THEME BASED PROJECT ON

ELECTRIC DISCHARGE INSECT CONTROL SYSTEM

SUBMITTED BY

R. E. Sai Harsha Sadhu (1602-17-734-034)

D. Sai Hrishika (1602-17-734-035)

P. Sai Samyukta (1602-17-734-036)

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

VASAVI COLLEGE OF ENGINEERING

IBRAHIMBAGH HYDERABAD – 500031 TELANGANA

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

AIM: To design an electric mesh that can prevent the insects from entering the closed premises and can protect humans from them.

Before we dwell into the project, let's first understand importance of it and know a bit of history.

The Mosquito netting has a long history, and its known as one of the first forms of protection used. It is said that Cleopatra, the last active pharaoh of Ancient Egypt, also slept under a mosquito net. Mosquito nets were also used during the malaria-plagued construction of the Suez Canal.

As the time passed, a few more insect repellents came into existence, but one of the things which is widely used in households other than mosquito nets or mesh is a Mosquito Killer Racket. A Taiwanese inventor, Tsao-I Shih, is often credited with inventing the modern mosquito racket; he filed for a patent for an "electronic insect-killing swatter" in 1996. The racket offers an effective alternative to other mosquito repelling/killing solutions; it does not use harmful chemicals or require expensive refills, does not produce smoke or fumes, and ensures that the insect is dead.

There were many modifications done to the Mosquito racket, like enhancing the swiping speed and operation angle, providing a shock absorbing effect by changing the body frame and using 9 other materials for construction. (Kuel-Tzu Su, Taichung County, Nov 29, 2007)

But, to kill the mosquitoes using the racket, human involvement is necessary. Hence, by joining the racket concept and the mesh, we are making an electric mesh. This mesh will not only help to prevent the insects to enter inside closed households but will also kill them.

COMPONENTS CHAPTER 2

S. No.	Name of the Component	Specification/Rating	Quantity
1.	Arduino	Uno	1
2.	Ultrasonic Sensor	HC-SR04	1
3.	2-Channel Relay Module	5 V	1
4.	4-Pin RGB LED	Common Cathode (-)	1
5.	LED: Green & Yellow	-	1 each
6.	AC-DC Power Adapter	240 V to 5 V, 1 A	1
7.	Centre-Tapped 1-Phase Step Down Transformer	18-0-18 V	1
8.	Diodes	1N4007	4
9.	Resistors	220 ohms	3
		10K ohms &	2
		2.2 ohms	1
10.	Capacitors	220 microfarad, 50 V	1
11.	Jumpers	All Types	Adequate
12.	General Purpose PCB	10 cm x 10 cm	1
13.	USB Cable	Type A to Type B	1
14.	Copper wires	Non Insulated	Adequate

CHAPTER 3

BLOCK DIAGRAM

The project is for creating an Electric Discharge Insect Control System which can prevent the insects to enter closed building premises. The below Block Diagram depicts the project:

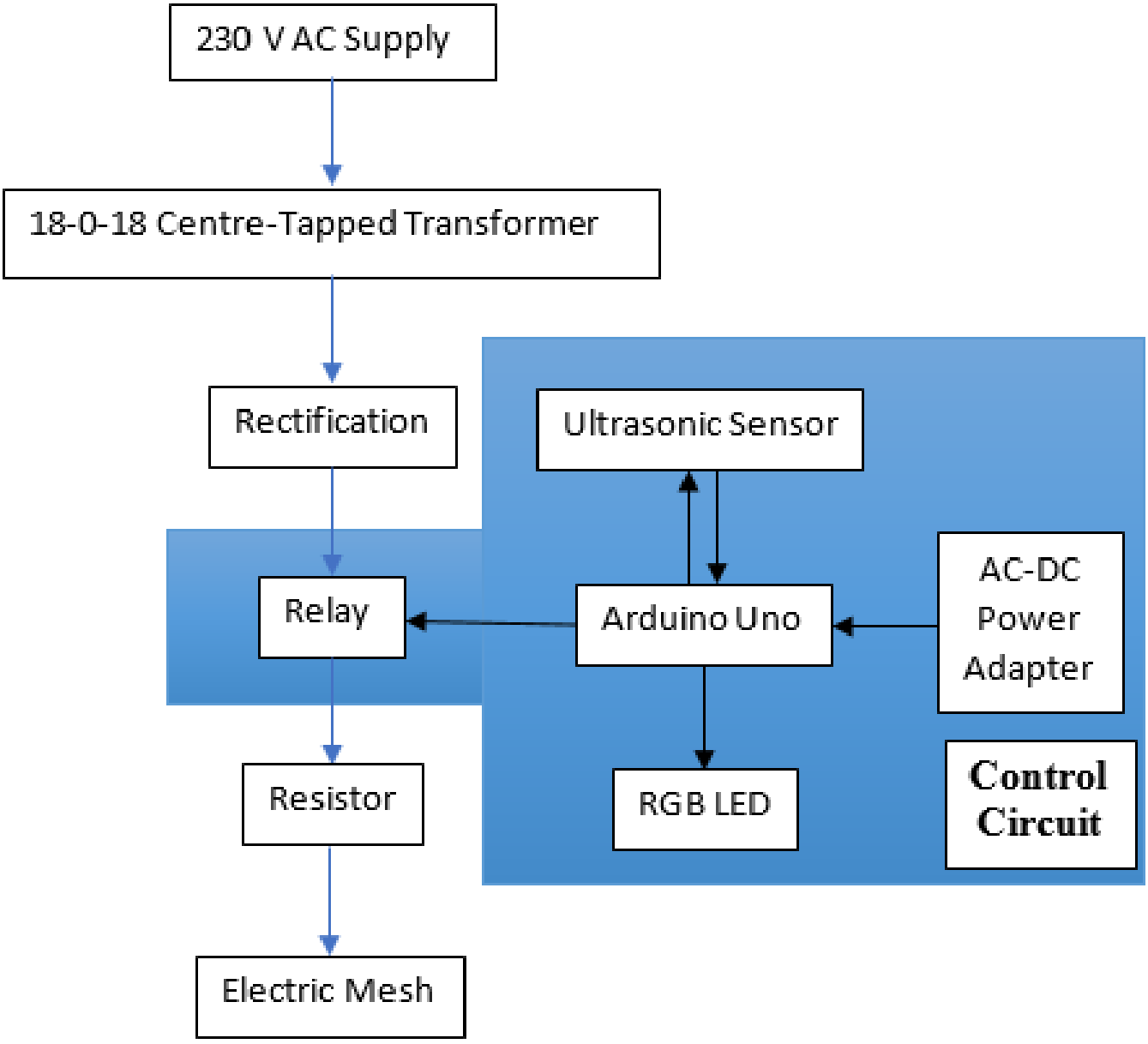

Fig. 01: Block Diagram of Entire Project

COMPONENTS DESCRIPTION

CHAPTER 4

1. Arduino Uno:

The Arduino Uno is a microcontroller board based on the Atmel manufacturer company's Atmega328p (here, 32 stands for the max program size it can store (32K), the 8 for the processing speed (8 bits) and the p for Pico Power (very low power)) model. It has 14 digital input/output pins (of which 6 can be used as Pulse Width Modulation (PWM) outputs), 6 analog inputs, a 16 MHz ceramic resonator, a Universal Serial Bus (USB) connection, a power jack, an In-Circuit Serial Programming (ICSP) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an Alternating Current-to-Direct Current adapter (commonly known as AC-to-DC adapter) or battery to get started. The Uno differs from all preceding boards in that it does not use the Future Technology Devices International (FTDI) USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into Device Firmware Update (DFU) mode.

Revision 3 of the board has the following new features:

- 1.0 pinout: added Serial Data (SDA) and Serial Clock (SCL) pins that are near to the Analogue Reference (AREF) pin and two other new pins placed near to the RESET pin, the Input Output Voltage Reference (IOREF) that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible both with the board that use the Automatic Voltage Regulator (AVR), which operate with 5 V and with the Arduino Due that operate with 3.3 V. The second one is a not connected pin, that is reserved for future purposes.
- Stronger RESET circuit.
- Atmega 16U2 replace the 8U2

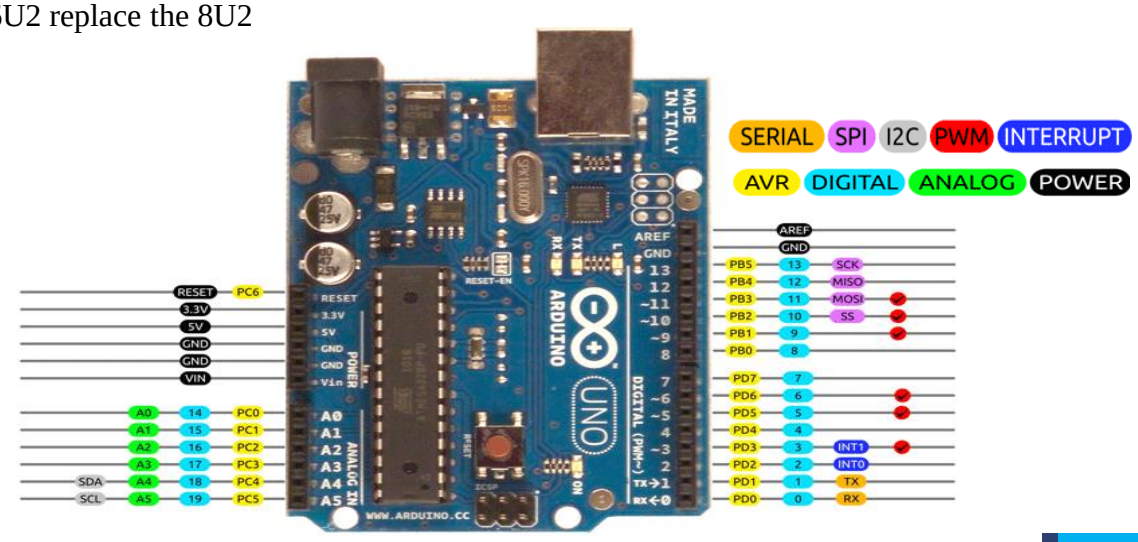

Fig. 02: Arduino Uno Pin Diagram

Pin Description:

Pin Category	Pin Name	Description
Power	Vin, 3.3 V, 5 V, GND	Vin: Input voltage to Arduino when using an external power source. 5 V: Regulated power supply used to power microcontroller and other components on the board. 3.3 V: 3.3 V supply generated by on-board voltage regulator. Maximum current draw is 50 mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5 V
Input/output Pins	Digital Pins 0 - 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit Transistor-transistor logic (TTL) serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
Serial Peripheral Interface (SPI)	10 (Slave Select), 11(Master Output Slave Input), 12 (Master Input Slave Output) and 13 (Serial Clock)	Used for SPI communication.
Inbuilt Light Emitting Diode (LED)	13	To turn on the inbuilt LED.
Two Wire Interface (TWI)	A4 (SDA), A5 Sneak Circuit Analysis (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

Arduino Uno Technical Specifications:

Microcontroller	ATmega328P – 8-bit AVR family microcontroller
Operating Voltage	5 V
Recommended Input Voltage	7-12 V
Input Voltage Limits	6-20 V
Analog Input Pins	6 (A0 – A5)
Digital Input/output (I/O) Pins	14 (Out of which 6 provide PWM output)
Direct Current (DC) 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)
Static Random Access Memory (SRAM)	2 KB
Electrically Erasable Programmable Read-Only Memory (EEPROM)	1 KB
Frequency (Clock Speed)	16 MHz

Schematic & Reference Design:

EAGLE files: arduino-uno-Rev3-reference-design.zip (NOTE: works with Eagle 6.0 and newer) Schematic: arduino-uno-Rev3-schematic.pdf

Note: The Arduino reference design can use an Atmega8, 168, or 328, Current models use an ATmega328, but an Atmega8 is shown in the schematic for reference. The pin configuration is identical on all three processors.

Power:

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an Alternating Current-to-Direct Current (AC-to-DC) adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1 mm centre-positive plug into the board's power jack.

Leads from a battery can be inserted in the Ground (GND) and Voltage Input (Vin) pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 V. If supplied with less than 7 V, however, the 5 V pin may supply less than five volts and the board may be unstable. If using more than 12 V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 V.

The power pins are as follows:

- Vin: The input voltage to the Arduino board when it's using an external power source (as opposed to 5 V from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5 V: This pin outputs a regulated 5 V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 – 12 V), the USB connector (5 V), or the Vin pin of the board (7-12 V). Supplying voltage via the 5 V or 3.3 V pins bypasses the regulator, and can damage your board. We don't advise it.
- 3.3 V: A 3.3 V supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND: Ground pins.

Memory:

The ATmega328 has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input & Output:

Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode (), digital Write (), and digital Read () functions. They operate at 5 V. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt () function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite () function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 V, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.

Additionally, some pins have specialized functionality:

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

There are a couple of other pins on the board:

- AREF. Reference voltage for the analog inputs. Used with analogReference().
- Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

Communication:

The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides Universal Asynchronous Receiver/Transmitter (UART), TTL (5 V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A Software Serial library allows for serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Software:

Arduino IDE (Integrated Development Environment) is required to program the Arduino Uno board.

Programming Arduino:

Once Arduino IDE is installed on the computer, connect the board with computer using USB cable. Now open the Arduino IDE and choose the correct board by selecting Tools>Boards>Arduino/Genuino Uno, and choose the correct port by selecting Tools>Port. Arduino Uno is programmed using Arduino programming language based on wiring. To get it started with Arduino Uno board and blink the built-in LED, load the example code by selecting Files>Examples>Basics>Blink. Once the example code (also shown below) is loaded into your IDE, click on the ‘Upload’ button given on the top bar. Once the upload is finished, you should see the Arduino’s built-in LED blinking.

Below is the example code for blinking:


```
// the setup function runs once when you press reset or power the board

void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT); }

// the loop function runs over and over again forever

void loop() {
  digitalWrite(LED_BUILTIN, HIGH);  // turn the LED on (HIGH is the voltage level)
  delay(1000);  // wait for a second
  digitalWrite(LED_BUILTIN, LOW);  // turn the LED off by making the voltage LOW
  delay(1000);  // wait for a second }
```

Automatic (Software) Reset:

Rather than requiring a physical press of the reset button before an upload, the Arduino Uno is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (Data Terminal Ready (DTR)) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nano-farad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload. This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labelled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5 V to the reset line.

USB Overcurrent Protection:

The Arduino Uno has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

Physical Characteristics:

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100-mil spacing of the other pins.

Applications:

- Prototyping of Electronics Products and Systems
- Multiple Do It Yourself (DIY) Projects.
- Easy to use for beginner level DIYers and makers.
- Projects requiring Multiple I/O interfaces and communications.

2. Ultrasonic Sensor:

Physical Features:

Ultrasonic ranging module HC - SR04 provides 2 cm – 400 cm non-contact measurement function, the ranging accuracy can reach to 3 mm. The modules include ultrasonic transmitters, receiver and control circuit.

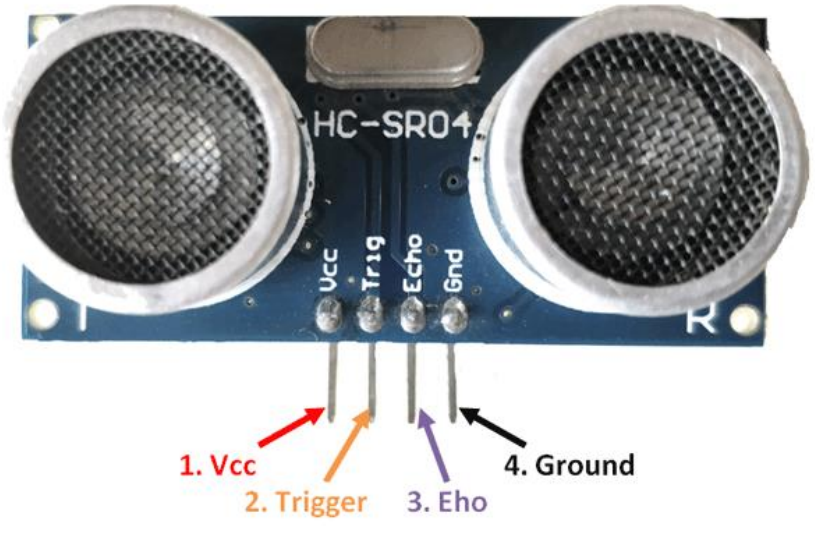

Fig. 03: Ultrasonic Sensor Pin Diagram

Pin Description:

Pin No.	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5 V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10 us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

Electric Parameters:

- Working Voltage DC: 5 V
- Working Current: 15 mA
- Working Frequency: 40 Hz
- Max Range: 4 m
- Min Range: 2 cm
- Measuring Angle: 15 degree
- Trigger Input Signal: 10 uS TTL pulse
- Echo Output Signal Input TTL lever signal and the range in proportion
- Dimension 45 x 20 x 15 mm

Timing Diagram:

The Timing diagram is shown below. You only need to supply a short 10 uS pulse to the trigger input to start the ranging, and then the module will send out 8 cycles burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion.

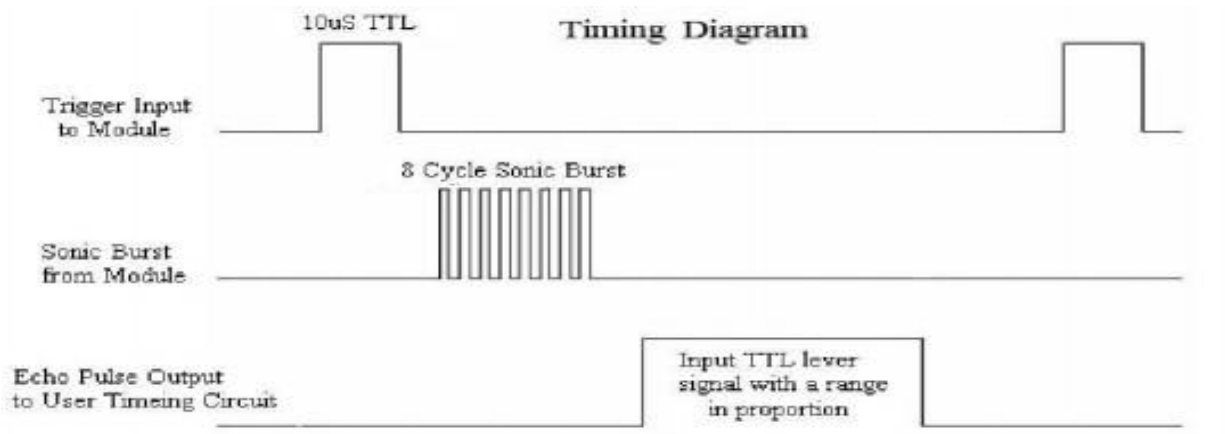

Fig. 04: Timing Diagram of a Ultrasonic Sensor

Equivalent Distance Measuring Sensors:

Ultrasonic (US) Sensor transmitter Receiver pair, infrared (IR) sensor module, IR sensor pair, IR Analog distance sensor.

HC-SR04 Ultrasonic Sensor - Working:

As shown above the **HC-SR04 Ultrasonic sensor** is a 4-pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

Fig. 04:Ultra Sonic Sensor – Transmitting and Receiving

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic (US) wave, we know the universal speed of US wave at room conditions which is 330 m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

How to use the HC-SR04 Ultrasonic Sensor?

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, Advanced Reduced instruction set computer Machine (ARM), Peripheral Interface Controllers (PIC), Raspberry Pie etc.

The following guide is universally since it has to be followed irrespective of the type of computational device used.

Power the Sensor using a regulated +5 V through the Vcc and Ground pins of the sensor. The current consumed by the sensor is less than 15 mA and hence can be directly powered by the on board 5 V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10 uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40 Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the Microcontroller Unit (MCU)/Microprocessor Unit (MPU) as it gives the information about the time taken for the wave to return back to the Sensor. Using this information, the distance is measured as explained in the above heading.

Applications:

- Used to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.
- Used to measure the distance within a wide range of 2 cm to 400 cm.
- Can be used to map the objects surrounding the sensor by rotating it.
- Depth of certain places like wells, pits etc can be measured since the waves can penetrate through water.

Attention:

- The module is not suggested to connect directly to electric, if connected electric, the GND terminal should be connected the module first, otherwise, it will affect the normal work of the module.
- When tested objects, the range of area is not less than 0.5 m^2 and the plane requests as smooth as possible, otherwise, it will affect the results of measuring.

3. Two Channel 5V Relay Module:

Introduction:

This is a LOW Level 5 V 2-channel relay interface board, and each channel needs a 15-20 mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC 250 V, 10 A or DC 30 V, 10 A. It has a standard interface that can be controlled directly by microcontroller.

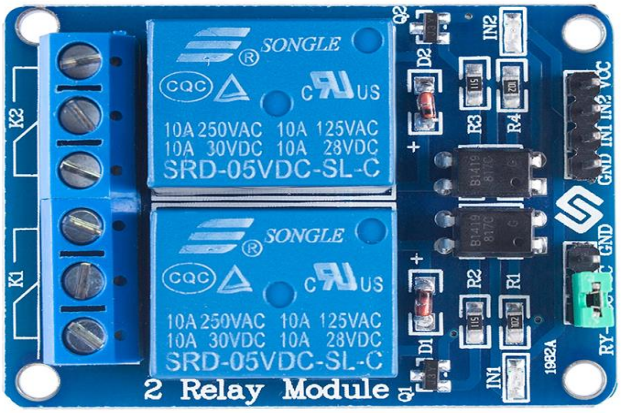

Fig. 05: Two Channel 5V Relay Module

Features:

- Relay Maximum Output: DC 30 V/10 A, AC 250 V/10 A.
- 2 Channel Relay Module with Optocoupler LOW Level Triger expansion board, which is compatible with Arduino.
- Standard interface that can be controlled directly by microcontroller (8051, AVR, *PIC, Digital Signal Processor (DSP), ARM, MSP430, TTL logic).
- Relay of high-quality loose music relays Single Pole Double Throw (SPDT). A common terminal, a normally open, one normally closed terminal.
- Optocoupler isolation, good anti-jamming.

Principle:

See the picture below: A is an electromagnet, B armature, C spring, D moving contact, and E fixed contacts. There are two fixed contacts, a normally closed one and a normally open one. When the coil is not energized, the normally open contact is the one that is off, while the normally closed one is the other that is on.

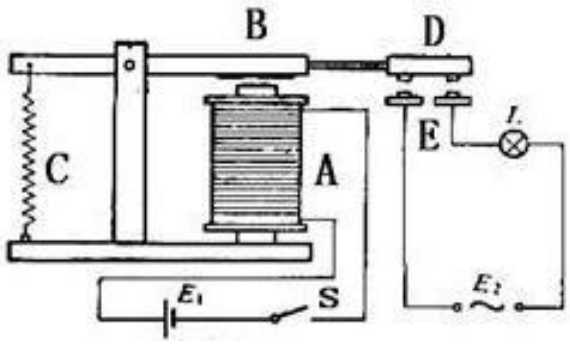

Fig. 06: Internal Schematic of a Relay Module

Add a certain voltage to the coil and some currents will pass through the coil thus generating the electromagnetic effect. So, the armature overcomes the tension of the spring and is attracted to the core, thus closing the moving contact of the armature and the normally open contact (or you may say releasing the former and the normally closed contact). After the coil is de-energized, the electromagnetic force disappears and the armature moves back to the original position, releasing the moving contact and normally closed contact. The closing and releasing of the contacts result in power on and off of the circuit.

Input:

VCC: Connected to positive supply voltage (supply power according to relay voltage)

GND: Connected to negative supply voltage

IN1: Signal triggering terminal 1 of relay module

IN2: Signal triggering terminal 2 of relay module

Output:

Each submodular of the relay has one Normal-Close (NC), one Normal-Open (NO) and one Common (COM). So, there are 2 NC, 2 NO and 2 COM of the channel relay in total.

NC: stands for the normal close port contact and the state without power,

NO: stands for the normal open port contact and the state with power.

COM means the common port.

You can choose NC port or NO port according to whether power or not.

Applications:

- Commonly used in switching circuits.
- For Home Automation projects to switch AC loads.
- To Control (On/Off) Heavy loads at a pre-determined time/condition.
- Used in safety circuits to disconnect the load from supply in event of failure.
- Used in Automobiles electronics for controlling indicators glass motors etc.

4. RGB LED:

Each submodular of the relay has one Normal-Close (NC), one Normal-Open (NO) and one Common.

An RGB LED is a combination of 3 LEDs in just one package:

- 1x Red LED
- 1x Green LED
- 1x Blue LED

You can produce almost any colour by combining those three colours.

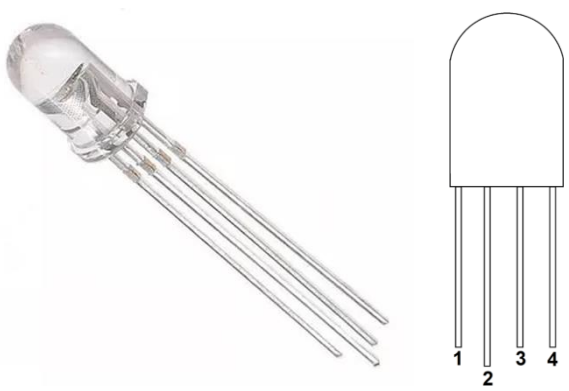

Fig. 07: RGB LED & it's Pin Diagram

Pin Description:

Pin No.	Pin Name	Description
1	R	This terminal used for glowing LED in Red Colour
2	GND	Common Cathode terminal (Ground)
3	G	This terminal used for glowing LED in Green Colour
4	B	This terminal used for glowing LED in Blue Colour

Features & Specifications:

- Low Thermal Resistance
- No Ultraviolet (UV) rays
- Super High flux Output and High luminance
- Forward Current for Red, Blue and Green colour: 20 mA
- Forward Voltage
  - Red: 2 V (typical)
  - Blue: 3.2 V (typical)
  - Green: 3.2 V (typical)
- Luminous Intensity
  - Red: 800 mcd
  - Blue: 4000 mcd
  - Green: 900 mcd
- Wavelength
  - Red: 625 nm
  - Blue: 520 nm
  - Green: 467.5 nm
- Operating Temperature: -25 ℃ to 85 ℃
- Storage Temperature: -30 ℃ to 85 ℃

Working:

With an RGB LED you can, of course, produce red, green, and blue light, and by configuring the intensity of each LED, you can produce other colours as well. For example, to produce purely blue light, you must set the blue LED to the highest intensity and the green and red LEDs to the lowest intensity. For a white light, you must set all three LEDs to the highest intensity. To produce other colours, you can combine the three colours in different intensities.

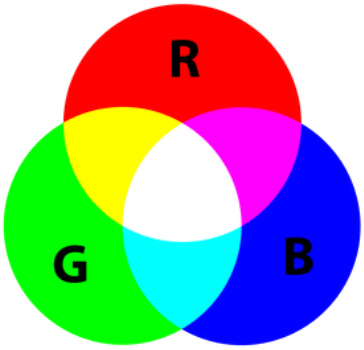

Fig. 08: Red – Green – Blue Colour Model

To adjust the intensity of each LED you can use a PWM signal. Because the LEDs are very close to each other, our eyes see the result of the combination of colours, rather than the three colours individually.

To have an idea on how to combine the colours, take a look at the following chart. This is the simplest colour mixing chart, but gives you an idea how it works and how to produce different colours.

Where RGB LED are Used?

An **RGB LED** is commonly used component in electronics, generally, as it is used for indication purpose. You can use RGB LED in various projects like portable flashlight, LED indicator etc. An RGB LED can also be used for work according to condition like for condition 1st Red will glow, for condition 2nd green will glow and for condition 3rd blue will glow. We can use three different LED to perform the same task, but this will increase the size of circuit and took more space on Printed Circuit Board (PCB) or perf board.

Applications:

- Industrial Application
- Portable Flashlight/torchlight
- Light guides
- Decorative Lighting
- LCD Backlight
- Multi-colour Light

5. Light Emitting Diode (LED):

In the simplest terms, a Light Emitting Diode is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor material.

Since light is generated within the solid semiconductor material, LEDs are described as solid-state devices. The term solid-state lighting, which also encompasses Organic LEDs (OLEDs), distinguishes this lighting technology from other sources that use heated filaments (incandescent and tungsten halogen lamps) or gas discharge (fluorescent lamps).

Fig. 09: Different Colour LEDs

Different Colours:

Inside the semiconductor material of the LED, the electrons and holes are contained within energy bands. The separation of the bands (i.e. the bandgap) determines the energy of the photons (light particles) that are emitted by the LED.

The photon energy determines the wavelength of the emitted light, and hence its colour. Different semiconductor materials with different bandgaps produce different colours of light. The precise wavelength (colour) can be tuned by altering the composition of the light- emitting, or active, region.

Main LED Materials:

The main semiconductor materials used to manufacture LEDs are:

- Indium gallium nitride (InGaN): blue, green and ultraviolet high-brightness LEDs
- Aluminium gallium indium phosphide (AlGaInP): yellow, orange and red high-brightness LEDs
- Aluminium gallium arsenide (AlGaAs): red and infrared LEDs
- Gallium phosphide (GaP): yellow and green LEDs

6. AC-DC Power Adapter:

Fig. 10: AC-DC 240V-5V, 1A Adapter

Alternatively known as an AC Adapter, AC Converter or charger, an AC-DC Adapter is an external power supply used with devices that run on batteries or have no other power source. As shown in the image, an AC adapter is made up of a central unit which draws power from an AC outlet. It then converts the power to DC, and reduces the voltage level to 5 V.

Each AC adapter has a specific power rating, measured in volts or watts that it can handle and output to an electronic device. Because the power rating and type of plug on the end is not universal the AC adapter can only be used with devices with the same requirements and connector.

7. Centre-tapped Transformer:

A Centre Tapped transformer works in more or less the same way as a usual transformer. The difference lies in just the fact that its secondary winding is divided into two parts, so two individual voltages can be acquired across the two-line ends.

Working Principle of a Centre Tapped Transformer:

The internal process is the same, which is when an alternating current is supplied to the primary winding of the transformer it creates a magnetic flux in the core, and when the secondary

winding is brought near, an alternating magnetic flux is also induced in the secondary winding as the flux flows through the ferromagnetic iron core and changes its direction with each and every cycle of the alternating current. In this way an alternating current also flows through the two halves of the secondary winding of the transformer and flows to the external circuit.

Construction:

When an additional wire is connected across the exact middle point of the secondary winding of a transformer, it is called a centre tapped transformer. The wire is adjusted such that it falls in the exact middle point of the secondary winding and is thus at zero volts, forming the neutral point for the winding. This is called the "centre tap" and this thing allows the transformer to provide two separate output voltages which are equal in magnitude, but opposite in polarity to each other. In this way, we can also use a number of turn ratios from such a transformer. As it can be seen from the figure that this type of configurations gives us two phases through the two parts of the secondary coil, and a total of three wires, in which the middle one, the centre tapped wire is the neutral one. So, this centre tapped configuration is also known as a two phase- three wire transformer system.

In this way, half the voltage appears across one half of the phase, that is from line 1 to neutral, and the other half of the voltage appears across the next phase, that is from neutral to line 2. If the load is connected directly between line 1 and line 2, then we get the total voltage, that is, the sum of the two voltages. This way, we can get more amperes of current at the same voltage.

Fig. 11: Centre-tapped Transformer

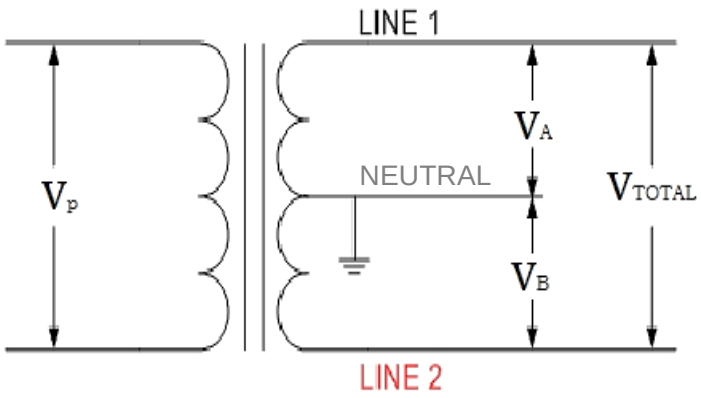

Fig. 12: Centre-tapped Transformer Circuit Diagram

8. Diodes:

A diode is defined as a two-terminal electronic component that only conducts current in one direction (so long as it is operated within a specified voltage level).

In the real world, a diode will have negligible resistance in one direction (to allow current flow), and a very high resistance in the reverse direction (to ***prevent*** current flow). A diode is effectively like a valve for an electrical circuit. Semiconductor diodes are the most common type of diode. These diodes begin conducting electricity only if a certain threshold voltage is present in the forward direction (i.e. the "low resistance" direction).

The diode is said to be "***forward biased***" when conducting current in this direction. When connected within a circuit in the reverse direction (i.e. the "high resistance" direction), the diode is said to be "***reverse biased***".

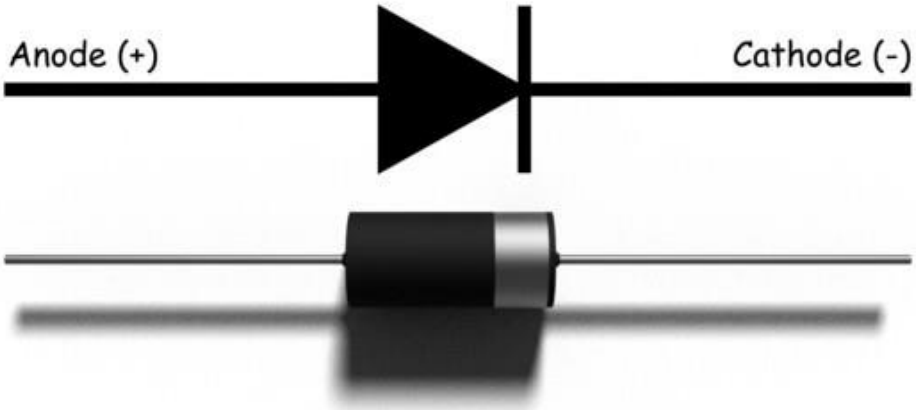

Fig. 13: Diode in Symbolic and Real form

A diode only blocks current in the reverse direction (i.e. when it is reverse biased) while the reverse voltage is within a specified range. Above this range, the reverse barrier breaks. The voltage at which this breakdown occurs is called the "reverse breakdown voltage". When the voltage of the circuit is higher than the reverse breakdown voltage, the diode is able to conduct electricity in the reverse direction (i.e. the "high resistance" direction). This is why in practice we say diodes have a high resistance in the reverse direction – not an infinite resistance.

A PN junction is the simplest form of the semiconductor diode. In ideal conditions, this PN junction behaves as a short circuit when it is forward biased, and as an open circuit when it is in the reverse biased. The name diode is derived from "di–ode" which means a device that has two electrodes.

9. Resistor:

A resistor is a passive two-terminal element that introduces a certain level of resistance into the electrical circuit. The primary roles that a resistor plays in any given electrical circuit are to reduce the flow of current, divide voltage level and adjust the signals.

V=I*R

The fundament electrical law, known as Ohms Law, has a fundamental connection to resistors in general.

Ohms Law states that the voltage across a resistor is proportional to the current flowing through it, where R remains as the constant of proportionality.

Fig. 14: Resistor

Fig. 15: Resistor Symbol

10. Electrolytic Capacitor:

An electrolytic capacitor is a type of capacitor that uses an electrolyte to achieve a larger capacitance than other capacitor types. An electrolyte is a liquid or gel containing a high concentration of ions. Almost all electrolytic capacitors are polarized, which means that the voltage on the positive terminal must always be greater than the voltage on the negative terminal. The benefit of large capacitance in electrolytic capacitors comes with several drawbacks as well. Among these drawbacks are large leakage currents, value tolerances, equivalent series resistance and a limited lifetime.

Fig. 16: Electrolytic Capacitor

They are simple passive device that can store an electrical charge on their plates when connected to a voltage source.

In its basic form, a capacitor consists of two or more parallel conductive (metal) plates which are not connected or touching each other, but are electrically separated either by air or by some form of a good insulating material such as waxed paper, mica, ceramic, plastic or some form of a liquid gel as used in electrolytic capacitors. The insulating layer between a capacitors plates is commonly called the **Dielectric**.

Due to this insulating layer, DC current cannot flow through the capacitor as it blocks it allowing instead a voltage to be present across the plates in the form of an electrical charge.

When used in a direct current or DC circuit, a capacitor charges up to its supply voltage but blocks the flow of current through it because the dielectric of a capacitor is non-conductive and basically an insulator. However, when a capacitor is connected to an alternating current or AC circuit, the flow of the current appears to pass straight through the capacitor with little or no resistance.

The above property is used for Rectification process.

11. Jumpers:

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

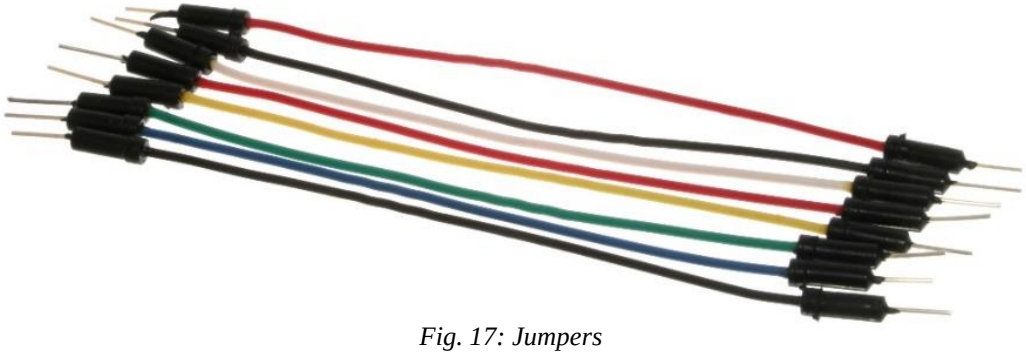

Fig. 17: Jumpers

Types of Jumper Wires:

Jumper wires typically come in three versions: male-to-male, male-to-female and female-to-female. The difference between each is in the end point of the wire. Male ends have a pin protruding and can plug into things, while female ends do not and are used to plug things into. Male-to-male jumper wires are the most common and what you likely will use most often. When connecting two ports on a breadboard, a male-to- male wire is what you'll need.

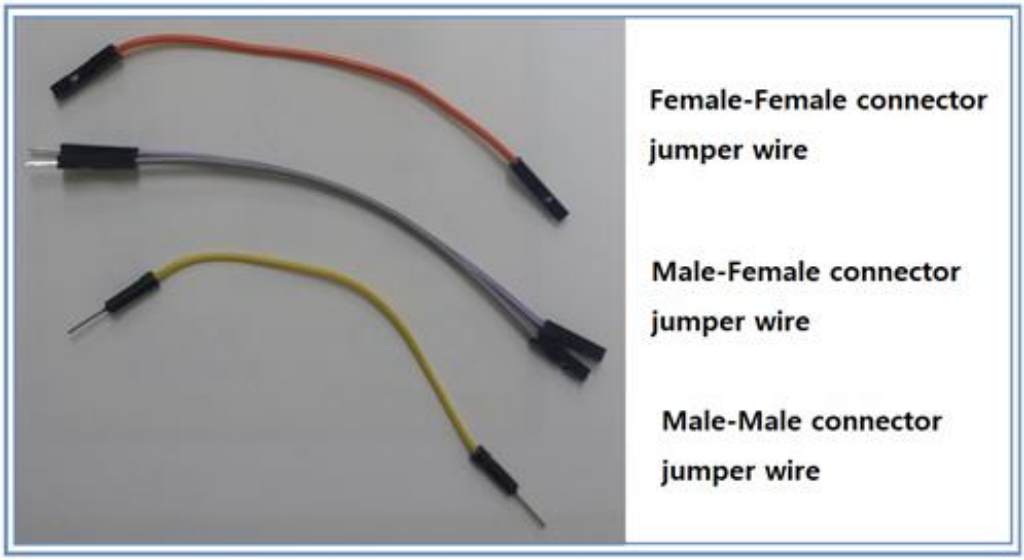

Fig. 18: Different Types of Jumpers

12. General Purpose Printed Circuit Board (PCB):

A printed circuit board (PCB) mechanically supports and electrically connects electrical or electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and or between sheet layer so fan on-conductive substrate. Components are generally soldered on to the PCB to both electrically connect and mechanically fasten them to it. A basic PCB consists of a flat sheet of insulating material and a layer of copper foil, laminated to the substrate.

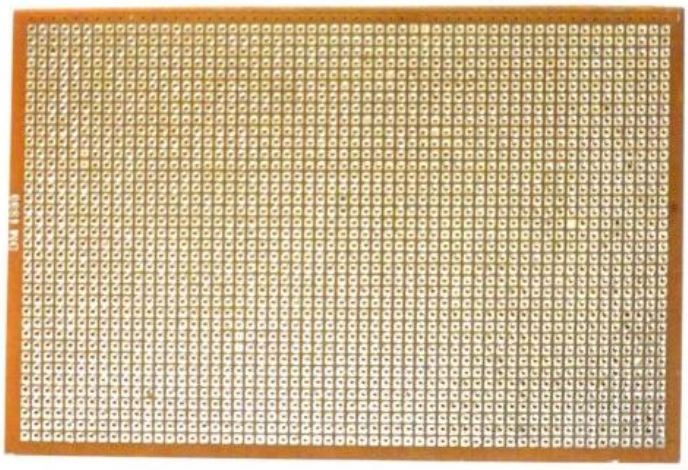

Fig. 19: General Purpose PCB

PCBs can be single sided (one copper layer), double-sided (two copper layers on both sides of one substrate layer), or multi-layer (outer and inner layers of copper, alternating with layers of substrate).

13. USB Cable Type A/B:

USB (Universal Serial Bus) designed to connect peripherals such as mice, keyboards, scanners, digital cameras, printers, hard disks, and networking components to PC. It has become the standard connection method for wide variety of devices.

Nowadays USB has replaced a variety of earlier PC interfaces (such as RS-232 serial, parallel port, and even FireWire). Due to the ability to supply power to the peripheral devices USB is often used as a power charger for portable devices.

An USB system architecture consists of a host controller, a USB ports, and multiple connected devices. Additional USB hubs may be included allowing branching into a tree structure with up to five tier levels.

We are using a USB cable type A/B Standard USB 2.0 cable for 2 purposes:

- To connect Arduino Uno, Arduino Mega 2560, Arduino 101 or any board with the USB female A port of your computer.
- To connect the Adapter to the Arduino Uno for power supply.

Fig. 20: USB Type A –USB Type B Data Cable

14. Copper Wires:

Copper has been used in electrical wiring since the invention of the electromagnet. Copper is the electrical conductor in many categories of electrical wiring. Copper wire is used in telecommunications, electronics circuitry, and countless types of electrical equipment. Next Para Some of the reasons for it are:

1. It has the highest electrical conductivity rating of all non-precious metals.
2. It's high tensile strength resists stretching, creep, nicks and breaks, and thereby also prevents service interruptions.
3. It can resist corrosion from moisture, humidity, and other atmospheric influences.
4. And, It is readily soldered to make durable connections.

Fig. 21: Bare Copper Wires

CHAPTER 5

CIRCUIT DIAGRAM

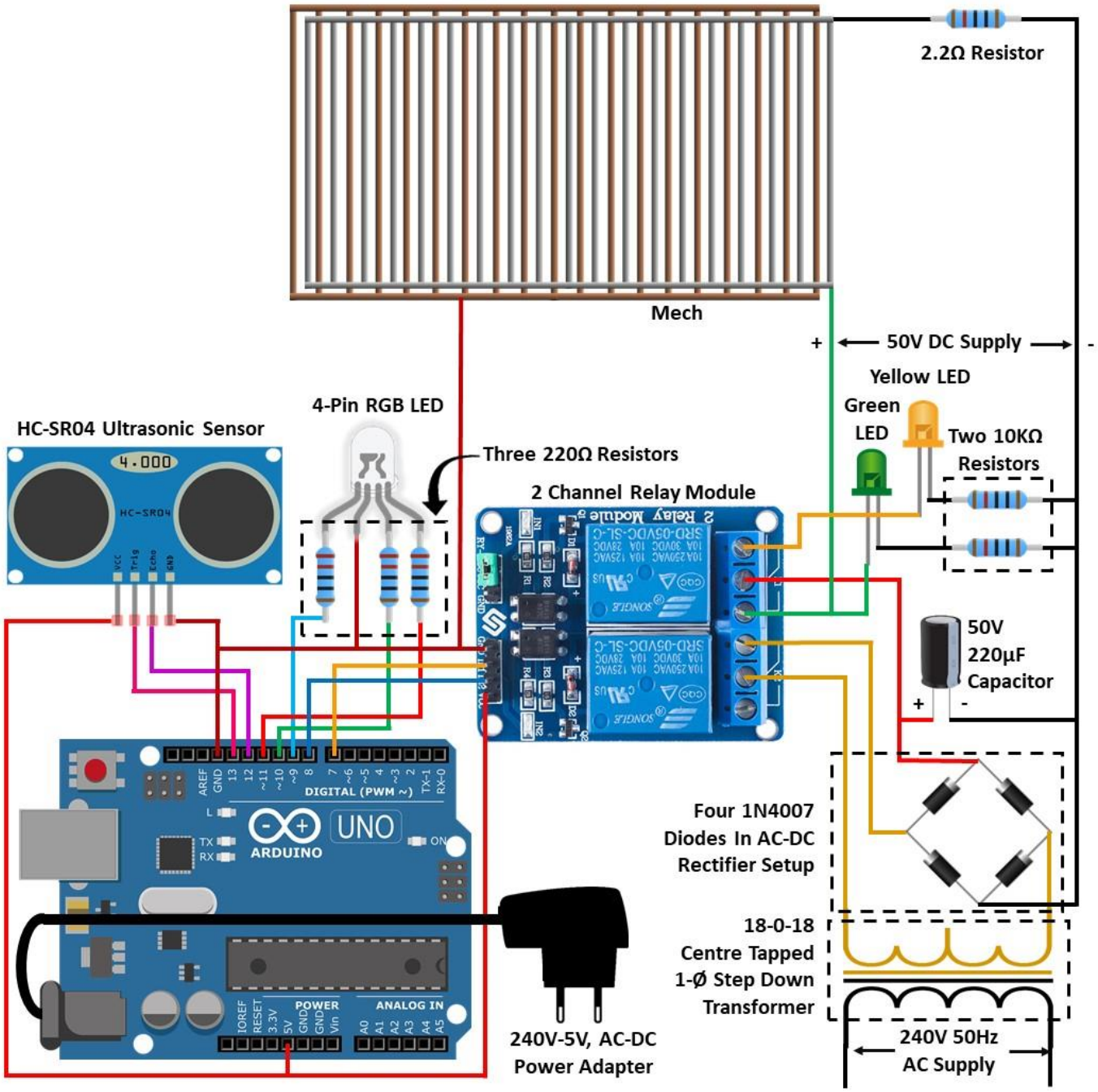

Fig. 22: Circuit Diagram of Electric Discharge Insect Control Systems

CHAPTER 6
MESH DESIGN

In this section, let's understand which type of mesh design will be suitable and also why the regular mesh or mosquito killing racket design will not work.

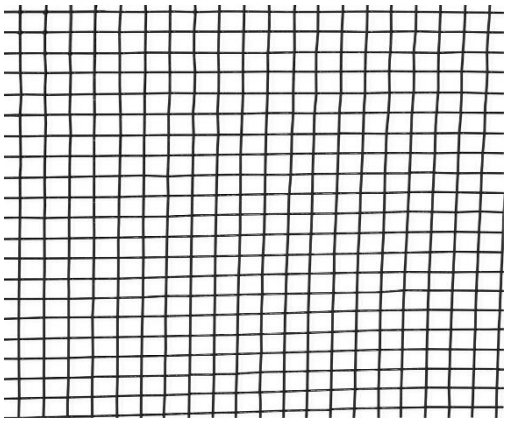

Fig. 23: Square Mesh Design

If we use the regular mesh as shown in the above figure, then there is no way to provide positive and negative voltage such that it won't lead to a Short Circuit.

Now, In the mosquito killing racket there are 3 layers, out of which the outer 2 is at positive potential and the inside layer is at negative potential as shown below:

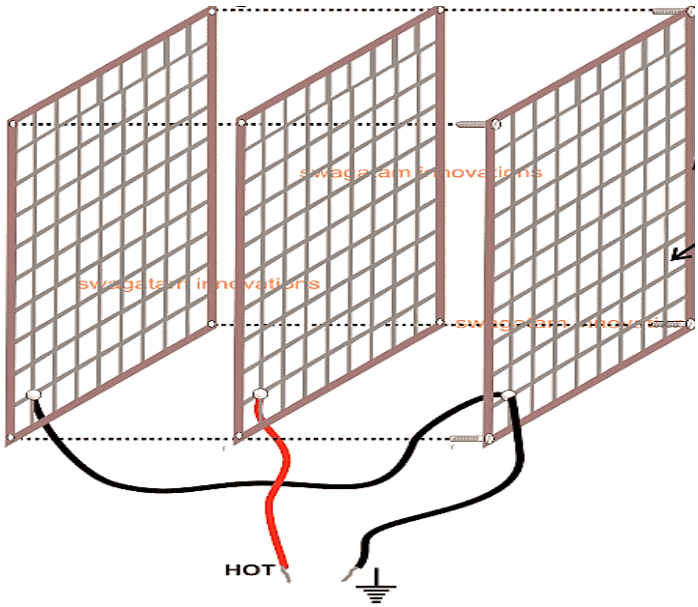

Fig. 24: Mosquito Zapper Bat Mesh Design

When the mosquito gets stuck in between the 2 layers out of the 3, because of the potential difference, the current flows through the mosquito, which kills it. But only when we zap using the racket, mosquito gets stuck in between. Hence, if it is in a still position, then it doesn't affect the insects.

Therefore, we will be using the following design:

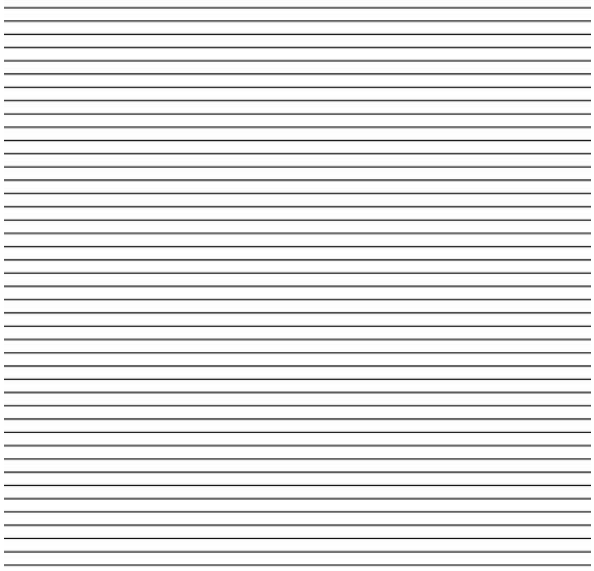

Fig. 25.1: Horizontal Bare Conductors Mesh Design

Here, all odd indexed wires are connected to the higher potential and even indexed are connected to lower potential. Hence, if an insect sits on the wire, its legs will be on one potential and the upper part of the body will touch other potential, as there is a potential difference and a conducting path which leads to the current flow through the insect's body, thereby killing it. Or else if the insect tries to enter, it experiences a shock.

Thus, the above design is used in making the product.

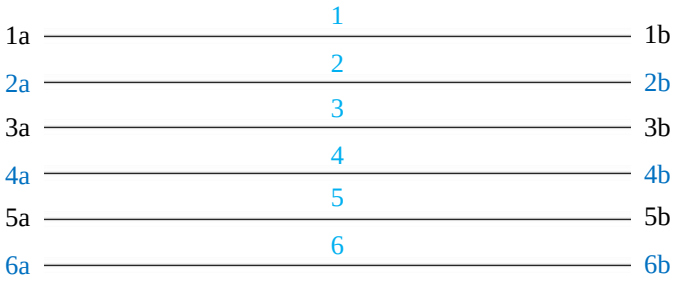

Fig. 25.2: Horizontal Bare Conductors Mesh Design

Let's consider the wires are numbered from top to bottom as 1, 2, 3 and so on. And, left side end comes under 'a' series and right side end comes under 'b' series. The connections are explained below:

1. In the 'a' series odd numbered are soldered together then connected to one terminal of the relay.
2. In 'b' series odd numbered are soldered together and connected to cathode of the capacitor, creating a closed circuit.
3. Then in the 'a' series even numbered are soldered together and connected to ground.
4. In the 'b' series even numbered are left open. Hence, this wire do not form a closed circuit now.

When an insect comes in contact with two wires it provides a conducting path. Because of this, the current flowing in higher potential wire passes through the insect and then using the lower potential wire, then, goes to the ground. As, current flows to the mosquito it experiences a shock and dies.

WORKING CHAPTER 7

We have a **230 volts AC supply** in buildings. However, the output must be a small direct-current (DC) which doesn't affect humans but can kill insects. Therefore, to reduce the voltage level, we are using a **18-0-18 Centre-tapped Step Down Transformer and** then to convert AC supply to a DC supply we use a Full-Bridge Rectifier for **Rectification** process.

Thereafter the current flow is further reduced using a **Resistor**. After this process, the reduced DC converted supply is sent to the **Electric Mesh** through a **Control Circuit**. This Mesh can kill any insect that comes close to it.

We are providing an extra protection system before the supply is sent to the Electric Mesh so that humans who come close to the Mesh are not affected. The protection system comprises the following components:

1. **AC-DC Adapter**
2. **Ultrasonic Sensor,**
3. **Arduino Uno,**
4. **Relay,**
5. **RGB LED, and**
6. **Three Resistors**.

The function of each of the components in this project is as explained below:

1. **AC-DC Adapter:** For providing supply to the microcontroller, i.e., Arduino Uno.
2. **Ultrasonic Sensor:** This is used to detect the presence of any object within 30 cm range and sends a signal to Arduino Uno.
3. **Arduino Uno:** It has two functions:
    i. It acts as medium between relay and ultrasonic sensor. When it receives a signal from Ultrasonic Sensor about the presence of an object it transmits it to the Relay and LED.
    ii. It also provides power supply to Ultrasonic Sensor, Relay and RGB LED.
4. **Relay:** It has two functions:
    i. As soon as it receives the signal from Arduino Uno, it opens the main circuit so that no current flows to the Electric Mesh.
    ii. It is also the one which switches back to close position if Ultrasonic Sensor cannot detect any one, i.e., if the human goes away.
5. **RGB LED:** This is used for letting the human know whether the current is flowing or not.
    i. It shows a red light when current is flowing, and
    ii. the green light when no current flows.
6. **Resistors:** They act as protection element for the RGB LED.

All these components together form the control circuit.

Working

Note: Due to the presence of a capacitor in the Rectification process, which gets charged during the supply is provided, it starts acting as a battery and discharges when the Relay opens the Main Circuit, thereby providing supply to all the components. To avoid this, we have added a 220 ohms resistor and a yellow LED in parallel to the capacitor and created a discharging path. It acts as a discharging path because the electrical energy gets converted into heat energy using the Resistor.

It is connected such that only, when the Relay opens the main circuit, it closes this discharging circuit.

Code: The code which has to be written in the Arduino Software is given below


```
#define trigPin 13
#define  echoPin 12
int red_light_pin= 11;
int green_light_pin = 10;
int blue_light_pin = 9;
int relayPin=8; //INT1
int relayPinPower=7; //IN2
void setup()
{
        Serial.begin (9600);
        pinMode(trigPin, OUTPUT);
        pinMode(echoPin, INPUT);
        pinMode(relayPin, OUTPUT);
        pinMode(relayPinPower, OUTPUT);
        pinMode(red_light_pin, OUTPUT);
        pinMode(green_light_pin, OUTPUT);
        pinMode(blue_light_pin, OUTPUT);
}
void loop()
{
        long duration, distance;
        digitalWrite(trigPin, LOW);
        delayMicroseconds(2);
        digitalWrite(trigPin, HIGH);
```

```
        delayMicroseconds(10);
        digitalWrite(trigPin, LOW);
        duration = pulseIn(echoPin, HIGH);
        distance = (duration/2) / 29.1;
        if (distance < 30)
        {
                digitalWrite(relayPinPower, LOW); //Power Realy in N0 i.e. Power OFF
                Serial.println("No Input Power");
                Serial.println("---------------------------------");
                delay (100);
                RGB_color(0, 255, 0); // Green
                digitalWrite(relayPin, HIGH); //Realy in NC and Capacitors SC
                Serial.println("Capacitor is Shorted");
                Serial.println("---------------------------------");
        }

        else
        {
                digitalWrite(relayPin,  LOW); //Realy in NO and Capacitors OC
                delay(100);
                RGB_color(255, 0, 0); // Red
                digitalWrite(relayPinPower, HIGH); //Power Realy in NO i.e. Power ON
                Serial.println("Yes Input Power");
                Serial.println("---------------------------------");
                Serial.println("Supply given to Mesh.");
                Serial.println("---------------------------------");
        }

        delay (500);
}

void RGB_color(int red_light_value, int green_light_value, int blue_light_value)
 {
          analogWrite(red_light_pin, red_light_value);
          analogWrite(green_light_pin, green_light_value);
          analogWrite(blue_light_pin, blue_light_value);
}
//END of CODE
```

RESULTS CHAPTER 8

When no objects are near the mesh, i.e., when ultrasonic sensor doesn't recognise presence of anyone or anything, the current flows through the mesh and RGB LED is in RED colour, as shown in left:

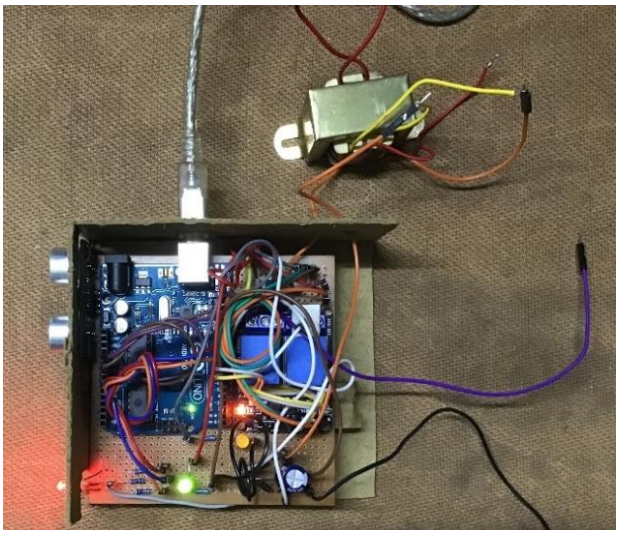

Fig. 26.1: Top view of the finished project when there is no object/human in front of the sensor.

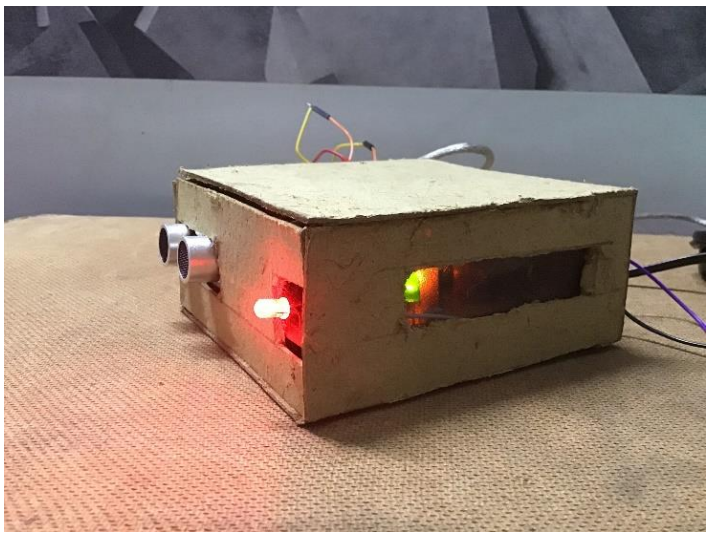

Fig. 26.2: Angular view of the finished project when there is no object/human in front of the sensor.

And, when there is an object present, the current stops flowing through the mesh and RGB LED shows GREEN colour.

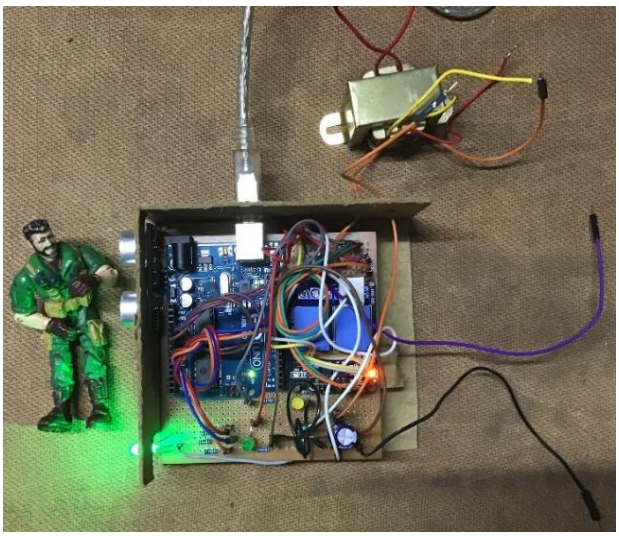

Fig. 27.1: Top view of the finished project when there is an object/human in front of the sensor.

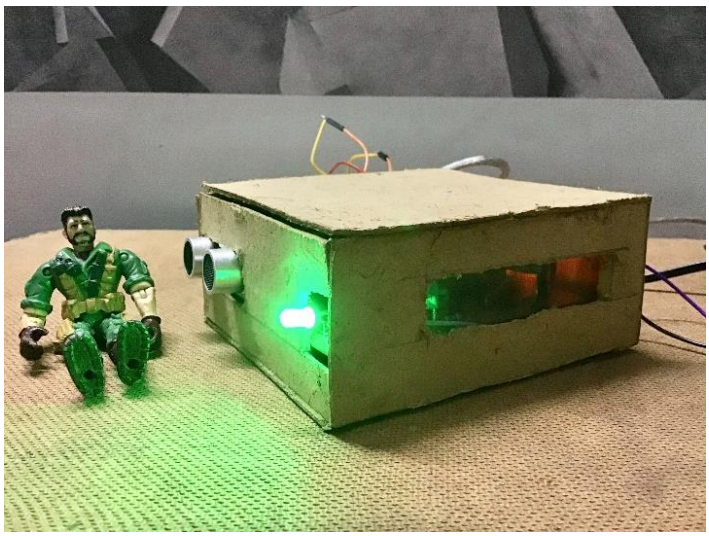

Fig. 27.2: Angular view of the finished project when there is an object/human in front of the sensor.

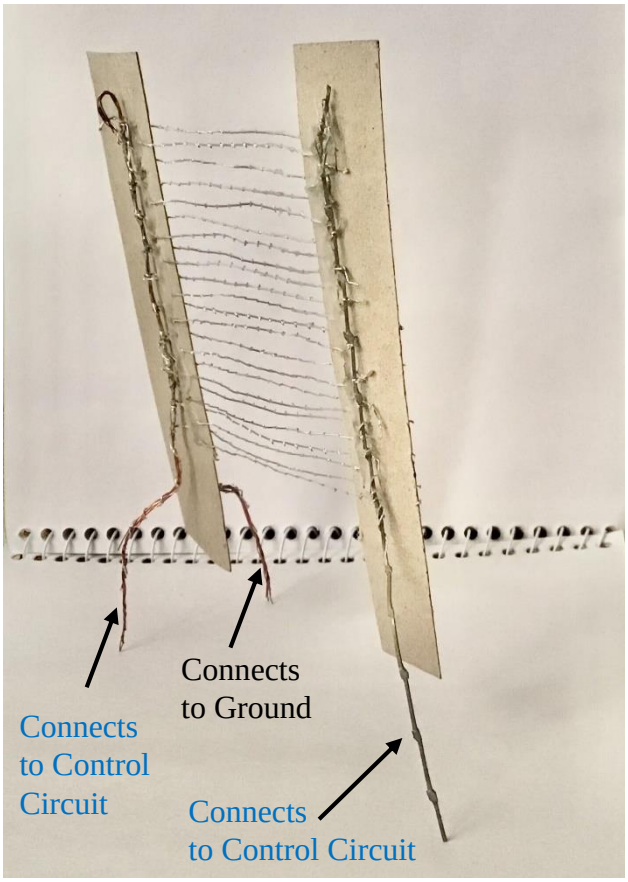

Fig. 28.1: Angular View of Vertical Mesh of finished project

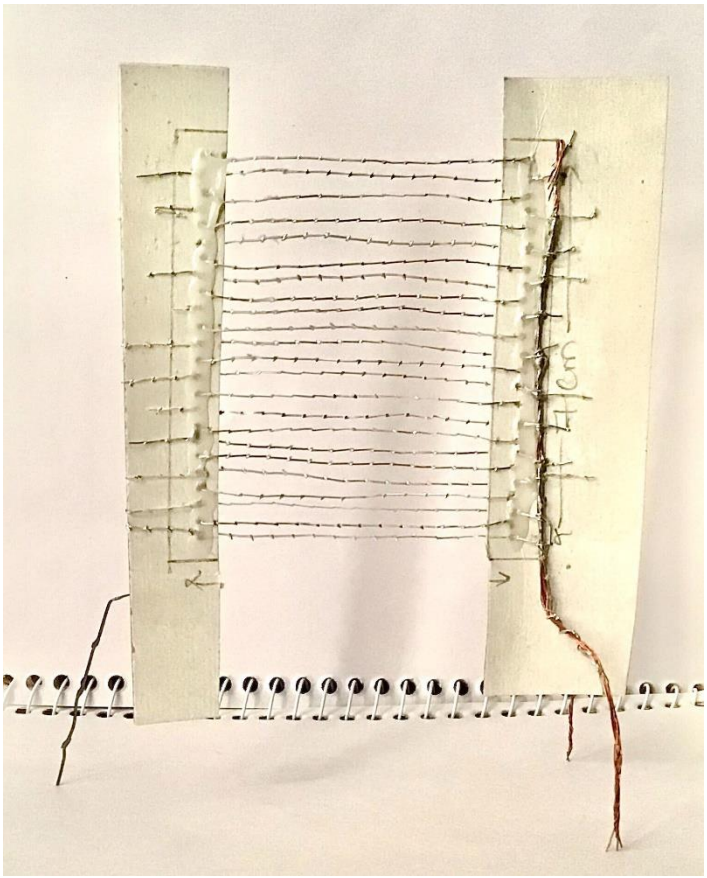

Fig. 28.2: Front View of Vertical Mesh of finished project

Mesh works perfectly and kills the insects.

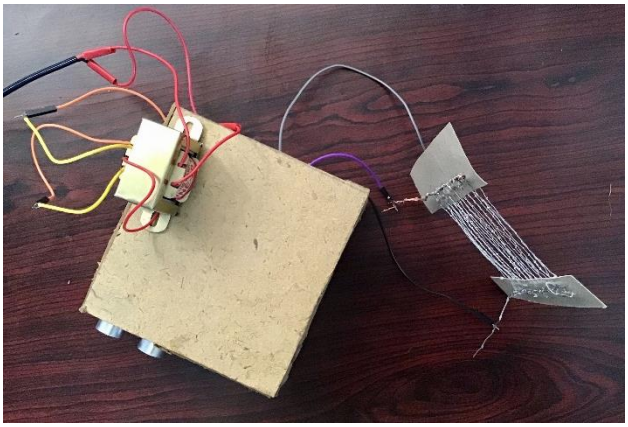

Fig. 29.1: Top View entire of finished project

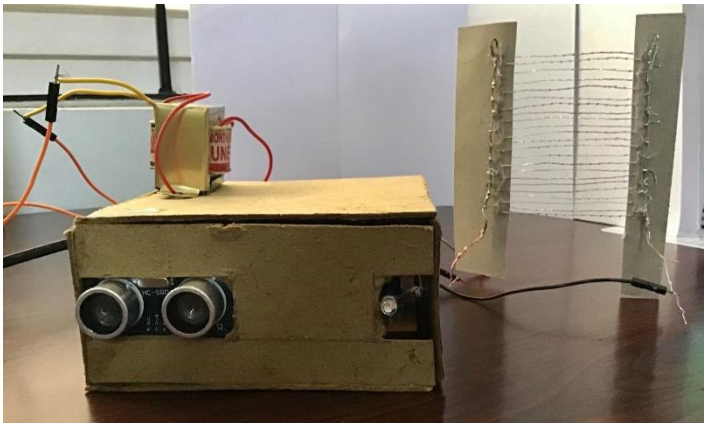

Fig. 29.2: Front View entire of finished project

ADVANTAGES AND DISADVANTAGES

CHAPTER 9

Advantages:

- Long Lasting,
- Robust,
- Cheap,
- Highly Reliable,
- Easy Maintenance,
- Improved Performance,
- Removes the need of Human Involvement,
- Safe, as there is no chance that the current can affect humans.

Disadvantages:

- Requires 2 inputs, hence takes 2 plug points.

CHAPTER 10

APPLICATIONS

- The Control Circuit of the project can be used:
  - At the places where there is any electrical appliance which has a possibility of affecting humans, like microwave oven,
  - At the places where live electricity is present.
- The Electric Mesh can be used to prevent insects in any closed premises.

CHAPTER 11
CONCLUSION

We have designed an Electric Discharge Insect Control System that can prevent the insects from entering the closed premises and protect humans against them.

And, with the everyday changes in the world, we have to keep updating in terms of protection. So, we feel that this can provide a unique solution for the issue.

CHAPTER 12

REFERENCES

1. https://components101.com/microcontrollers/arduino-uno
2. https://components101.com/sites/default/files/component_datasheet/Arduino%20Uno%20Datasheet.pdf
3. https://components101.com/ultrasonic-sensor-working-pinout-datasheet
4. https://components101.com/sites/default/files/component_datasheet/HCSR04%20Datasheet.pdf
5. http://wiki.sunfounder.cc/index.php?title=2_Channel_5V_Relay_Module
6. https://www.electrical4u.com/diode-working-principle-and-types-of-diode/
7. https://www.electronics-tutorials.ws/capacitor/cap_1.html
8. en.m.wikipedia.com
9. https://www.google.com/imghp?hl=en
10. Electronic Mosquito Racket, Kuel-Tzu Su, Taichung County, Nov. 29, 2007