different values of supply voltage. In the circuit, the V2 source is considered as the output from voltage transducer circuit. The considered output from the voltage transducer LV25P is as between range from 2 to 2.6 which fed into signal conditioning circuit.

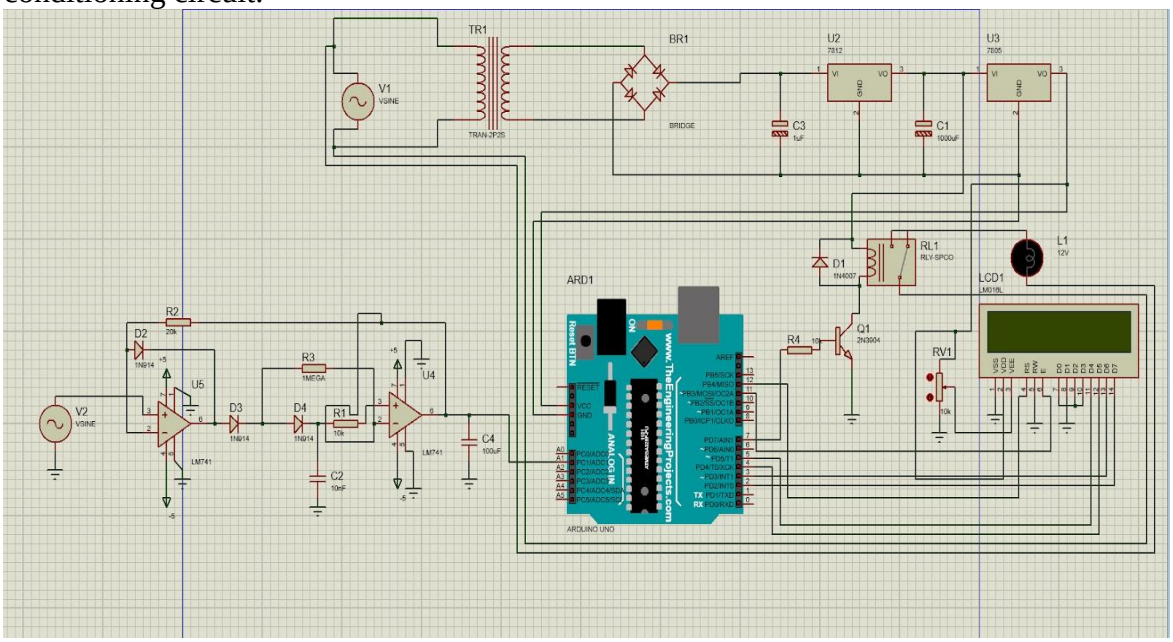

Fig 2 circuit design of under voltage and over voltage protection system

Undervoltage condition:

Simulation result with 180 V main input supply, which is considered as 1.8 in V2 source.

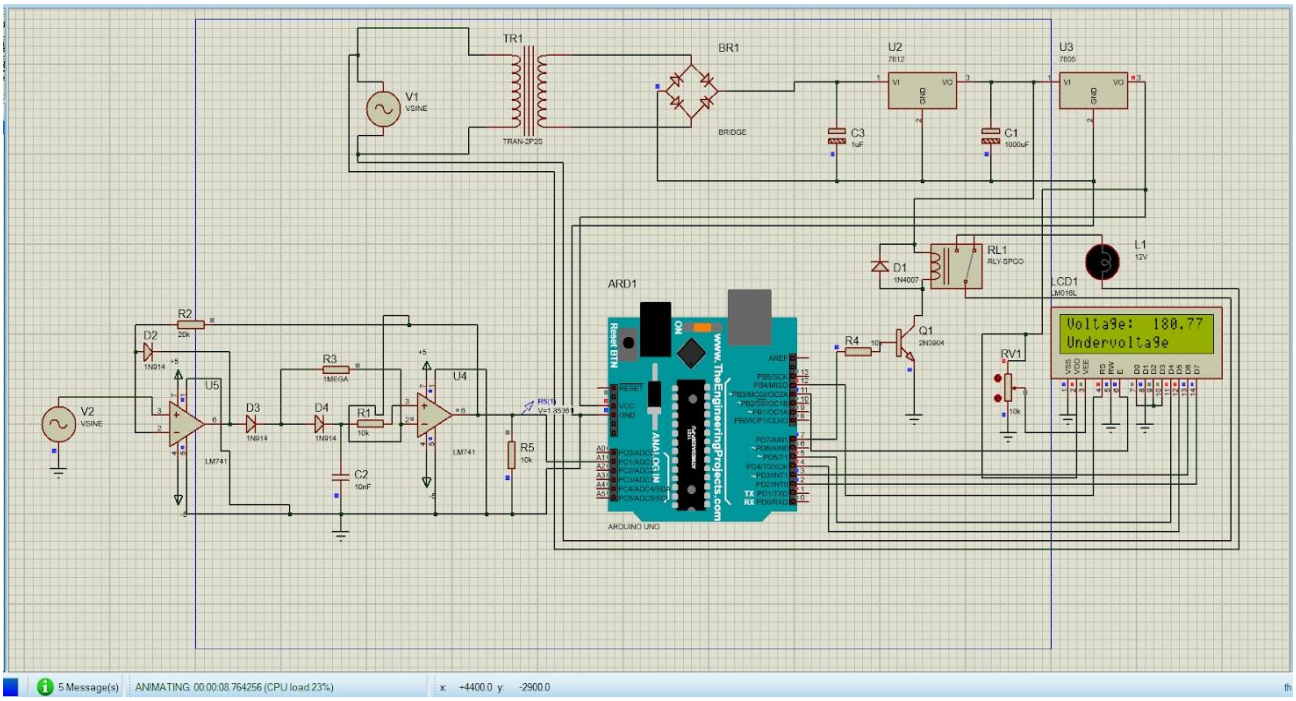

Fig 3 circuit design of under voltage condition

Normal condition

Simulation result with 230 V main input supply, which is considered as 2.3 in V2 source.

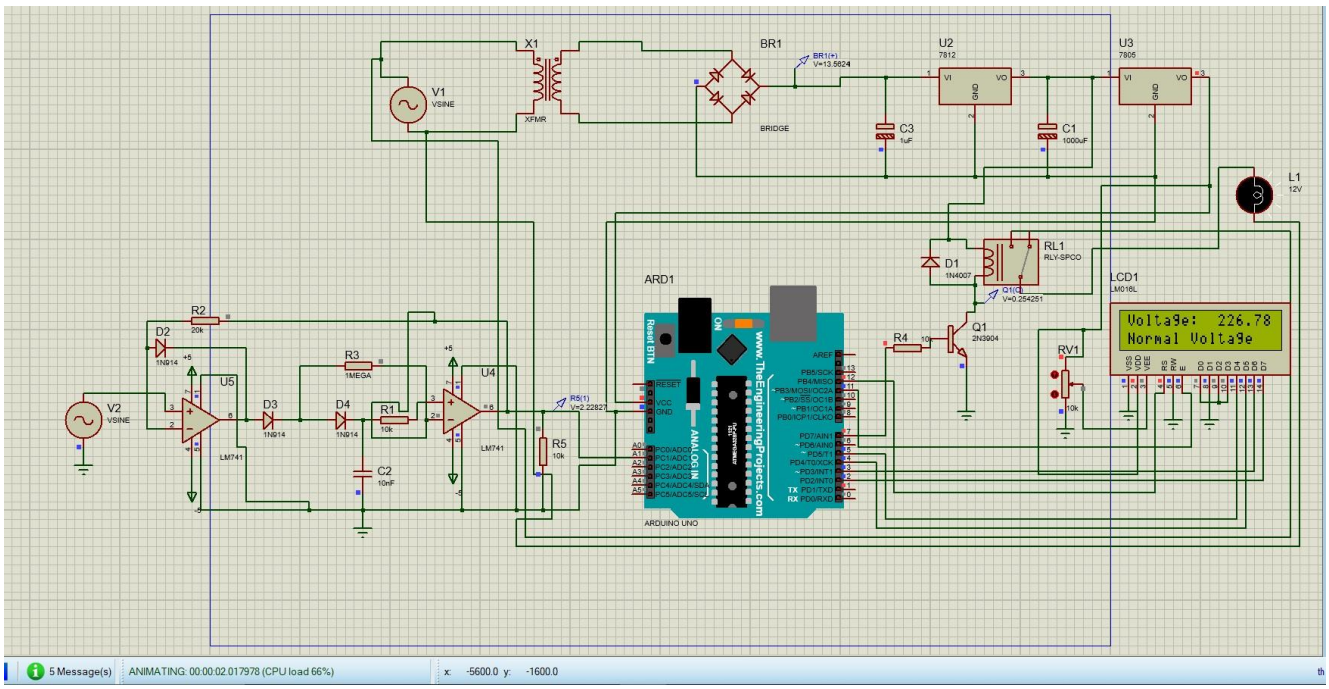

Fig 4 circuit design of normal voltage condition

Over voltage condition

Simulation result with 260 V main input supply, which is considered as 2.6 in V2 source.

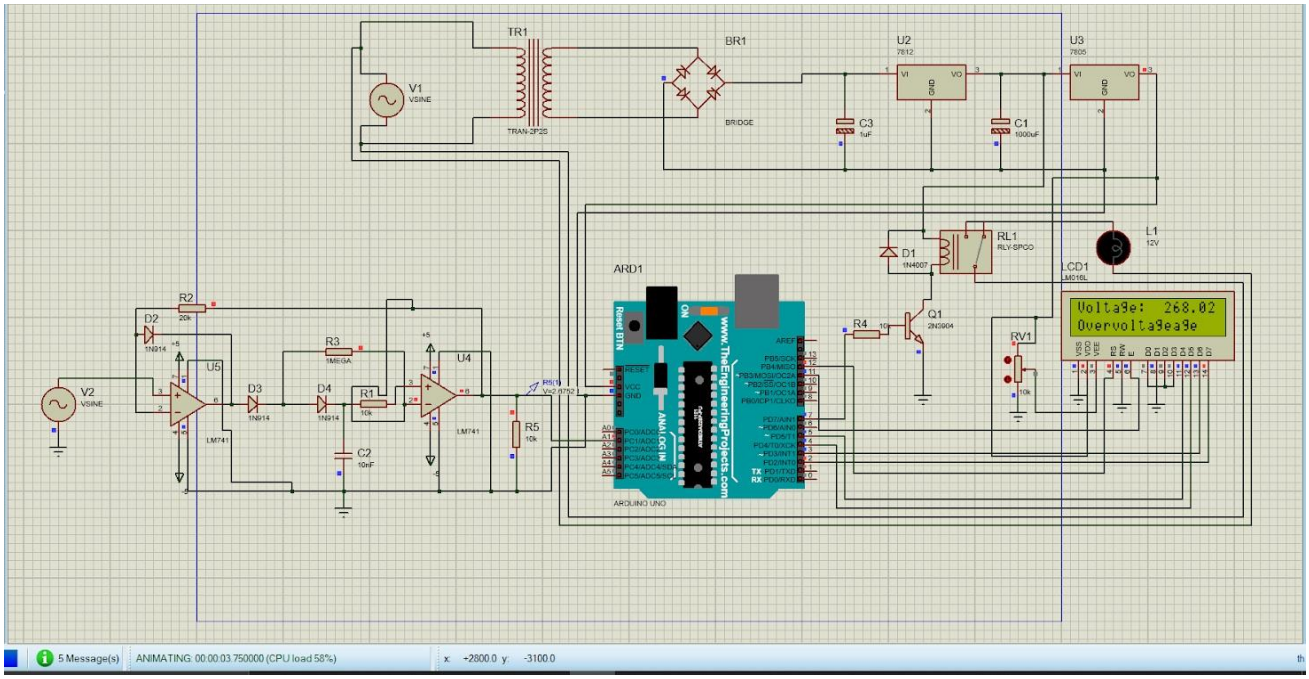

Fig 5 circuit design of over voltage condition

ARDUINO CODE

```
#include <LiquidCrystal.h>

#define rs 12
#define en 11
#define d4 5
#define d5 4
#define d6 3
#define d7 2
#define HIGH 0x1
#define LOW  0x0

// initialize the library with the numbers of the interface pins
LiquidCrystallcd(rs, en, d4, d5, d6, d7);

int analogInput = A1;
float vout = 0;
int relay = 7;
int value = 0;
float vol = 0;

void setup() {
Serial.begin(9600);
    // set up the LCD's number of columns and rows:
lcd.begin(16, 2);
  // Print a message to the LCD.
lcd.print("Voltage:");
pinMode(relay, OUTPUT);
pinMode(analogInput, INPUT);

}

void
loop()
{
   // read the value at analog input
value = analogRead(analogInput);

vout = (value / 1023.0)*5.0; vol
= vout*100;
```

```
    Serial.print("INPUT V= ");
    //Serial.println(value);

lcd.setCursor(10,0);
lcd.print(vol);
if (vout> 2.6)
    {
digitalWrite(relay,LOW);
lcd.setCursor(0,1);
lcd.print("Overvoltage");
    }
if (vout<2.0)
    {
digitalWrite(relay,LOW);
lcd.setCursor(0,1); lcd.print("Undervoltage
");
    }
if ((vout> 2.0)&&(vout<2.6))
    {
digitalWrite(relay,HIGH);
lcd.setCursor(0,1);
lcd.print("Normal Voltage ");
    }
}
```

CHAPTER - 5

PRESENT AND FUTURE SCOPE OF PROJECT

The scope of this project is to add automatic functionality to turn off and turn on main power supply to home devices in case of over voltage and under voltage of main power supply.If we control the tap changing transformer automatically then we can operate the load normally in under voltage and over voltage condition. Hence we can protect as well as operate the load in abnormal voltage.. This System can be later improved by integrating it with GSM modem that alerts user by sending an SMS about the tripping occurred.

CONCLUSION

The protection circuit can be used to protect the costly electrical appliances from abnormal conditions like under voltage and overvoltage and avoid appliances being effected from harmful effects. By using Arduino, the system is made completely automated. There is no need turn ON and OFF the main switch manually. Using of LV25P make the system more sensitive and useful for industries as it can measure voltage of higher ranges. The proposed project can have many more modification and can be use for several purposes in future.

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