

# **ADVANCED RESIDUAL CURRENT CIRCUIT BREAKER**

**A Project and Thesis submitted in partial fulfillment of the requirements  
for the award of Degree of  
Bachelor of Science in Electrical and Electronic Engineering**

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**December 2018  
Certification**

This is to certify that this project and thesis entitled “**Advanced Residual Current Circuit Breaker.**” is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held in December 2018.

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The project entitled “**Advanced Residual Current Circuit Breaker.**” submitted by **Khandaker Mehedi Hasan**, ID No: 151-33-2392 & **Sabbir Hossain**, ID No: 151-33-2388 Session: Fall 2018 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** on December 2018.

**Dedicated to**

**Our Parents**

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## List of Abbreviations

RCCB	Residual Current Circuit Breaker
LED	Light Emitting Diode
IREDD	Infrared Ray Emitting Diode
IR	Infrared Ray
GND	Ground
IDE	Integrated Development Environment
TTL	Transistor–transistor logic
CT	Current Transformer
USB	Universal Serial Bus
CB	Circuit Breaker
PWM	Pulse Width Modulation
SPI	Serial peripheral interface
TWI	Two wire interface
DC	Direct Current
AC	Alternating Current
ICSP	In-circuit serial programming
EEPROM	Electrically Erasable Programmable Read-Only Memory
SRAM	Static Random Access Memory

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# ABSTRACT

In this modern age, the use of electricity is everywhere. One of the saddest things about using electricity is through the death of a person by electricity. The steps taken so far to avoid this tragic event are not enough. In this paper, we introduce a circuit breaker that can protect a person from death by electrification.

This circuit breaker is basically a differential circuit breaker that measures the current of Phase and neutral, and if there is a slight disruption, it detects and trips the breaker. At present, such circuit breakers are available which are analog and because of this, the sensitivity is very low.

We have brought it into the digital mode and its sensitivity is so high that it is very effective in saving a person's life.

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

Electric shock is the flow of electrical current through a human's body that can damage the skin or internal organs. It can kill the person if the voltage and current are high enough. It depends on three-factor which are voltage, current and time of contact with electrical current. Voltage, current and longer contact is directly proportional to the damage.

Being electrified can result in extreme damage to the organs of a human body and can even cause death. Such incidents occur widely throughout the world.

#### 1.1.1 Problem Definition

There are effective solutions to almost every problem in the electrical transmission and distribution sector. However, no effective technology has yet come to prevent shock.

If there is no leakage on the skin then a person can feel the electricity from the 30V. And if it goes beyond 50V, it can reach dangerous levels. And the higher the voltage, the higher the current level according to Ohm's formula.

In the case of homesteads, 230 volts are used in Bangladesh and in some countries it is 110 volts. Which is very dangerous. It is very easy for current to flow through the human body when the voltage is high. And this is also very difficult for circuit breakers to measure this low current.

#### 1.1.2 The Effects of Electric Shock

In this matter of electric shock, the damage is relatively more severe as the current rises. According to data from the New Jersey State Council of Electrical Contractors Associations, Inc. For currents above 10 milliamps, the victim cannot let go of the wire that is shocking him because of muscular contractions are so strong that time. When the value increased to 20 milliamps, breathing will become labored, sooner or later ceasing absolutely even at values under 75 milliamps. A related table is shown below.

Table 1.1: Effect on Electric shock

<b>Amount of Current (Amps)</b>	<b>Effect</b>
0.001	Threshold of Sensation
0.009	Mild Sensation
0.01	Painfull Shock. Can not let go. Muscular Paralysis. Severe Shock. Labored. Breathing Upset.
0.09	Extreme Breathing Difficulties.
0.1	DEATH
0.2	
0.2	Severe Burns
1.0	Breathing Stops.

### 1.1.3 Solution of The Problem

When the body of the Victim touches the line, the current flows through the body and goes into the ground through the body. This can be identified as a ground fault. A ground fault can be detected by a differential Circuit breaker.



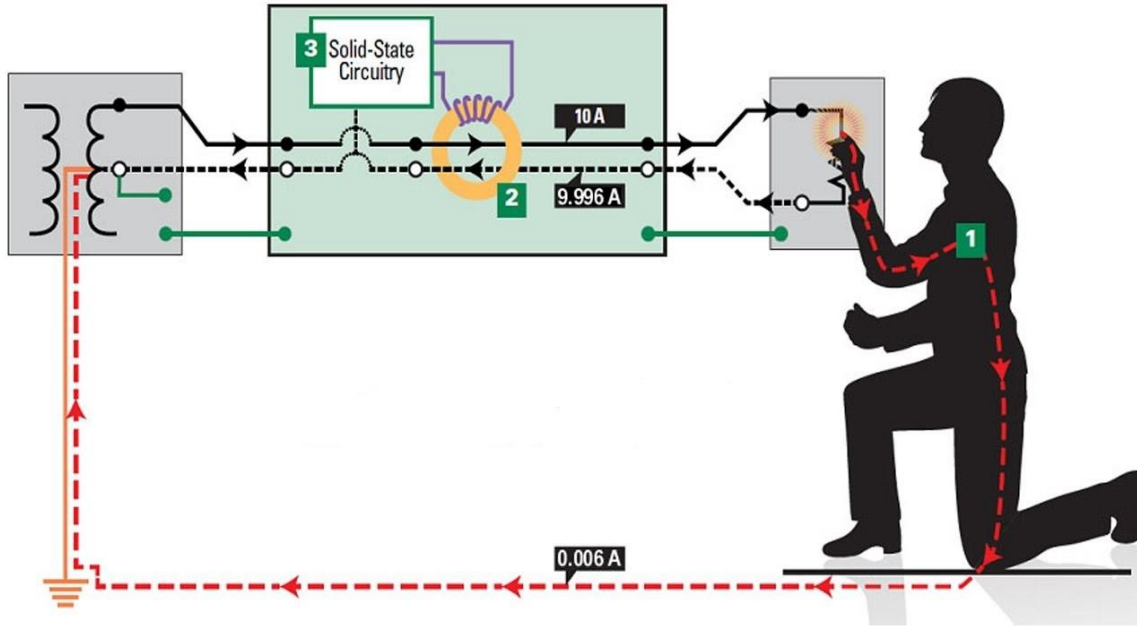


Fig 1.1 Differential Circuit Breaker

### 1.1.3.1 Definition of the Figure

1	Current Travels through Body.
2	CT Picks up the imbalance of current.
3	CT operates a relay and Turn Circuit Breaker On.

## 1.2 Objectives

The objective of this project is to free people from the harmful side of electric shock. The main function of this device is to shut down the entire system's power supply first if one is electrified. And alerting victims surrounding people via alarm so that they can receive early treatment. The device will then re-power the system after a specified time.

### ➤ Cost

The cost of the device is very low and after the mass production, it will cost down to 500 BDT.

### ➤ Ease of Use

This device can be used in conjunction with the main switch of each residence and can also be used in crowded electrically dangerous places.

### ➤ **Power Consumption**

The device uses extremely low power. Tested power consumption is 5 watt approximately but it can be developed for below 2 watts.

### **1.3 Scopes and Limitation**

This device can be used in residential homes and it can be used for industrial purposes in the future. And this device can also be marketed and used for business purposes.

However, this device cannot be used for short circuit protection right now and short circuit protection can be added to it.

This device is based on electronics parts and they can be damaged and stops its work.

### **1.4 Methodology**

The current out of the source within a loop must be returned to the source. Here the input current and output current must be equal and they will be equal to zero. If the current is found in any other way then the input current and output current will not be equal. And that time the sum of input current and output current will not equal zero.

If the current difference of two poles is created then it is identified by the current transformer.

And ferret core rings have been used for this purpose.

The signal found in the current transformer has been amplified by a transistor to detect very small differences.

Then it has been expanded and converted into a digital signal.

Then this digital signal is given as input to the microcontroller and some commands are given to the microcontroller depending on this input.

The command condition is as follows:

- If the input signal is high then it is counted as a fault condition.

- If the fault condition is detected then send the HIGH signal to a relay module. (The relay is used as a switch of a circuit breaker)
- If the fault condition detected the buzzer is on to warn the other persons.
- The circuit breaker is closed after 5 seconds.

## **1.5 Project Outline**

This project report comprises six sections which are Introduction, Literature review, Description of Components, Analysis, Result and Discussions, and Conclusions.

Part 1 is the presentation of the project overview. In this section, we are discussing what is our problem, how to deal with this problem, and what will be the future goal of the project.

Part 2 is the foundation of the undertaking. In this part audits of some related deals with outwardly disabled strolling helps. In this section, we are discussing the previous history of RCCB. The basic principle of RCCB, circuit diagram.

Part 3 is the Description of segments where portray all segments that are utilized in the undertaking. The full details of the component are described in this section.

Part 4 is the Analysis and recreation of the task that shows the proposed answer for outwardly hindered individuals with the square graph and flowchart. Additionally in this section concentrated on equipment and programming structure of the undertaking.

Section 5 is the Result and Discussion where all the tried outcome is acquired. Additionally, examine about that outcome. In this part, the total cost of the project, details of the result have been discussed.

Part 6 is the Conclusions. In this section, we are talking about the future goal of the project and how to get more benefitted from the work. And this is the end of the project.

# CHAPTER 2

## LITERATURE REVIEWS

### 2.1 Related Works and Existing System

This is kind of device are used to protect instruments, circuits and operators during Earth leakage.ELCB is the past name of RCCB. Early ELCBs were voltage operated devices detecting a voltage upward thrust between installation metalwork, and an external electrode. These have now been changed by present day sensing devices (RCD/RCCB).In modern-day literature voltage sensing devices are called ELCB or VOELCB and cutting-edge sensing gadgets are called RCCB or RCD.Voltage sensing ELCBs have been first brought about sixty years ago. Current sensing ELCBs had been first brought approximately forty years ago. For many years, the voltage operated ELCB and the differential contemporary operated ELCB had been both called ELCBs because it become a less difficult call to remember. But the use of a not unusual call for two different gadgets gave upward thrust to extensive confusion inside the electrical industry.

#### 2.1.1 RCCB

A residual current circuit breaker is a device that can sense current and disconnect a circuit quickly where any ground fault occurs.

Such electrical wiring devices are designed to disconnect a circuit easily and automatically when it detects that a circuit's supply and return conductors are not balanced by the electrical current. Some difference in the currents in these conductors shows the current of the leakage, which poses a danger of shock. There is theoretically a current of about 30 mA (0.030 amperes) through the human body which can cause cardiac arrest and it's lead to kill any human within a few fractions of a second.

#### 2.1.2 Purpose of RCCB

- RCCB trips coil and give protection when earth fault, as well as leakage current, occur.
- It offers the possibility of dual termination capability for both cable and busbar connections.

- It protects against voltage fluctuation since it includes a filtering device that protects against voltage transient level.
- When the rated sensitivity level is exceeded, it disconnects the circuit.

### 2.1.3 Types of RCCB

There are two types of RCCB based on how many poles in the device.

- **Two Poles:** It consists of two poles, one is a live wire and another is the neutral wire. This is used for a single-phase line.
- **Four Poles:** It consists of three live wire and one neutral wire. This is used for a three-phase system.

### 2.1.4 Working principle of RCCB

RCCB work based on the principle of “Kirchoff’s current law” as the incoming current is equal to the outgoing current. This circuit breaker is made in such a way, the incoming current through a live wire does not match with the outgoing current through the neutral wire that is mean fault current occurs.

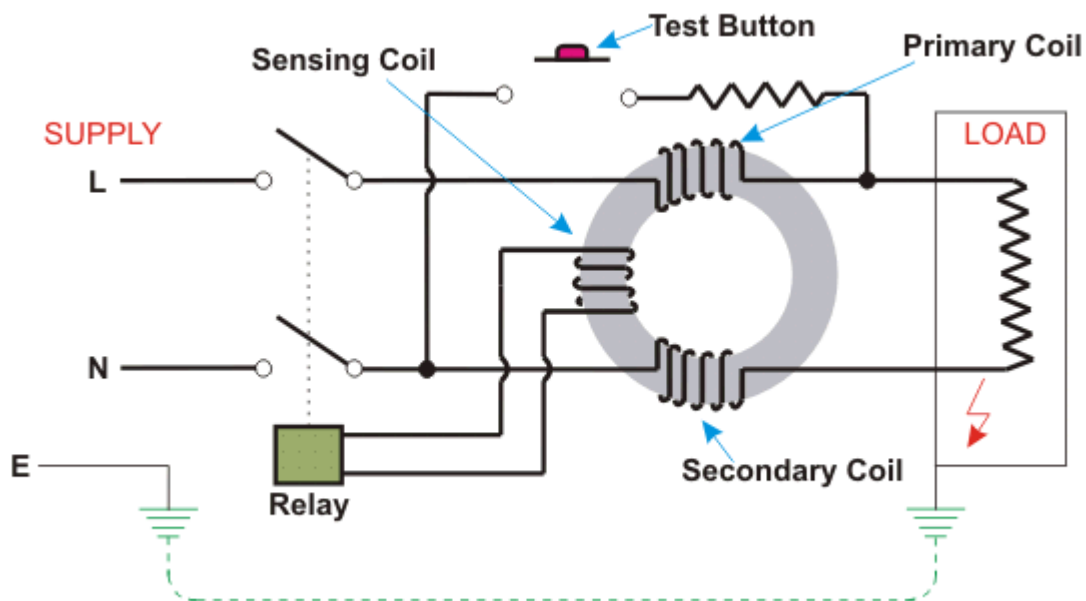


Fig 2.1 Working Principal of RCCB

The basic principle lies in the Toroidal Transformer shown in the circuit diagram. There are three different coils in there. Primary coil containing the live line, secondary coil containing neutral line which produces the equal and opposite flux if the current in both wires is the same. And sensing coil in the relay circuit.

Under the normal operating condition, there is no break of the circuit. When any fault occurs there is the difference between the live line and neutral line, the relay coil detects the difference and trip the coil. ‘

### 2.1.5 Limitations of the RCCB

- RCCB does not guarantee operation if the load doesn't contain any standard waveform. This is primarily because RCCB is designed to operate on a typical waveform in the supply.
- RCCB will not protect against live-neutral shocks.
- RCCBs are designed to operate on normal supply waveforms.

## 2.2 Proposed RCCB and Difference with Existing RCCB

The current RCCB device usually starts operating when a 30mA current differential is created. However, there are some new products that are capable of operating at 20mA. These devices usually work in analog mode. We propose to bring in a digital system that starts sensing from the current of 0.04mA, which is not possible in analog way.

### 2.2.1 The limitation we worked with

We have replaced the relay portion of the RCCB. Because A certain amount of current is required to start the relay. In the case of very small current differences, the amount of current generated in the current transformer does not turn on the relay. And Which is a major limitation of the RCCB circuit breaker?

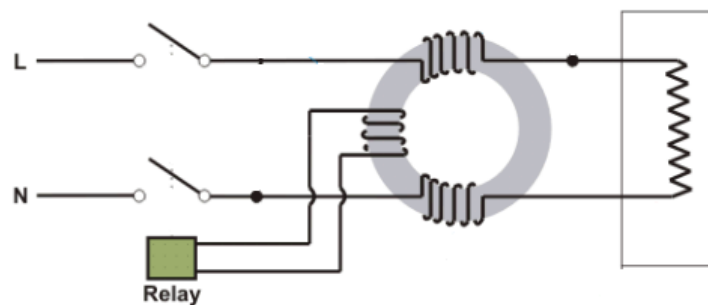


Fig 2.2 The limitation we worked with

### 2.2.2 General Block Diagram

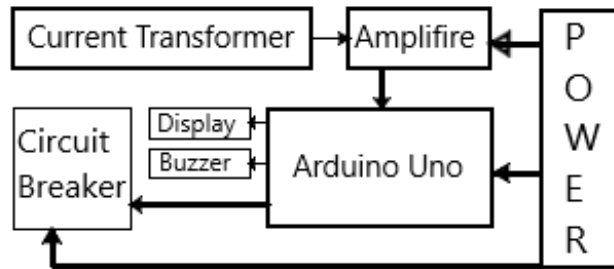


Fig 2.3 General Block Diagram

### 2.2.3 Description of Block Diagram

The current value found in the current transformer will be amplified so that its data can be analyzed.

The data will then be inputted into the Arduino Uno and if the fault is detected then the Arduino will turn on the circuit breaker according to its command. And the running task will be displayed on the LCD display. Here the Arduino will get power through a power supply while simultaneously connected to the amplifier and relay power supply. The Buzzer run from the computer's internal power supply.

### 2.3 Circuit Diagram

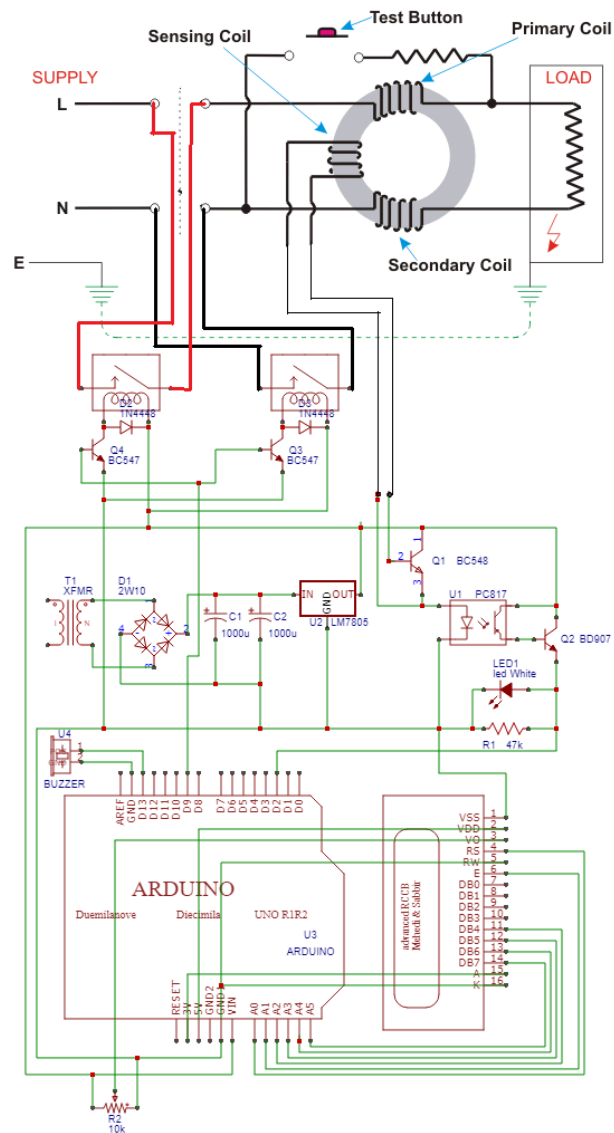


Fig 2.4 Circuit Diagram

### 2.3.1 Working procedure of the circuit diagram

- When the fault occurred the current transformer will pick it up by producing a certain amount of current.
- Current transformer is connected to BC548 Transistors Base. Current Transformer Triggers BC548 Transistor.
- BC548 enables PC817 Optocoupler and its emitter is connected to BD907 Transistors Base.
- BD907 Transistor connects 5 volt to arduino pin D2.
- Arduino Count 5V as Binary 1.



- When Arduino get input as 1 then it sends command HIGH(5V) To Arduino pin D9
- D9 Is Connected to Relay Module and when the relay Module gets 5V Signal then it Turns on the relay and Opens the circuit.
- After 5 Seconds Arduino sends command as LOW to D9 Pin and relay Module turns off.
- And the whole system will run again.

## 2.4 List of the components used in the circuit

Table 2.1: List of components used in circuit

Serial No	Component	Quantity	Application
01.	RCCB circuit breaker	1	Existing System.
02.	Arduino	1	Central Processing Unit.
03.	Transformer	1	Provide power to the system.
04.	Ferromagnetic Ring	2	Detecting Difference.
05.	Optocoupler 817	1	Electrically Isolate from the current transformer between microcontroller.
06.	Veroboard	1	Placing components to make the circuit.
07.	Relay 5v	2	Switch of CB
08.	Potentiometer 10k	1	Controlling contrast.
09.	Current transformer	1	Masuring current.
10.	1602 LCD	1	Display output.
11.	Transistor BC547	1	Amplify signal from the Current transformer.
12.	Transistor BD907	1	Making Digital input signal.
13.	LED	1	Visual Detection.
14.	Buzzer	1	Warning. (output)
15.	Diode 1N4007	6	Resist reverse current.
16.	Resistor	1	Clearing noise.
17.	Incandescent light bulb & Holder	1	Load Example.

18.	Capacitors 100uf 16V	2	Filtering
19.	LM7805	1	Fixed voltage regulator.

## **2.5 Summery:**

In this chapter we discussed about history of existing device, block diagram and circuit diagram of proposed device. And in the final section we listed all of the component.

# CHAPTER 3

## DESCRIPTION OF COMPONENTS

### 3.1 Introduction

In this chapter, we discuss in detail each component of our designed circuit.

### 3.2 RCCB

A residual current circuit breaker is a device that can sense current and disconnect a circuit quickly where any ground fault occurs.

Such electrical wiring devices are designed to disconnect a circuit easily and automatically when it detects that a circuit's supply and return conductors are not balanced by the electrical current. Some difference in the currents in these conductors shows the current of the leakage, which poses a danger of shock. There is theoretically a current of about 30 mA (0.03amperes) through the human body which can cause cardiac arrest and it's lead to kill any human within a few fractions of a second.



Figure 3.1: RCCB

### 3.3 The Arduino Uno

The Uno is a microcontroller board based on the ATmega328P. It consists of 14 digital input/output pins, 6 of them used for PWM outputs, 6 of them are for analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset switch. It has everything to support the microcontroller, a USB cable is used to connect with computers and also used to power it with an AC-to-DC adapter or battery to get started. You can tinker together with your Uno without traumatic too ample about doing something wrong, worst case scenario you may update the chip for some dollars and begin over again. "Uno" method one in Italian and was a desire to mark the assertion of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved releases. The Uno board is the first in a chain of USB Arduino forums, and the reference version for the Arduino stage; for a comprehensive, listing of current, past or outdated forums see the Arduino inbox of forums.



Figure 3.2 Arduino Uno

#### 3.3.1 Technical Specifications of Arduino Uno

Table 3.1 Arduino Uno Technical Specifications

Microcontroller	ATmega328P – 8bit AVR family microcontroller
Operating Voltage	5V

Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA
Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

### 3.3.2 Pin diagram of Arduino UNO R3

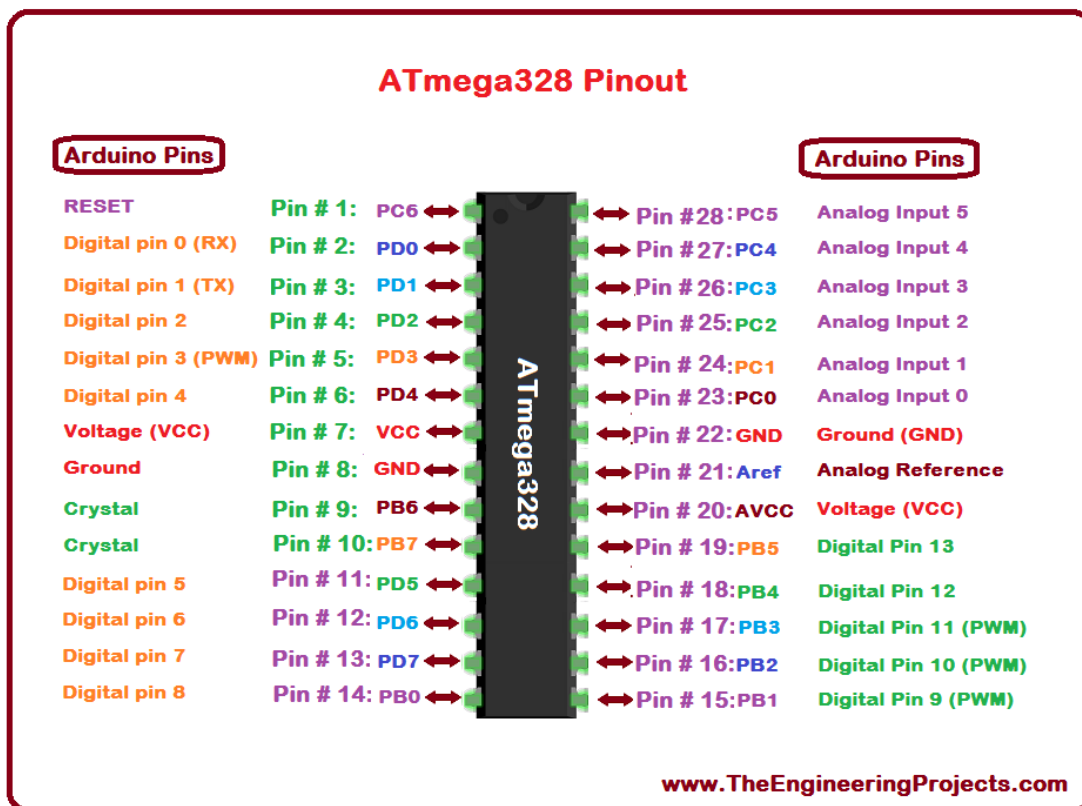


Fig: 3.3 Pin diagram of Arduino UNO R3

### 3.3.3 Short description of the pins

Table: 3.2 Short descriptions of the pins

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: External Power input (5V) 3.3V,5V: Output Power GND: Ground
Reset	Reset	Resets the program running on the board
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Pins of Input /Output	Digital Pins 0 - 13	Used as output or input pins.
Serial	0(Rx), 1(TX)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	It is known as Serial Peripheral Interface and used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide notice, voltage for input voltage.

## 3.4 LCD Display

LCD 1602 is the most common and popular type display used in the market. It is a liquid crystal character type display. It is made of dot matrix module and used to show character, number, letter. It is composed of 5\*7 or 5\*11 matrix for positions, each of these position show one character. There is a dot pitch between characters and a space between lines so character and lines are separated.



Figure 3.4 LCD 1602

### 3.4.1 Pin Specification of LCD1602

Table 3.3 Short description of Pin specification

LCD Pin	Arduino Pin	Purpose
VSS	GND	Ground
VCC	5V	Power supply
VEE	10K Resistor	Adjust Contrast
RS	A0	Register Select
RW	GND	Ground
E	A1	Enable
D4	A2	Data
D5	A3	Data
D6	A4	Data

D7	A5	Data
LED+	3.3V	Display light
LED-	GND	Ground

### 3.5 Ferrit Core(Ring Type)

A ferrite core is a type of magnetic core used in inductor and transformer purposes. In this project, we use a ferrite core to measure the difference between the current between the two poles. It is made of ferrite and it has high permeability. It also has low electrical conductivity and this feature helps to avoid the eddy current losses.



Fig 3.5 Ring type Ferrite Core

### 3.6 Buzzer

A buzzer is an analog electronic device that is used in an alarm device, timer doorbell, and in another device. It also called the beeper. It is an audio signaling device which is piezoelectric. It's operating voltage is 5V.





Figure 3.6 Buzzer

### 3.6.1 Applications for Buzzer

Typical uses of buzzers include:

- Alarm devices
- Timers
- Confirmation of user input
- Electronic metronomes
- Annunciator panels
- Game shows
- Sporting events
- Household machinery

## 3.7 Led

An LED is a semiconductor device that emits light. A light-emitting diode is a two-lead semiconductor light source. It is a p–n junction diode that emits light while activated. When an appropriate voltage is applied to the leads, electrons are able to recombine with electron holes inside the device, releasing power in the form of photons. This impact is known as electroluminescence, and the color of the light (similar to the electricity of the photon) is determined with the aid of the power bandgap of the semiconductor.



Figure 3.7 Led

### 3.8 Optocoupler (PC817)

PC817 is a four-pin optocoupler that is made of an IRED and a phototransistor. The IRED enables the phototransistor. The main feature of PC817 is it connects to the section of the circuit by optically not electrically. When there is a power supply on the input side, IRED emits IR(Infrared Ray) waves and enables phototransistor.



Figure 3.8 Optocoupler(PC817)

#### 3.8.1 PIN configuration and application to the circuit

Table 3.4 PIN configuration and application to the circuit

<b>PIN Number</b>	<b>PIN Name</b>	<b>Description</b>
<b>1</b>	Anode	Connected to the BC547 output
<b>2</b>	Cathode	Ground
<b>3</b>	Emitter	Connected to BD907 base
<b>4</b>	Collector	Connected to 5V

#### 3.8.2 PC817 Feature

- Input forward voltage:1.25V

- Collector-emitter voltage: 80V (Max)
- Collector Current: 50mA(Max)
- Cut-off Frequency: 80KHz
- Rise time: 18us
- Fall time: 18us

### 3.9 Veroboard

Veroboard is a printed circuit board that is designed with rows of copper tracks with holes drilled in them for digital components to be soldered to assemble electronic circuits. It becomes delivered as a general-purpose cloth to be used in constructing electronic circuits - differing from purpose-designed published circuit boards (PCBs) in that a lot of electronics circuits can be constructed the usage of a preferred wiring board.

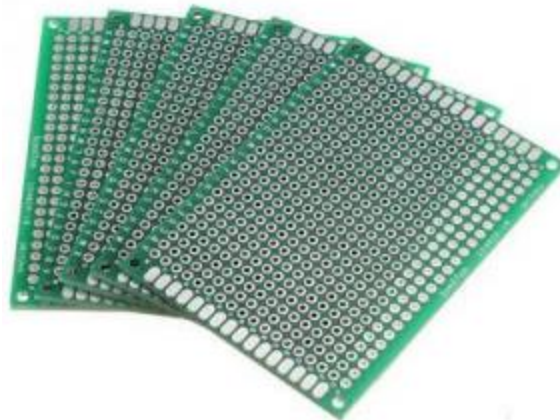


Fig 3.9 Veroboard(dotted)

### 3.10 Relay

A relay is an electrically operated switch. It consists of fixed input terminals for an unmarried or a couple of manage signals, and a set of operating touch terminals. The switch may additionally have any range of contacts in multiple touch forms, which include making contacts, damage contacts, or mixtures, therefore.



Fig 3.10 Relay

### 3.11 Potentiometer 10K

A potentiometer is a three-terminal resistor with a sliding or rotating touch that bureaucracy an adjustable voltage divider. If the simplest two terminals are used, one gives up and the wiper, it acts as a variable resistor or rheostat.



Fig 3.11 Potentiometer10K

### 3.12 Current Transformer

A current transformer is a tool transformer, which is used to measuring current to protective devices. the secondary current of a current transformer is proportional to the primary current.

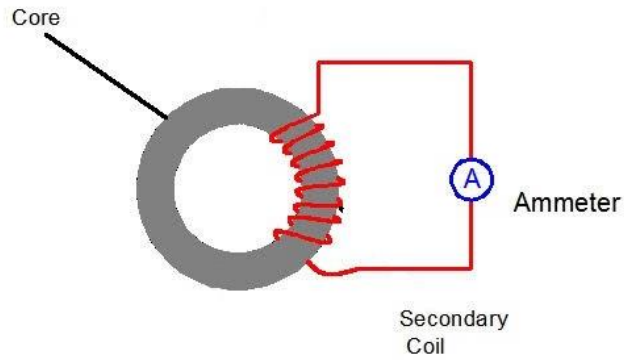


Fig 3.12 Current Transformer

### 3.13 Transistor BC547

The BC548 is a bipolar junction transistor. It is commonly used to amplify a signal or a switch in electronics equipment. This is an NPN Transistor. This transistor can amplify a very low signal. The base current of this transistor is a maximum of 200mA.



Fig 3.13 Transistor BC547

### 3.14 Transistor BD907

BD907 is a complementary silicon plastic power transistor. This is an NPN type transistor. In this Circuit this component used to Connect between 5volt power supply and Arduino pin D2.

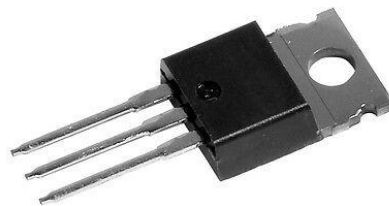


Fig 3.14 Transistor BD907

### 3.15 Diode 1N4007

A 1N4007 is a PN junction diode. This diode allows the current to flow in one direction. It is basically used to convert the AC current to DC current. It is electrically compatible with other rectifiers and this can be replaced any other diode of the series of 1N400X. This diode is also used as a freewheeling diode, inverters, converters, general-purpose diode.



Fig 3.15 Diode 1N4007

### 3.16 Resistor 47K

A resistor is 2 passive terminal component that is used in the circuit to limit the current. It is used almost every electrical circuit. It is also used to divide the voltage, control the signal level, terminate transmission lines, etc.



Fig 3.16 Resistor 47K

### 3.17 Incandescent light bulb

An incandescent light bulb is an electric bulb where the wire filament is used to heat up and it glows the light. A bulb is used to protect the filament from oxidization. This



Fig 3.17 Incandescent light bulb

### 3.18 Transformer

A transformer is a static device that transfers the electrical energy primary side to the secondary side without changing the frequency. It is used to step up or step down the voltage. In this project, we used a transformer as a step-down transformer. In this project, it used as an AC power supply.



Fig 3.18 Transformer

### 3.19 Capacitor (1000uf 16V)

The capacitor is a passive electronic component that stores energy. In this project, we used a capacitor as a filter. The output of the Transformer is 6VAC. After Converting it to DC the voltage is 7 Volt. The capacitor is used to make it pure DC voltage.

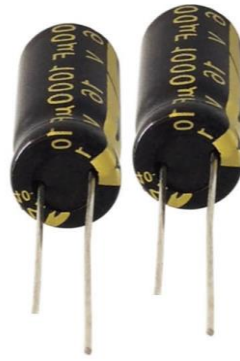


Fig 3.19 Capacitor

### 3.20 LM7805 Voltage Regulator

LM7805 is a 3-terminal positive voltage regulator. This is a monolithically integrated circuit design used as a fixed voltage regulator. This regulator employs internal current limiting, thermal shutdown, wide-area expansion. They can deliver output current in excess to 1.5A with an adequate heat sink.



Fig 3.20 LM7805 Voltage regulator

### 3.21 Summary of the chapter

In this section, we presented every equipment that we have utilized in the task. Additionally, we examine the element, working principle, types, and the case of the equipment.



# CHAPTER 4

## ANALYSIS

### 4.1 Analysis of Trigger current

From the graph of the diagram, it is shown that the BC548 can trigger at 0.04 mA current when the emitter-collector voltage is 0.4 volts.

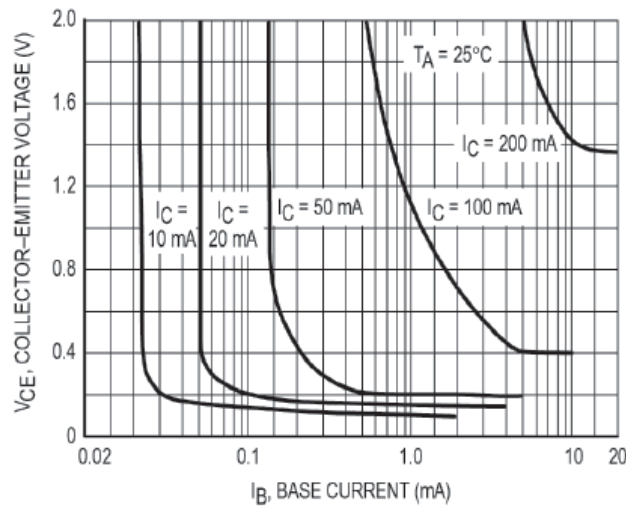


Fig 4.1: Saturation Region

### 4.2 Block diagram of the project

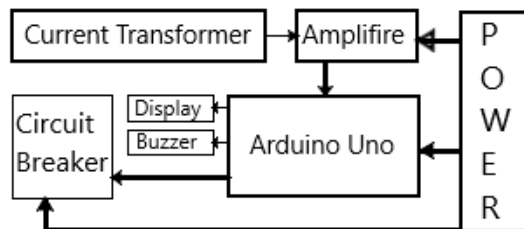


Fig 4.2 Block diagram of the project.

### 4.3 Flowchart

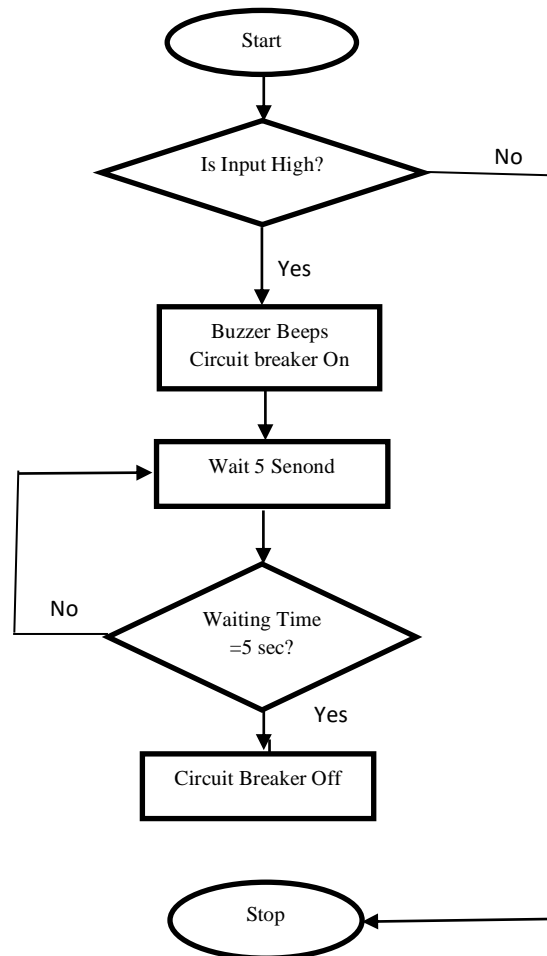


Fig 4.3 Flowchart of the Project

### 4.4 Circuit Design

We have built the circuit to simulate the project using Proteus v7.8 which is shown in Fig. 4.3. Proteus is a simulation and design software tool developed by Labcenter Electronics for Electrical and Electronics circuit design.

#### ➤ About PROTEUS

It has ISIS which is used for circuit designing with simulation and ARES which is used for PCB designing [16].

- ISIS is the software used to draw schematics and simulate the circuits in actual time. The simulation permits human access during run time, thus providing real-time simulation.

- ARES is used for PCB designing. It has the feature of watching output in a 3D view of the designed PCB along with components.

➤ **Features**

- ISIS has a wide range of components in its library. It has sources, signal generators, measurement and analysis tools like oscilloscope, voltmeter, ammeter et cetera. probes for real-time monitoring of the parameters of the circuit, switches, displays, loads like engines and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semi-conductor switches, relays, microcontrollers, processors, sensors et cetera.
- ARES offers PCB designing up to 14 inner layers, with surface mount, and through whole packages. It is embedded with the footprints of various categories of components like ICs, transistors, headers, connectors and other discrete components. It gives Auto routing and manual routing options to the PCB Designer. The schematic drawing in the ISIS can be frankly transferred ARES.

Proteus is the facile and most essential software with the latest technology for circuit implementation and simulation. Including necessary components with corresponding information from its library, it can be simulated after setting up the circuit. The microcontroller needs to include the hex file for the execution of the whole project. Proteus combines circuit simulation to facilitate the co-simulation of complete microcontroller based designs [15].

We are using this software because this is very much user-friendly to design and simulate any circuits than using other software. The equipment used for the design and implementation of the following circuit is Arduino Uno R3, LCD Display, Buzzer, and other components.

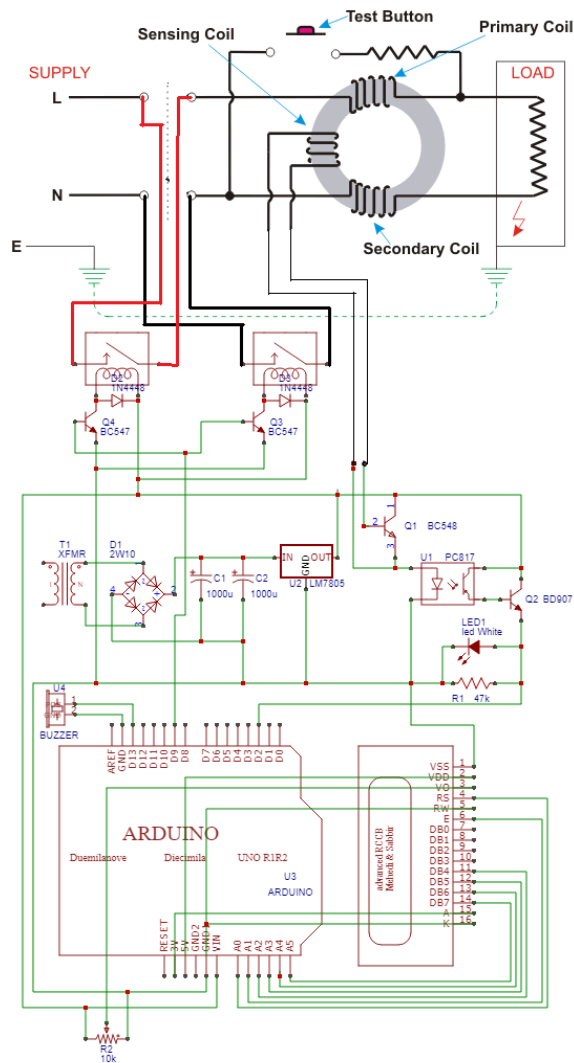


Fig 4.4: Designed Circuit

## 4.5 Hardware Design

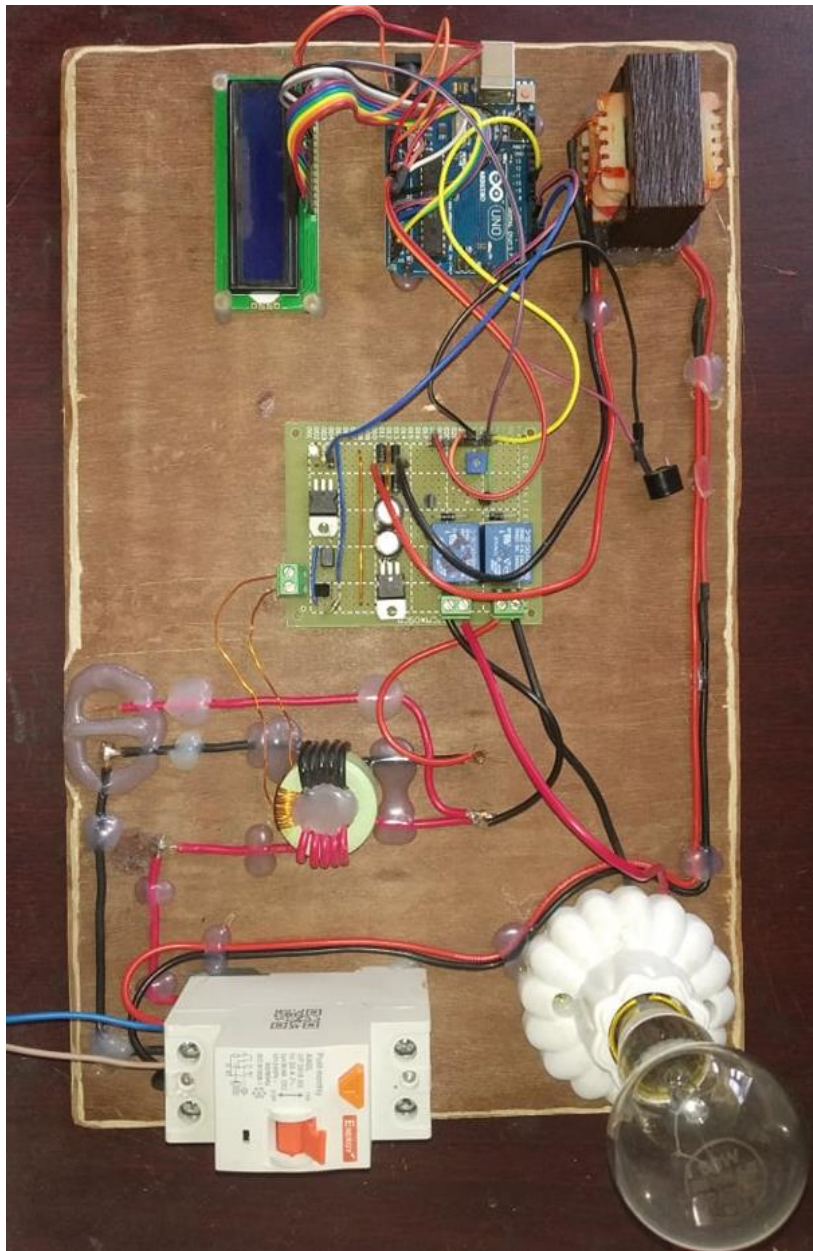


Fig 4.5: Hardware Design

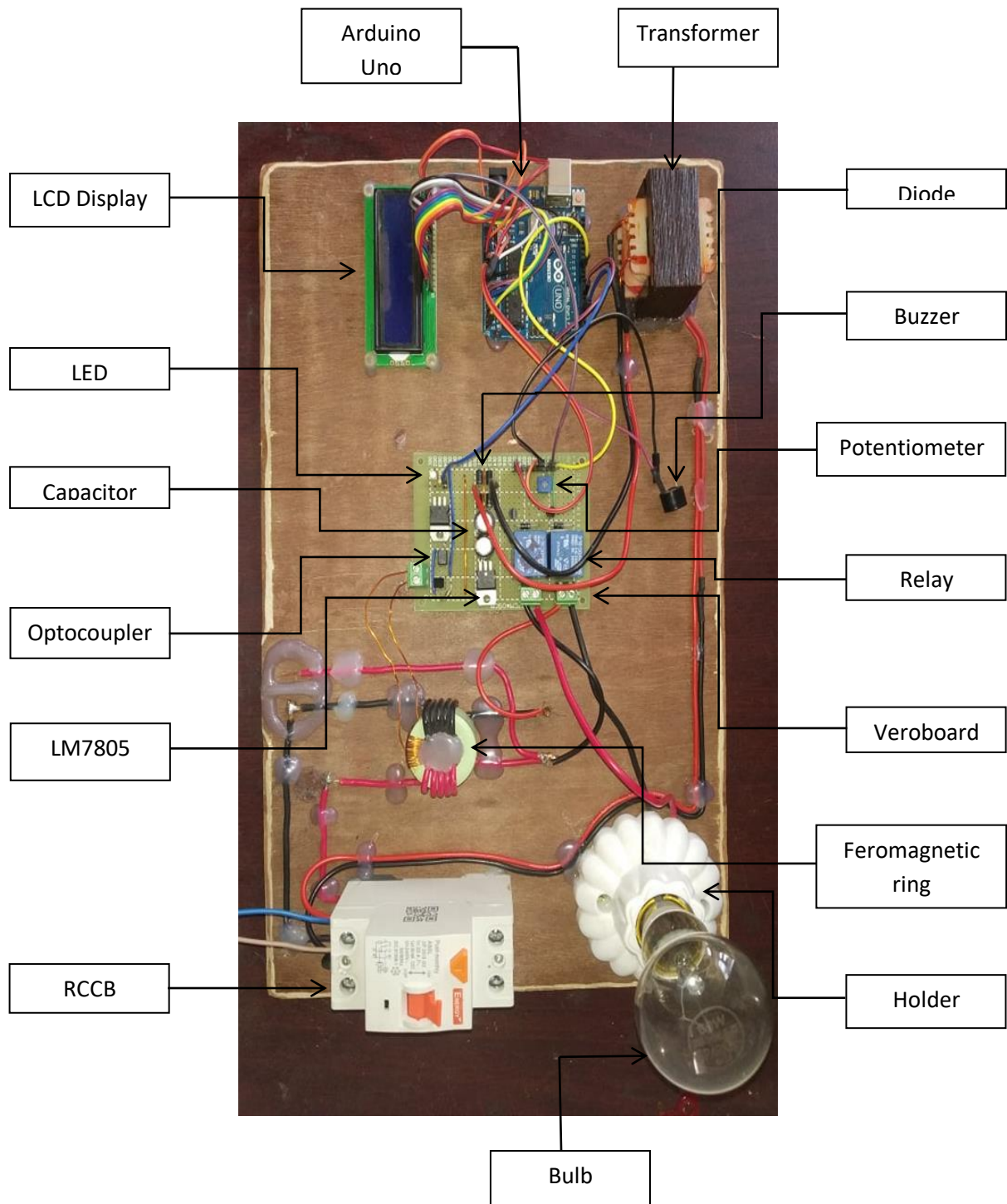


Fig 4.6: Components marking.

## **4.6 Summary of the chapter**

In this chapter we showed an analysis of trigger current, a block diagram of the project, Circuit Design of the project, Flowchart of Command and placed an exact picture of the project.

# CHAPTER 5

## RESULT AND DISCUSSION

### 5.1 Result

After implanting the design and testing it, we get optimistic results. The circuit breaker works at a current difference of 0.04mA which is very satisfactory.

The test outcomes have been recorded in Table 5.1.

Table 5.1: Result Table

Operating Differential Current	0.04mA to 1 A
Arduino Processing Time	05 microsecond
Relay operating time	10 millisecond
Circuit breaking time	140 milisecond
Reconnecting Time	5 Seconds
Operating Power	3 Watts

### 5.2 Discussion of Result

The device uses 0.04mA of differential current to operate. Which is a very low amount of current that is not harmful to the human body. Wherever the current RCCB group uses 30mA current, our device uses 0.04 mA current. Its running time is also very short due to which the device is expected to gain a lot of popularity.



### 5.3 Cost Analysis

Table 5.2: Cost analysis of the Project

No	Equipment Name	Quantity	Price(Taka)
1	Arduino Uno	1	380
2	RCCB	1	1250
3	Buzzer	1	20
4	Transformer	1	60
5	Relay(5v)	2	70
6	LCD Display 1602	1	120
7	Ferrit Core(Ring Type)	2	40
8	Optocoupler (PC817)	1	15
9	Led	1	2
10	Veroboard	1	45
11	Potentiometer 10K	1	15
12	Transistor BC547	1	1
13	Transistor BD907	1	8
14	Current Transformer	1	10
15	Capacitor (1000uf 16V)	2	24
16	LM7805 Voltage Regulator	1	10

17	Diode 1N4007	6	12
18	Resistor 47K	1	1
19	Incandescent light bulb & Holder	1	50
Total			2133

### 5.4 Cost Comparison

The above table shows an example of RCCB with a total cost of Tk 2133 BDT. Where an RCCB is priced at Tk 1250 BDT. So our project costs  $2133-1250=883$ BDT.

In the future, using a small 4-pin microcontroller IC instead of Arduino, the cost will be greatly reduced in terms of production and mass production.

So we can say that the cost of our project is much less than the cost of the Existing product, and there is a lot more benefit than the Existing product.

### 5.5 Summary of the chapter

In this chapter, we have discussed the project's results and compared the cost of the existing system with its cost. In this, we have come to realize that our proposed Idea is the Best Idea.

# CHAPTER 6

## CONCLUSIONS

### 6.1 Conclusion

Our designed device works perfectly and the results are very satisfying. It has some other features that are discussed below to make the device user-friendly. Moreover, if the technical facilities available to us were sufficient, we could make the device more beautiful and efficient. In particular, it would have been possible to further reduce its size and power consumption. Finally, I would like to say that we are very pleased with the results and effectiveness of our project.

Advantages:

1. The system can be protected from a person from being electrified for a long time.
2. The system can alert surrounding people to take early action.
3. Detects very low current.
4. It is a very low cost compare to the existing device.
5. Very low power consumption
6. High and accurate performance.

### 6.2 Limitation of the Study

Our device cannot guarantee the proper performance of the non-standard waveform. It can trip in case of a sudden change of load. This circuit breaker can trip, especially during an old fridge or ground fault on the computer. Our device may not work in overload protection. Because it was designed to work just for ground faults. Moreover, it cannot work in phase and neutral shock as the device will then consider it as a load.

### **6.3 Future Works**

As a first step in the transition from analog technology to digital technology, our project will play a leading role. Digital electronics have a huge workspace space. So from then on, this device will be able to make many improvements. Some of the steps are outlined below.

1. A GSM Module can be used with Arduino to inform Emergency contacts.
2. PIC microcontroller ic can be used for making it small size.
3. Short circuit protection can be used with it.
4. Overcurrent protection can be used with this device.
5. Research on other frequencies.
6. A transformerless power supply can be used to make device light.

### **6.4 Summary of the chapter**

In this chapter, we discuss the advantage of our project. Also, we discuss the limitation of its. And then we discuss the future work of our project.

# REFERENCES

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# Appendix

## Programming Code uses in the microcontroller:

```
#include <LiquidCrystal.h>

LiquidCrystal lcd(A0,A1,A2,A3,A4,A5);

const int buttonPin = 2; // the number of the pushbutton pin

const int ledPin = 9; // the number of the LED pin

int buttonState = 0; // variable for reading the pushbutton status

#define Buzzer 5

void setup() {

  pinMode(ledPin, OUTPUT); // initialize the LED pin as an output:

  pinMode(buttonPin, INPUT); // initialize pin 2 as an input:

  pinMode(Buzzer, OUTPUT);

  lcd.begin(16, 2);

  lcd.print("ADVANCED RCCB");

  lcd.setCursor(0, 1);

  lcd.print("Analog+Digital");

  delay (3000);

  lcd.clear();

  lcd.print("Submitted by,");

  delay (2000);

  lcd.clear();

  lcd.print("KH Mehedi Hasan");

  lcd.setCursor(0, 1);
```

```

lcd.print("ID:151-33-2392 &");

delay (3000);

lcd.clear();

lcd.print("Sabbir Hossain");

lcd.setCursor(0, 1);

lcd.print("ID:151-33-2388");

delay (3000);

lcd.clear();
}

void loop() {

  buttonState = digitalRead(buttonPin); // read the state of the pushbutton value:

  if (buttonState == HIGH) {

    digitalWrite(ledPin, HIGH);
circuitbreaker();

  } else {

    digitalWrite(ledPin, LOW);

  }

}

void circuitbreaker()

{ digitalWrite(Buzzer, HIGH);

  lcd.print("Fault detected,");

  lcd.setCursor(0, 1);

  lcd.print("Reconnecting 5");

  delay (1000);

  lcd.clear();

  lcd.print("Fault detected,");

```

```
lcd.setCursor(0, 1);

lcd.print("Reconnecting 4");

delay (1000);

lcd.clear();

  lcd.print("Fault detected,");

lcd.setCursor(0, 1);

lcd.print("Reconnecting 3");

delay (1000);

lcd.clear();

  lcd.print("Fault detected,");

lcd.setCursor(0, 1);

lcd.print("Reconnecting 2");

delay (1000);

lcd.clear();

  lcd.print("Fault detected,");

lcd.setCursor(0, 1);

lcd.print("Reconnecting 1");

delay (1000);

lcd.clear();

  lcd.print("Circuit Breaker");

lcd.setCursor(0, 1);

lcd.print(" Reconnected. ");

delay (1000);

lcd.clear();

}
```