

PCB DESIGNING



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BASIC ELECTRONIC COMPONENTS

➤ .RESISTOR:



A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor.

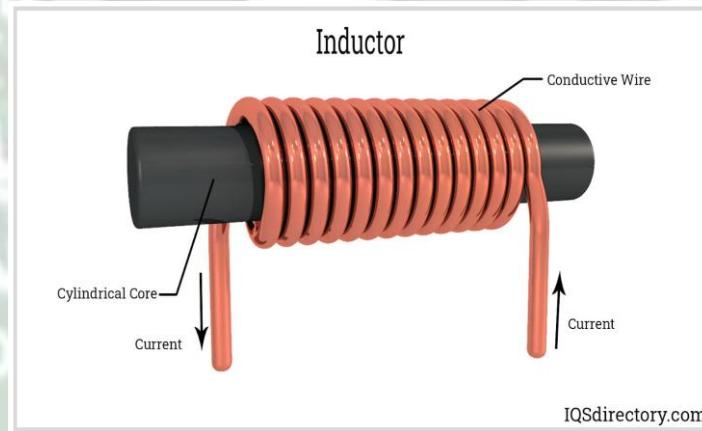
The Variable resistors are used for variating voltage as per the need in a circuit. The outer two pins are connected to Vcc and 0V, and cetner pin outputs a variable volatge between 0v and Vcc as the rotary cermet is rotated.

➤ CAPACITOR:



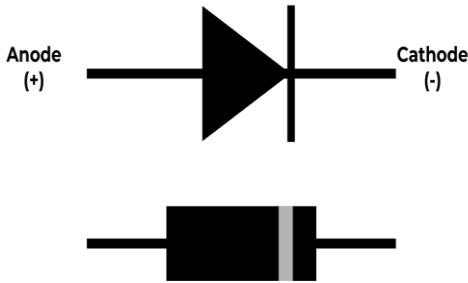
In a circuit, a non-polarized ("non-polar") capacitor has no implied polarity and can be utilized in any direction. But the intrinsic polarity of a polarized ("polar") capacitor means it may only be connected in one direction in a circuit. This is the primary difference between them.

➤ INDUCTOR:



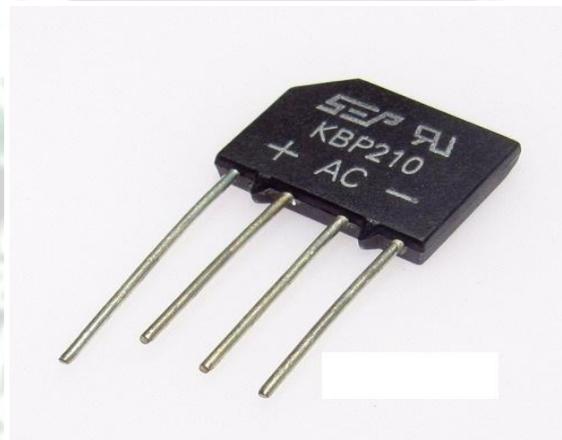
An inductor is a passive component that is used in most power electronic circuits to store energy in the form of magnetic energy when electricity is applied to it. One of the key properties of an inductor is that it impedes or opposes any change in the amount of current flowing through it.

➤ **DIODE:**



A diode is a semiconductor device with two terminals that controls the direction of electrons through an electrical circuit. It allows current to flow easily in one direction, but restricts current from flowing in the opposite direction.

➤ **Rectifier:**



A rectifier is an electrical device that converts alternating current (AC) to direct current (DC). The process of converting AC to DC is called rectification.

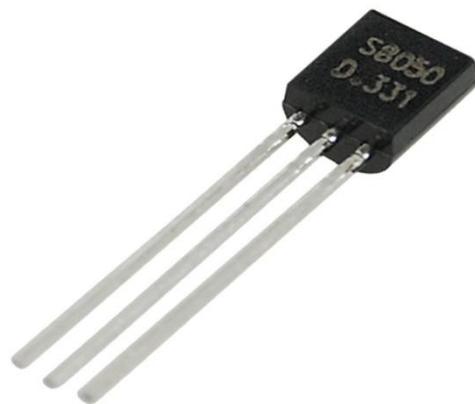
Rectifiers are made up of one or more diodes that only allow current to flow in one direction. Diodes work like one-way valves within the rectifier to maintain this flow of current.

➤ **Light Emitting Diode:**



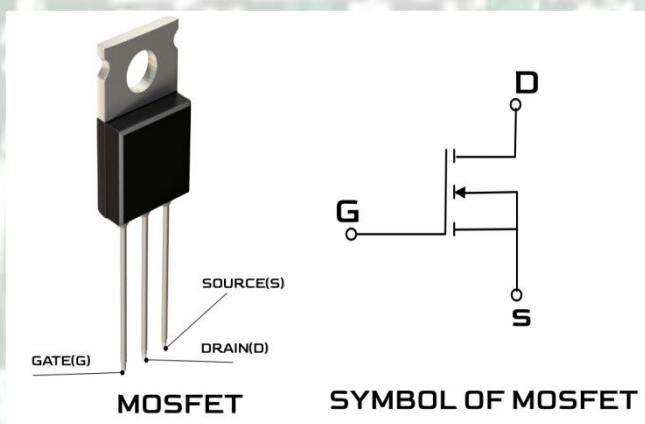
LED stands for light emitting diode. LED lighting products produce light up to 90% more efficiently than incandescent light bulbs. An electrical current passes through a microchip, which illuminates the tiny light sources we call LEDs and the result is visible light.

➤ **Transistor:**



A transistor is a semiconductor device that can amplify or switch electronic signals. It is a basic building block of modern electronics. Transistors are made of materials like silicon or germanium that allow electrical current to flow through them in a controlled manner. They are typically made up of three layers, or terminals, of a semiconductor material, each of which can carry a current.

➤ **MOSFET:**



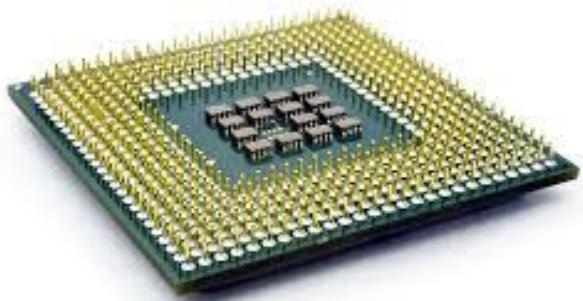
A metal-oxide-semiconductor field-effect transistor (MOSFET) is a voltage-controlled device that switches or amplifies voltages in circuits. MOSFETs are used as electrical switches and amplifiers. They control the amount of electricity that can flow between the source and drain terminals based on the voltage applied to the gate terminal. MOSFETs are used in both digital and analog circuits.

➤ **Voltage Regulator:**



Voltage regulator, any electrical or electronic device that maintains the voltage of a power source within acceptable limits. The voltage regulator is needed to keep voltages within the prescribed range that can be tolerated by the electrical equipment using that voltage.

➤ **Microprocessor:**



A microprocessor is a computer processor that contains the logic, arithmetic, and control circuitry required to perform the functions of a computer's central processing unit. It's an electronic component that's used by a computer to do its work.

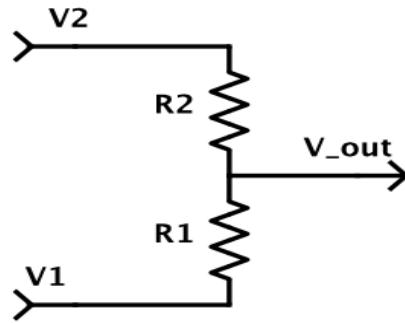
➤ **Microcontroller:**



A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.

NOTE : SOC i.e. System On Chip contains both Microprocessor and Microcontroller on one chip.

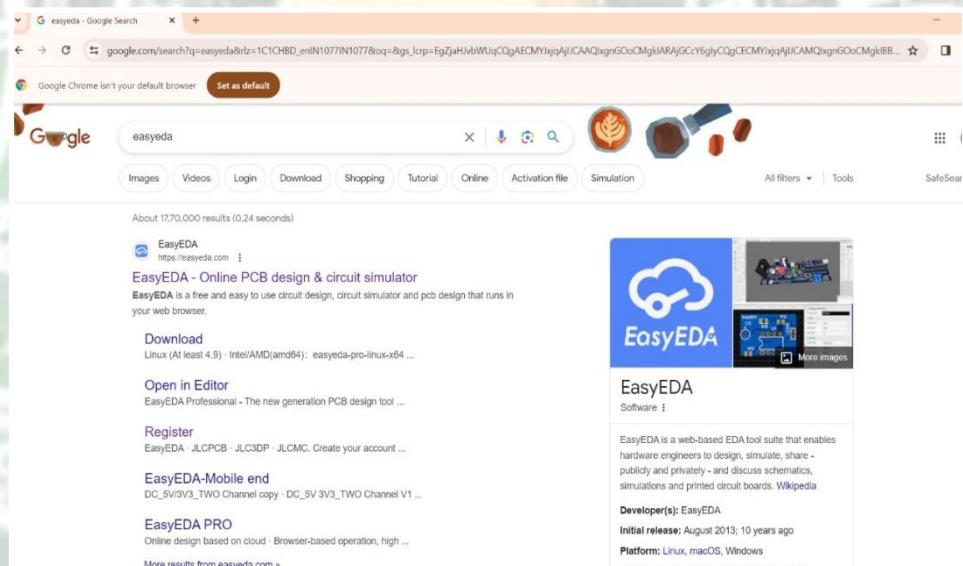
➤ **Voltage Divider:**



A voltage divider is a simple series resistor circuit. Its output voltage is a fixed fraction of its input voltage. The divide-down ratio is determined by two resistors.

DAY 1 - PCB DESIGNING

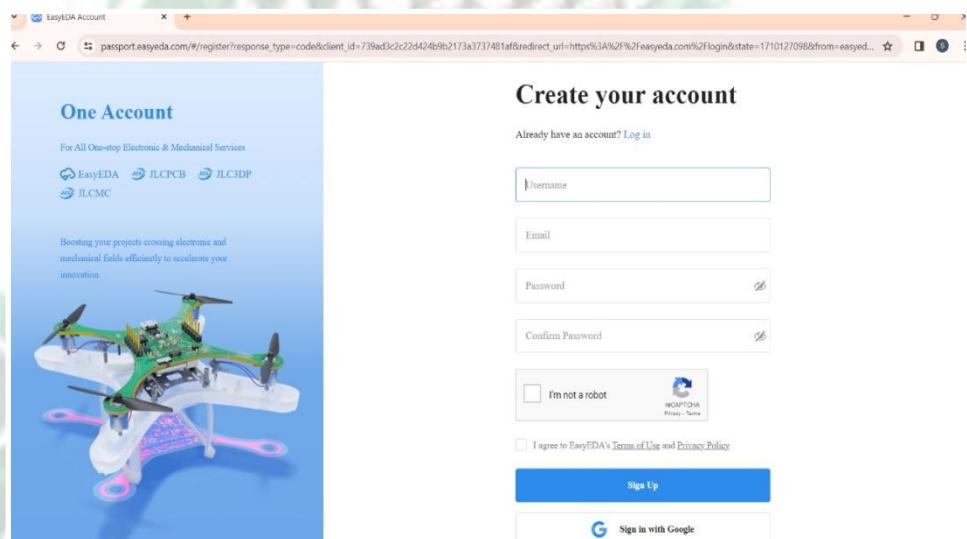
✓ Start with EasyEDA software:



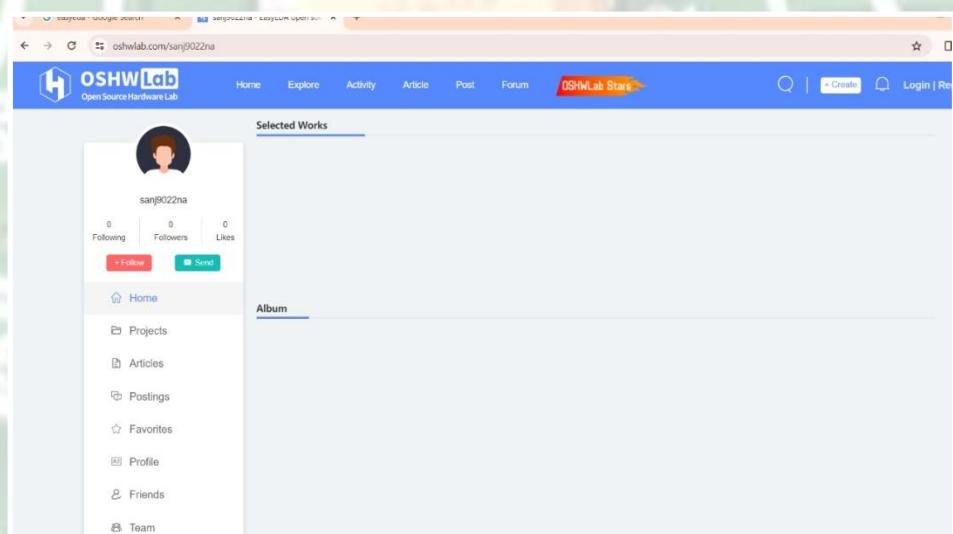
- ✓ Register on the EasyEDA Software:



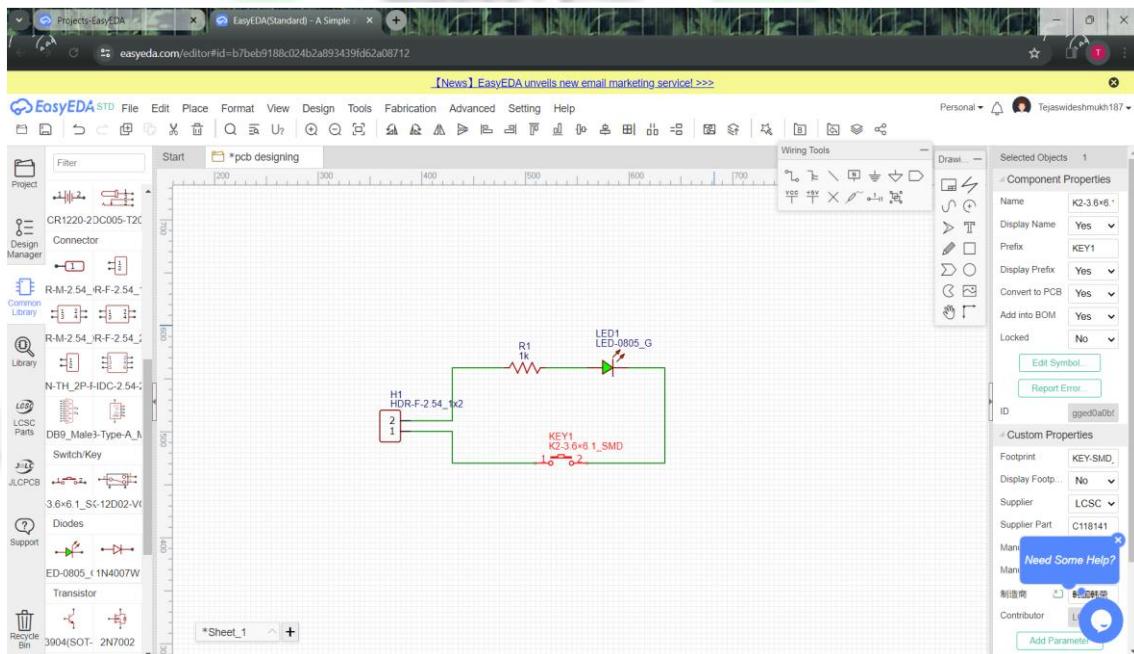
- ✓ Create account or Sign in with Google:



- ✓ Sign in with Google our profile is created:

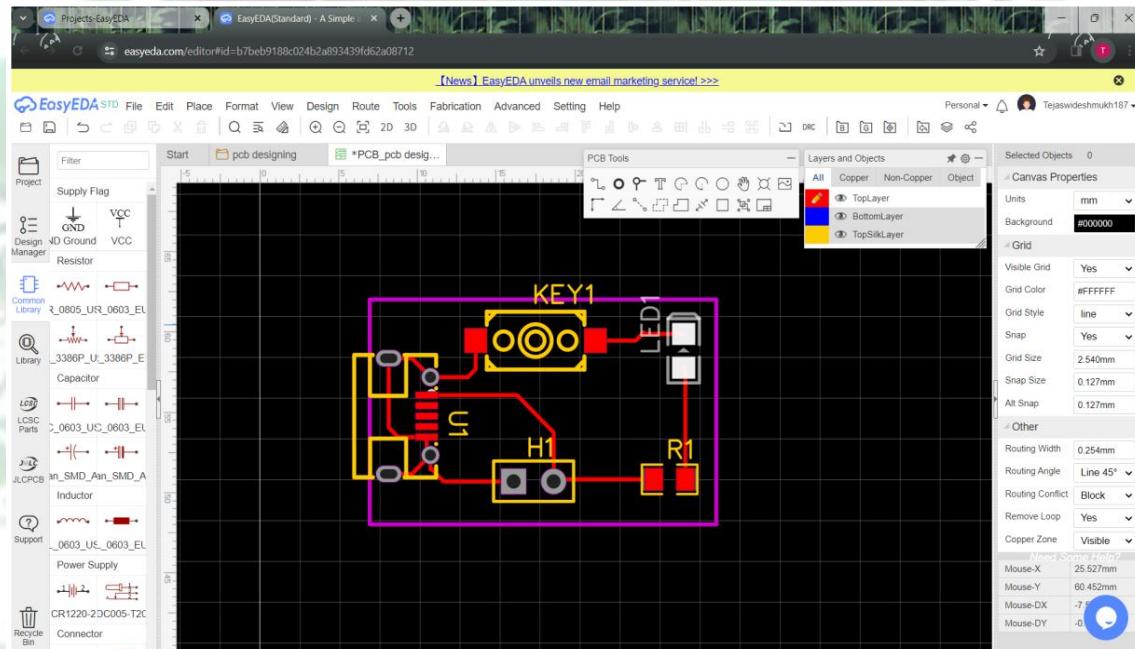


- **Schematic of Basic LED Circuit:**



- ✓ Begin by creating a schematic of your LED circuit in the PCB design software.
- ✓ Place the LED, resistor, power source, and any other components you may have in your circuit.
- ✓ Connect the components with wires to represent the electrical connections.

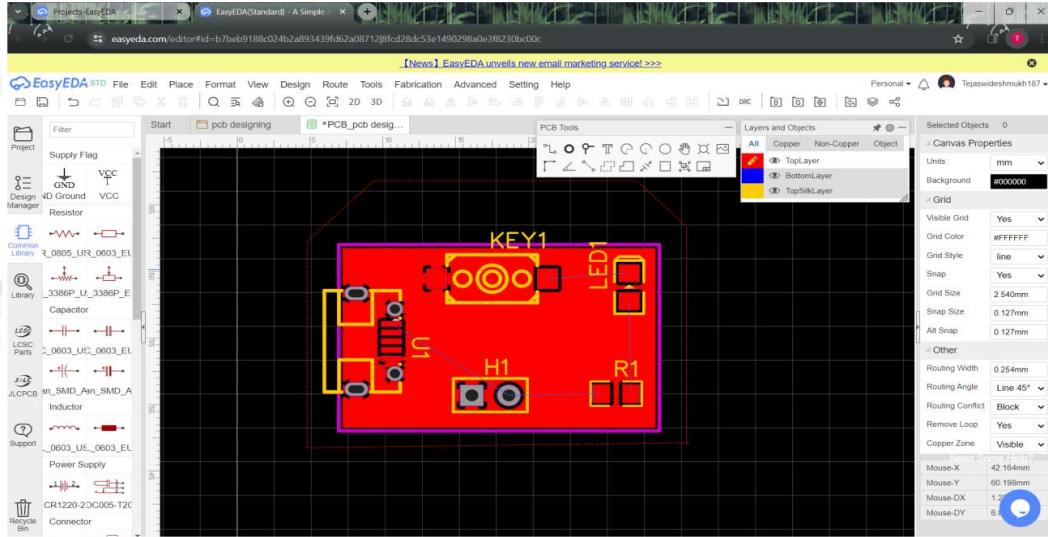
- **Without copper pore:**



- ✓ Once you've created the schematic, you can proceed to the PCB layout design phase.

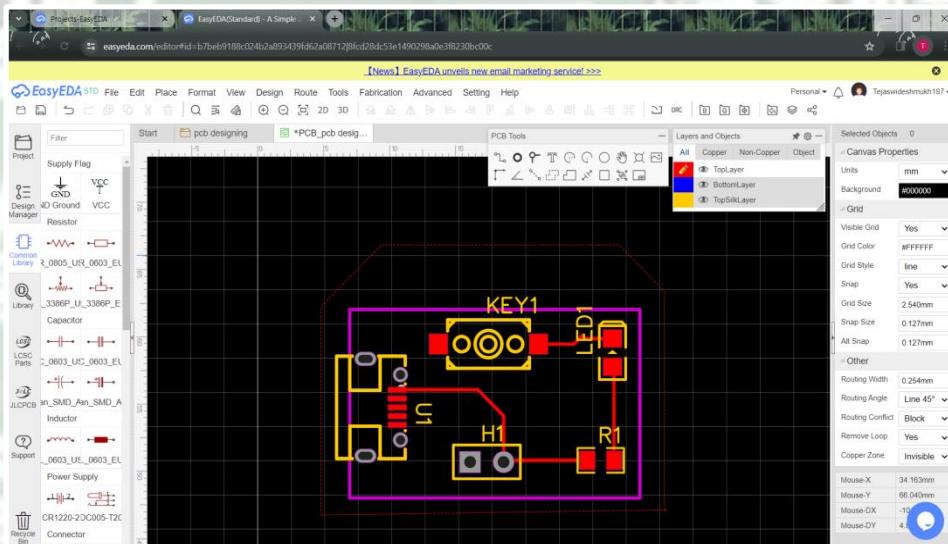
- ✓ Place the components on the PCB layout in a way that makes the layout compact and efficient.
- ✓ Draw traces on the PCB layout to connect the components according to the connections in the schematic.

- **With copper pore:**

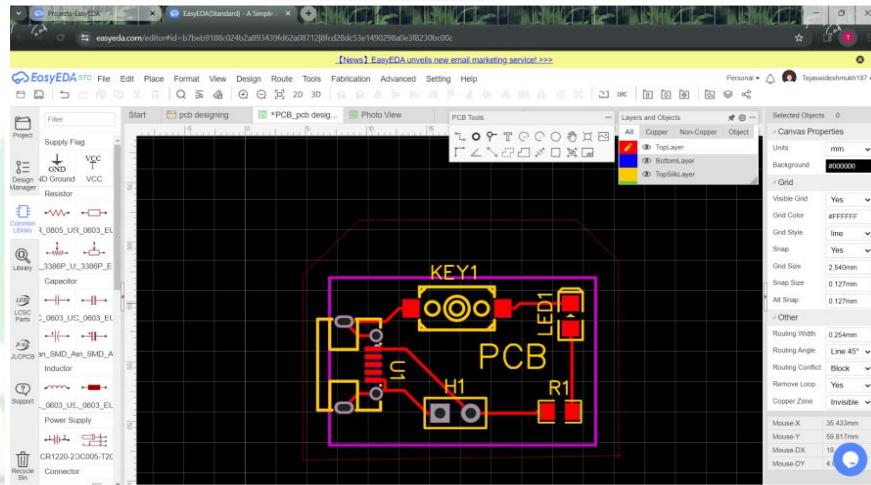


- ✓ Most PCB design software allows you to specify the layer on which the traces are placed.
- ✓ If necessary, create a ground plane on the bottom layer of the PCB to improve signal integrity and reduce electromagnetic interference.
- ✓ However, ensure that this ground plane doesn't interfere with the operation of your LED circuit.

- **Ground lines vanishes because of copper pore:**

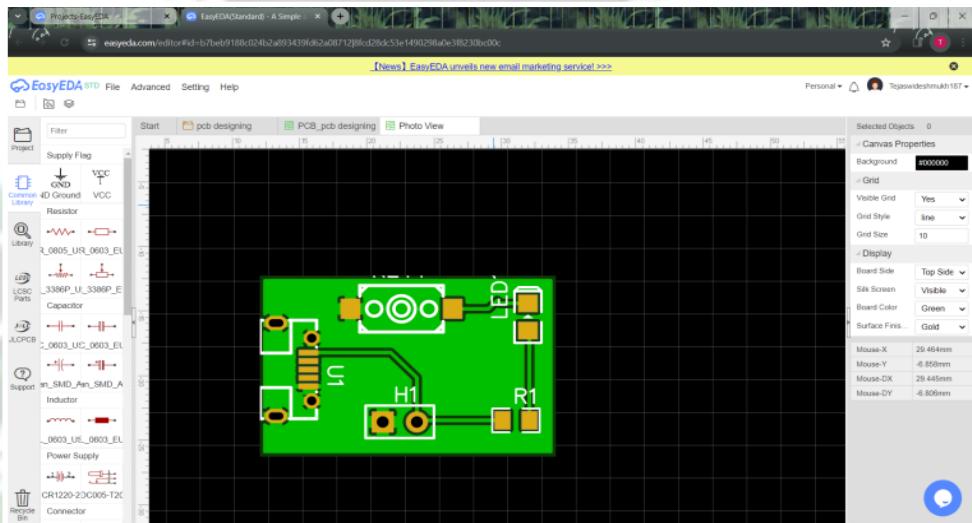


- **By autoroute:**



- ✓ Autorouting is a feature that automates the process of routing traces between components on the PCB layout.
- ✓ Rather than manually routing each trace, which can be time-consuming, autorouting algorithms automatically determine the best paths for traces.

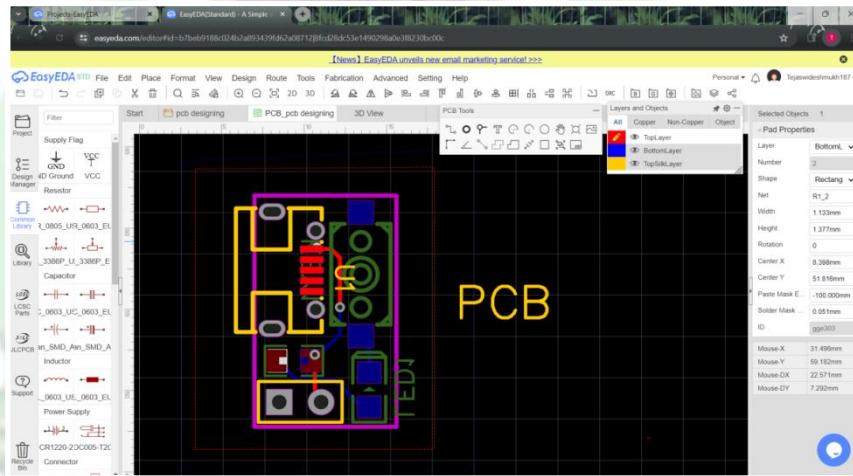
- **2D Visualization of Basic LED Circuit:**



- **3D Visualization of Basic LED Circuit:**



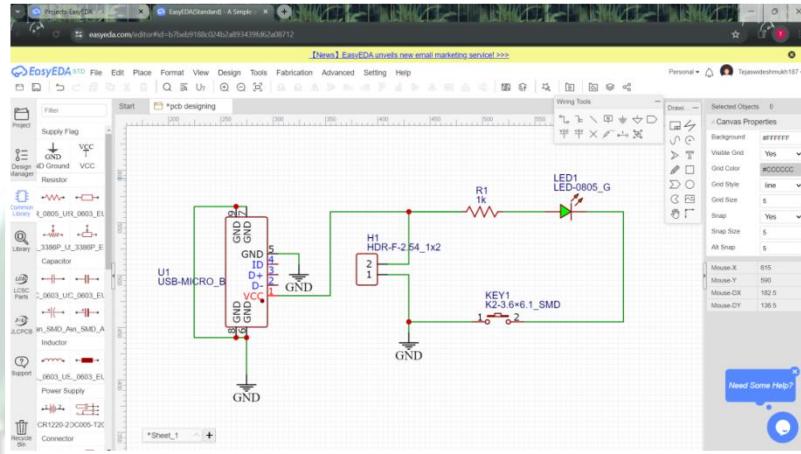
- Joining Top Layer and Bottom Layer Devices by Via:



- Customize Water Tank PCB Design :

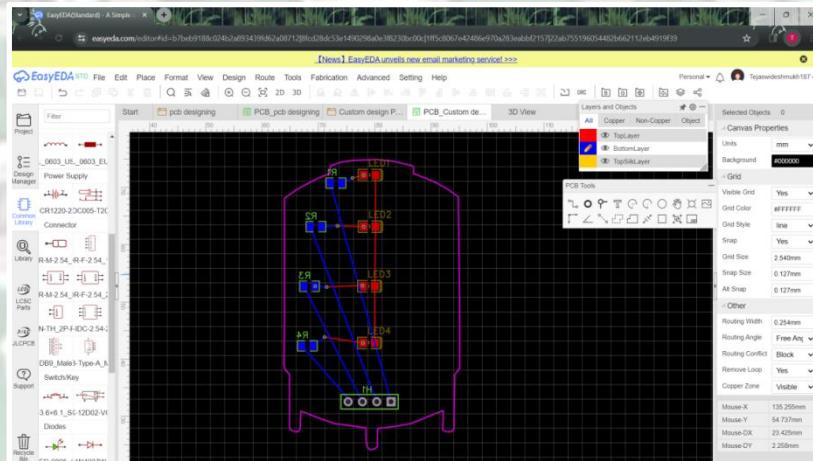
Custom PCB (Printed Circuit Board) designing involves creating a circuit board tailored to specific requirements.

- Schematic of Customize Water Tank:



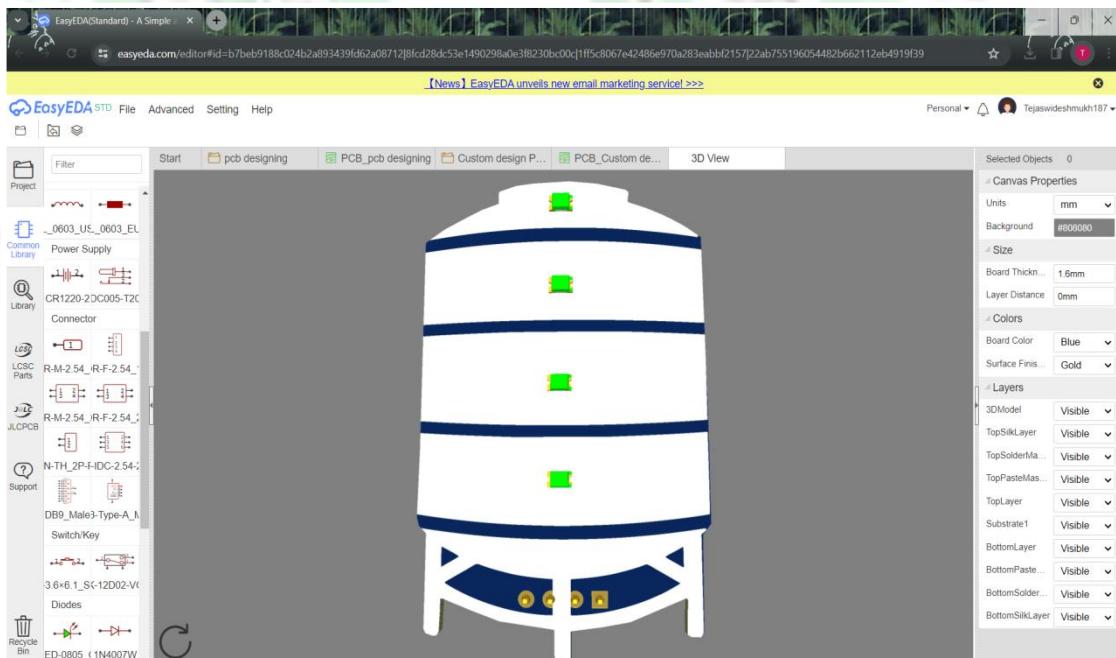
- ✓ Create a schematic diagram of the circuit using schematic capture software.
- ✓ Place components such as resistors, capacitors, integrated circuits, connectors, and any other necessary parts.

- PCB Design of Customize Water Tank:



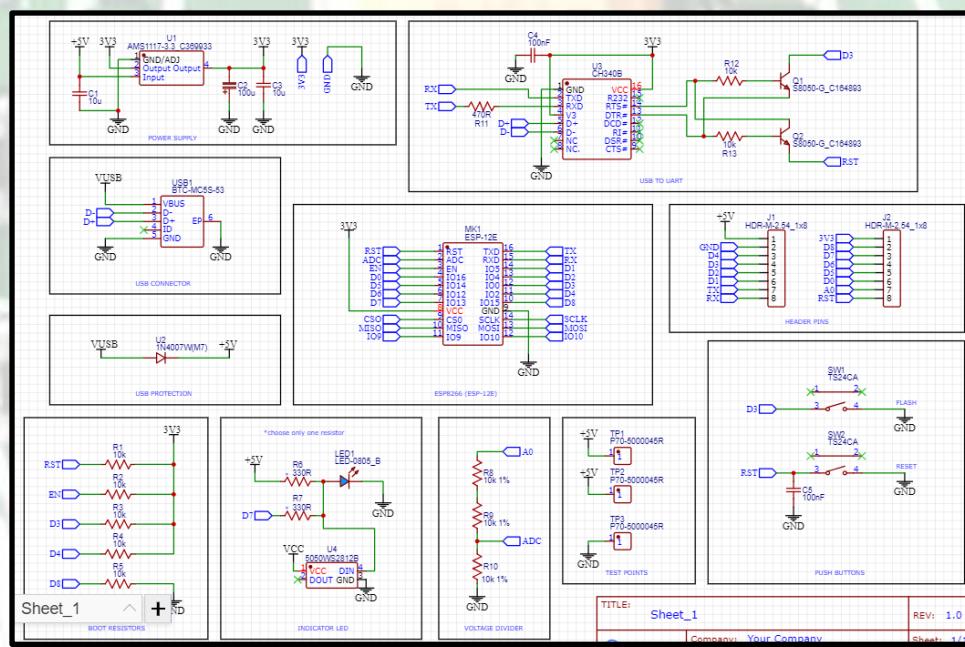
- ✓ Transfer the schematic to the PCB layout design software.
 - ✓ Arrange components on the PCB layout according to the schematic diagram.
 - ✓ Route traces to connect the pads of components according to the schematic connections.
 - ✓ Create ground and power planes on the PCB to provide stable reference voltages and efficient power distribution.
 - **3D Visualization of Customize Water Tank Circuit:**

- **3D Visualization of Customize Water Tank Circuit:**

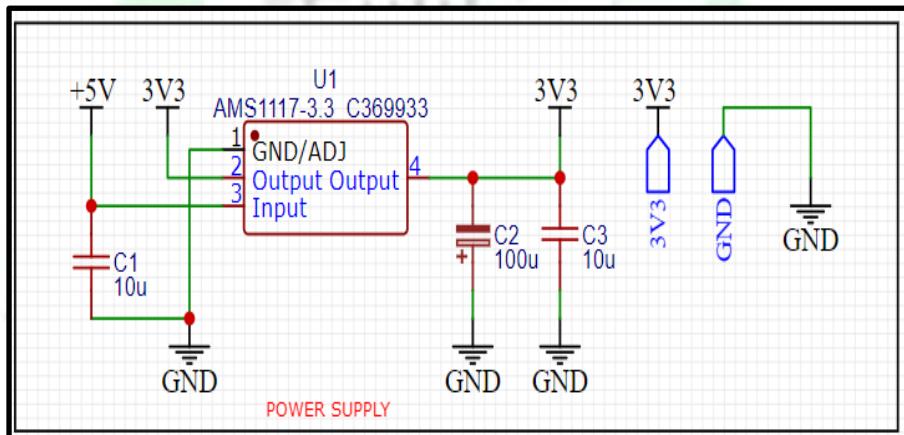


DAY 2-PCB FABRICATION

- **Schematic of Hedy MCU:**

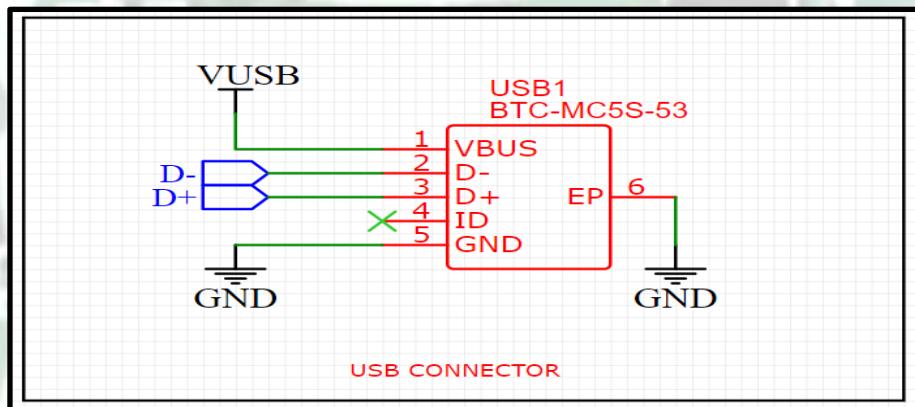


- **Schematic of Power Supply:**



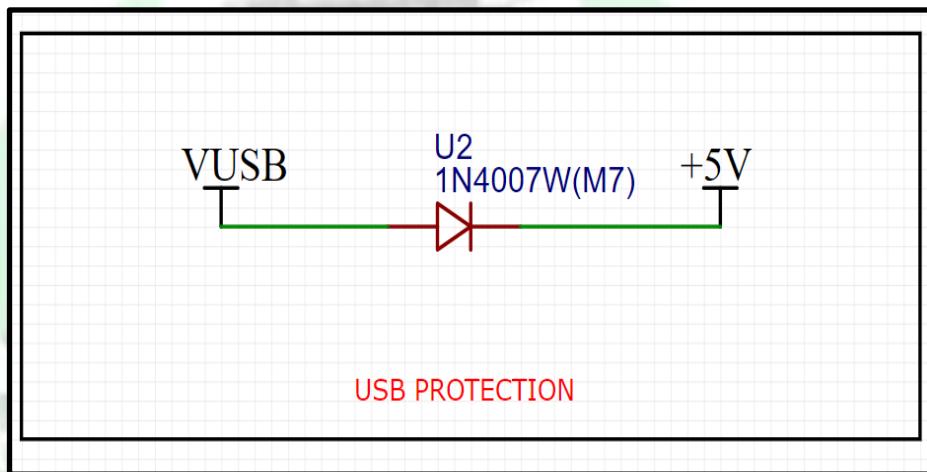
- ✓ A power supply is a device or system that provides electrical energy to one or more electric loads.
- ✓ AC (Alternating Current) power supply converts alternating current from a power grid into direct current (DC) required by most electronic devices.
- ✓ DC (Direct Current) power supply provides a constant voltage or current to electronic devices.
- ✓ Linear Power Supply uses a transformer, rectifier, and regulator to produce a stable output voltage. Linear power supplies are simple but can be inefficient.

- **Schematic of USB Connector:**



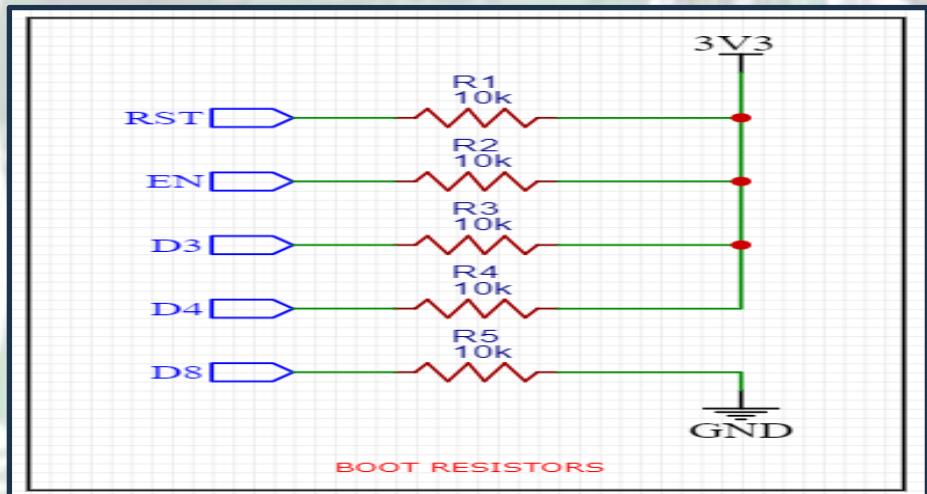
- ✓ USB (Universal Serial Bus) connectors are widely used in modern computing and electronic devices for connecting peripherals, such as keyboards, mice, printers, external storage devices, smartphones, and more.
- ✓ USB connectors are used for data transfer, charging devices, and powering peripherals.
- ✓ They provide a universal interface for connecting various devices to computers, laptops, and other hosts.
- ✓ USB technology has evolved over the years, with newer versions offering faster data transfer rates and more power delivery capabilities.

- **Schematic of USB Protection:**



- ✓ USB protection refers to measures taken to secure USB (Universal Serial Bus) devices and ports from unauthorized access, data theft, malware infection, and other security risks.
- ✓ USB devices, such as flash drives, external hard drives, and even smartphones, are widely used for data storage and transfer, making them potential vectors for security breaches if not properly protected.
- ✓ Encrypting data stored on USB devices ensures that even if the device falls into the wrong hands, the data remains inaccessible without the encryption key.
- ✓ Endpoint security software can monitor and control the use of USB devices on a network.

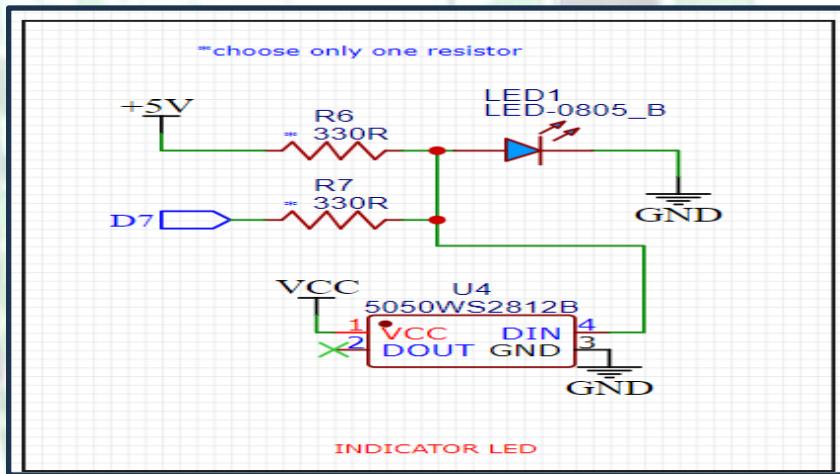
- **Schematic of Boot Resistors:**



- ✓ Boot resistors, also known as bootstrap resistors or bootstrap capacitors, are components commonly used in electronic circuits.
- ✓ They play a crucial role in the operation of MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) switches and drivers.
- ✓ Boot resistors are used in conjunction with bootstrap capacitors to generate a voltage higher than the power supply voltage.

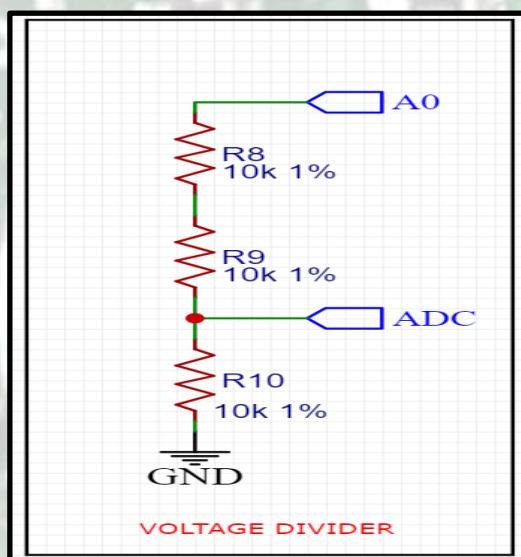
- ✓ In many circuits, a bootstrap capacitor is connected between the high side gate driver output and the source of the high side MOSFET.

- **Schematic of Indicator LED:**



- ✓ An indicator LED, or light-emitting diode, is a small electronic component that emits light when an electric current passes through it.
- ✓ Indicator LEDs are primarily used to visually convey information to users. They can indicate various states such as power on/off, device activity, connectivity status, battery level, or error conditions.
- ✓ Indicator LEDs are typically small, low-power devices. They are often mounted on circuit boards and come in various package types such as surface-mount (SMD) or through-hole.

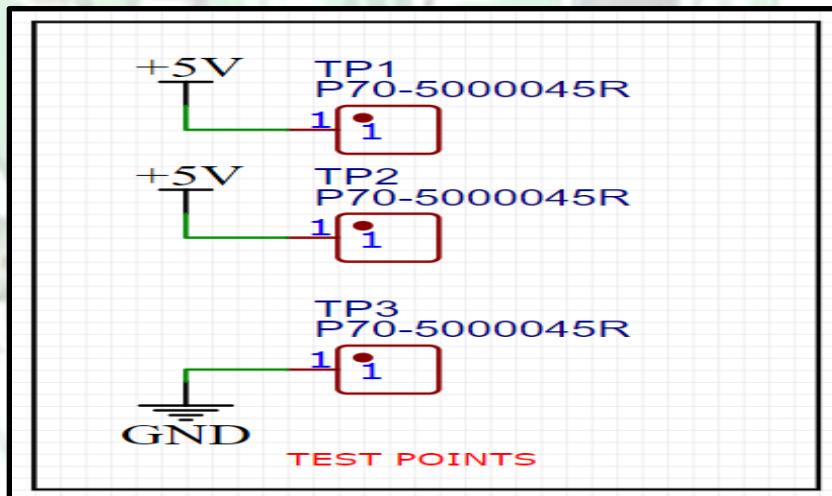
- **Schematic of Voltage Divider:**



- ✓ A voltage divider is a basic circuit used to produce a fraction of an input voltage as an output.
- ✓ It consists of two resistors connected in series across a voltage source. The output voltage is taken from the connection between the two resistors.

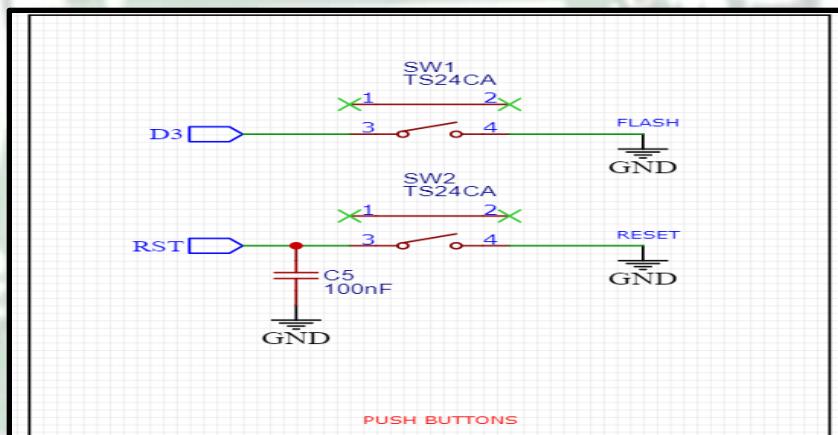
- ✓ Voltage dividers are commonly used in electronic circuits for various purposes, including biasing transistors, setting reference voltages, level shifting, and providing feedback in amplifier circuits.

- **Schematic of Test Points:**



- ✓ In software testing, a test point refers to a specific condition or situation that is tested during the execution of test cases.
- ✓ Test points can be derived from requirements, user stories, or other sources of specifications.
- ✓ In electronics and circuitry, a test point is a designated location on a printed circuit board (PCB) where test probes or instruments can be connected to measure voltages, currents, or signals.
- ✓ Test points are often marked on the PCB to facilitate testing during manufacturing, troubleshooting, or quality assurance processes.

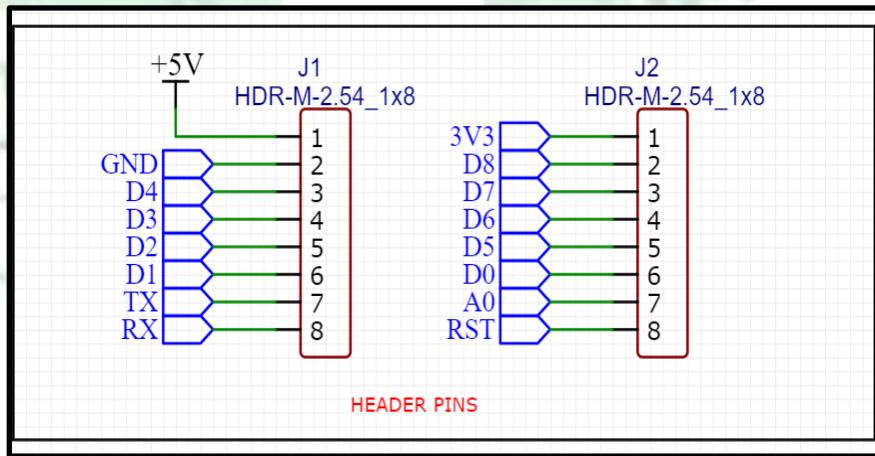
- **Schematic of Push Buttons:**



- ✓ Push buttons, also known as tactile switches or momentary switches, are switches that only make contact when they are pressed.

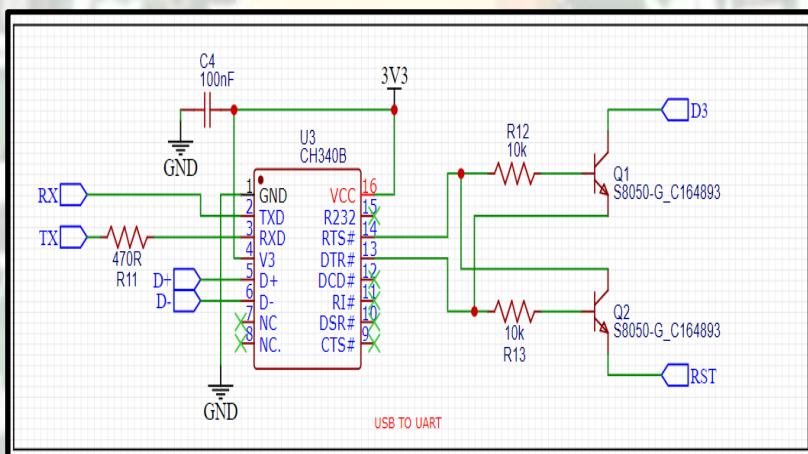
- ✓ Push buttons are used in a wide range of electronic devices for various purposes, including power on/off, resetting, triggering actions, user interface controls, and more.
 - ✓ Flash memory is a type of non-volatile computer storage medium that can be electrically erased and reprogrammed.
 - ✓ Flash memory is used for data storage in a wide range of consumer electronics, industrial applications, and embedded systems.

- **Schematic of Header Pins:**



- ✓ Header pins are small, usually metallic connectors commonly used in electronics to connect two circuit boards or electronic components together.
 - ✓ Header pins come in various pin counts, ranging from 2 to 40 pins or more, depending on the application.
 - ✓ The pitch refers to the distance between the centers of adjacent pins. Common pitches include 2.54 mm (0.1 inches), 2.0 mm, and 1.27 mm.
 - ✓ Header pins are typically made from metals like brass or phosphor bronze, which offer good conductivity and durability.

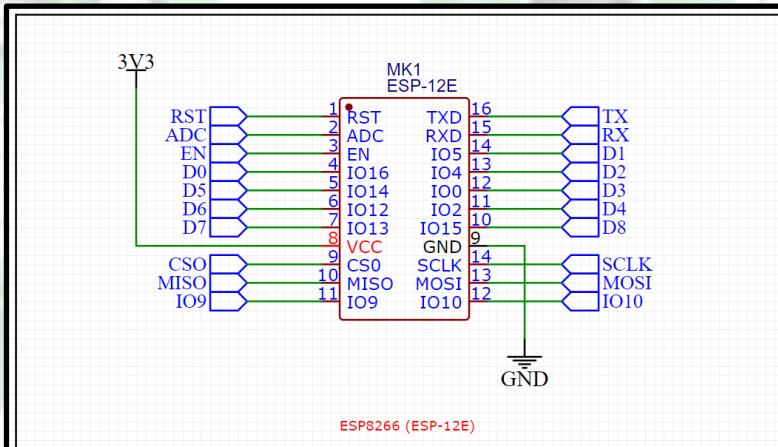
- **Schematic of USB to UART:**



- ✓ USB to UART (Universal Asynchronous Receiver/Transmitter) adapters are commonly used to connect devices with UART interfaces to computers via USB ports.

- ✓ USB to UART adapters convert USB signals to serial UART signals and vice versa.
- ✓ Most USB to UART adapters require drivers to be installed on the computer to enable communication.
- ✓ USB to UART adapters support different baud rates, which determine the speed of communication between the computer and the connected device.

- **Schematic of ESP8266:**



- ✓ The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability, produced by Espressif Systems, a company based in Shanghai, China.
- ✓ It gained immense popularity among hobbyists, makers, and IoT (Internet of Things) developers due to its affordability, ease of use, and robust features.
- ✓ Along with Wi-Fi capabilities, the ESP8266 also features a powerful microcontroller unit (MCU) based on the Tensilica Xtensa LX106 architecture.
- ✓ One of the standout features of the ESP8266 is its low cost, which makes it accessible for hobbyists, students, and small-scale projects.

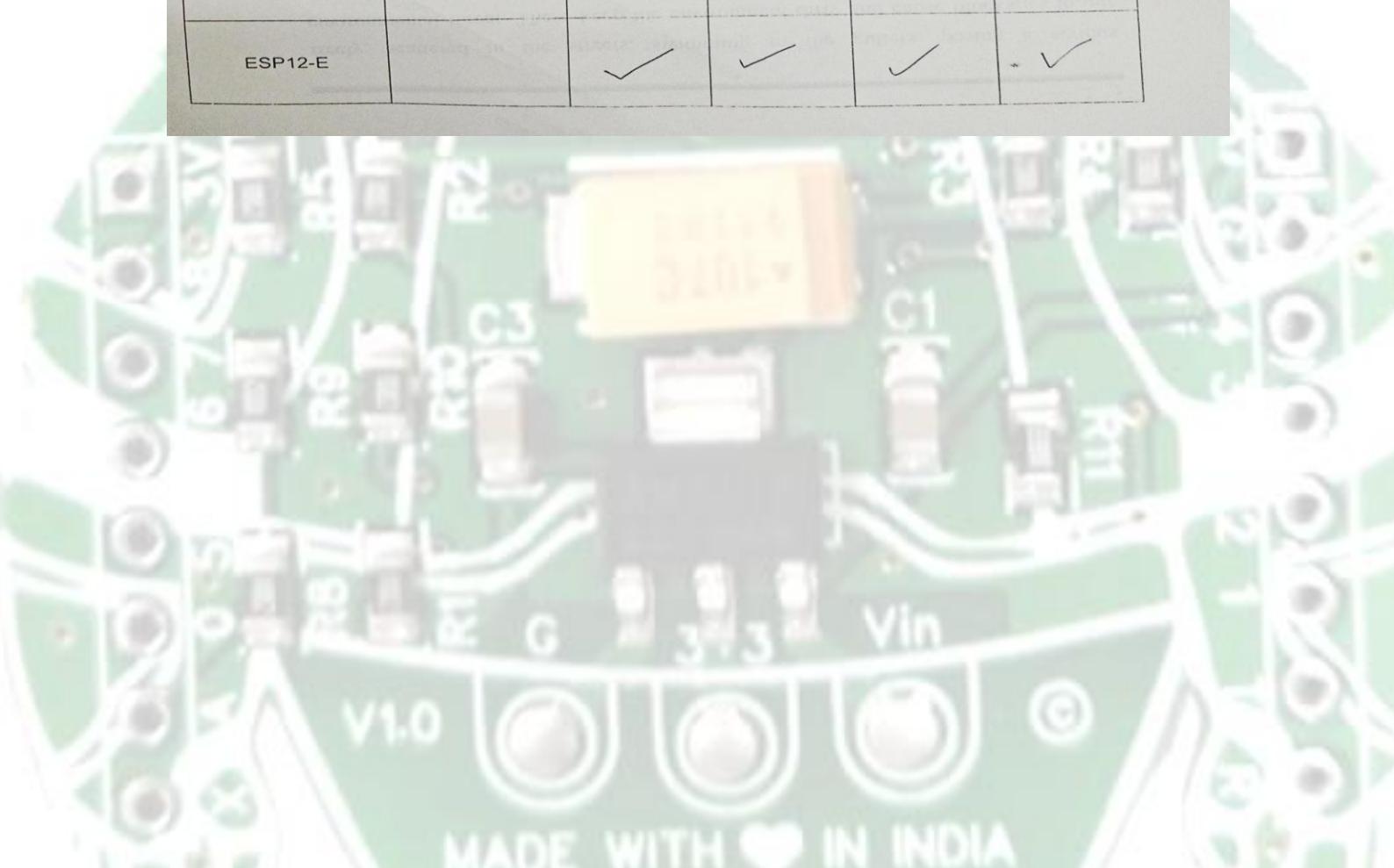
DAY 3 - PCB TESTING

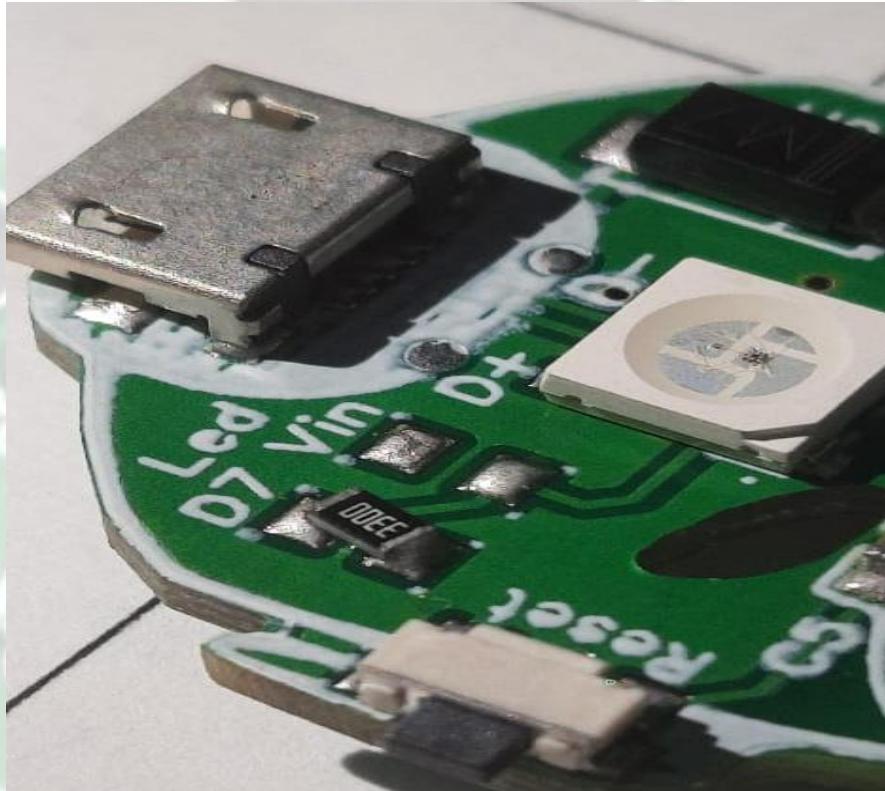
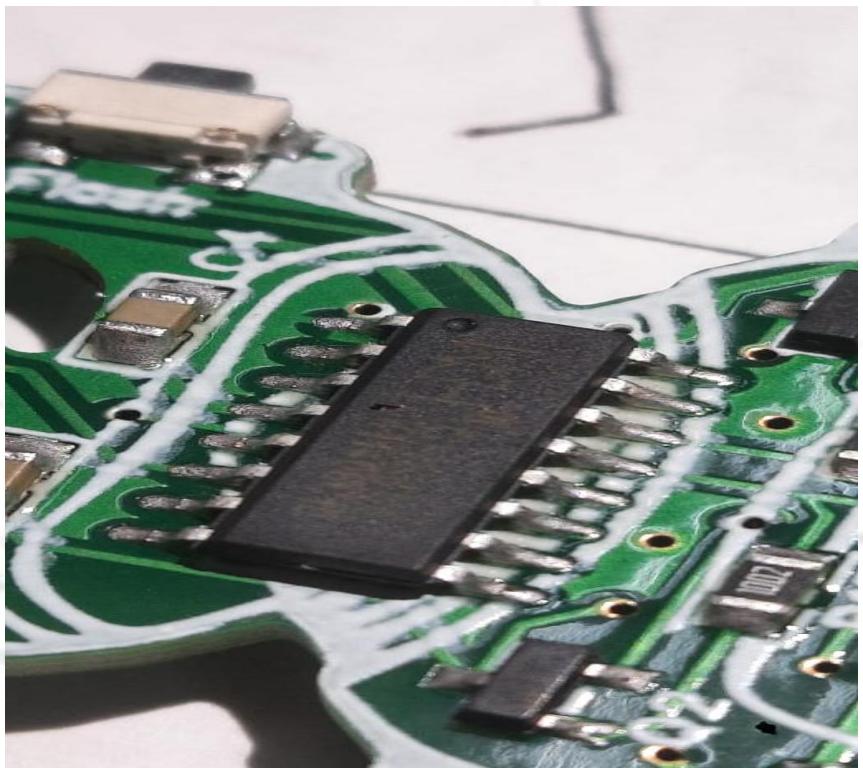
- **Visual Inspection:**

- ✓ Visual inspection is a method commonly used for quality control, data acquisition, and analysis.
- ✓ It involves inspecting equipment and structures.
- ✓ In this we can check each and every components either its soldered or not.

Visual Inspection

component	Shorting/ Issue	Visual inspection done			
		Vaishnavi	Nikita	Tejaswi	Sachin.
All components orientation		✓	✓	✓	✓
Solder quantity (All Components)		✓	✓	✓	✓
USB connector	not properly set shorted	✓	✗	✗	✗
IC	first & last pin is not soldered	✗	✗	✓	✓
Voltage Regulator	Last pin is not soldered	✗	✓	✓	✓
Switches	S2 is not soldered pro.	✗	✓	✗	✓
Diode		✓	✓	✓	✓
LED		✓	✓	✓	✓
All Resistors	R4 is not set properly shorted	R7 is not properly soldered	✗	✗	R7 ✗
All Capacitors		✓	✓	✓	✓
ESP12-E		✓	✓	✓	✓



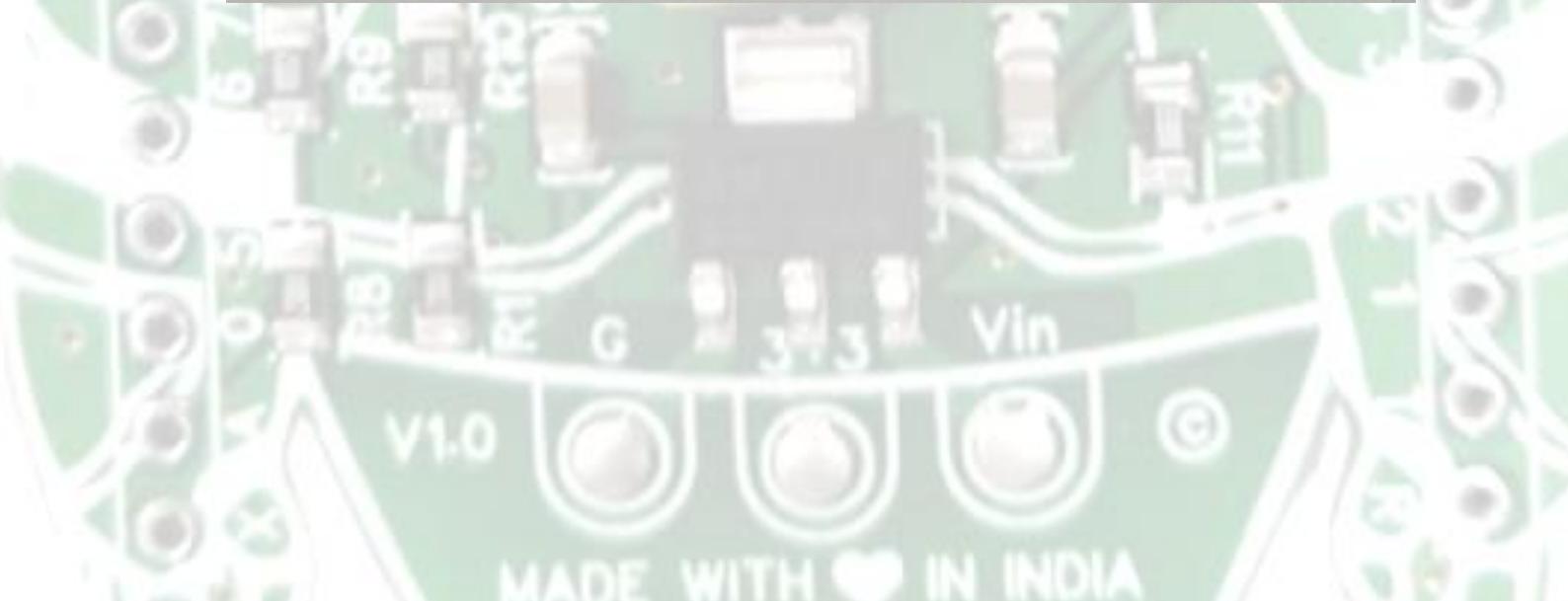


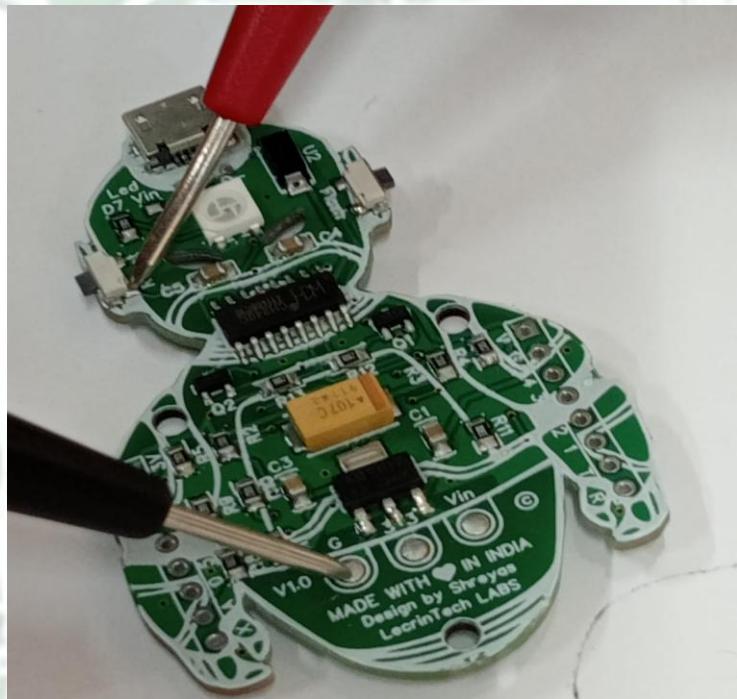
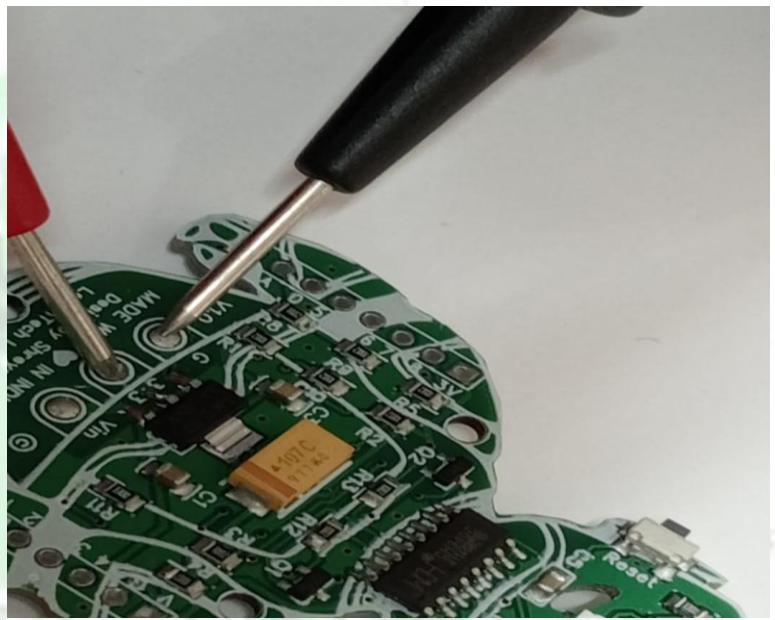
- **Cold testing:**

- ✓ Cold testing, also known as temperature testing or thermal cycling, is a crucial process in the quality assurance of Printed Circuit Boards(PCBs).
- ✓ It's important for Reliability Assessment, Identifying Weaknesses, Quality Assurance.

Cold Testing		
component	Shorting	OK
3.3 wrt GND	✓	Resolved
Vin wrt GND		✓
3.3 wrt Vin		✓
D+, D- wrt GND		✓
D+ wrt D-		✓
LED wrt GND		✓
switches wrt GND		✓

cold Testing done .

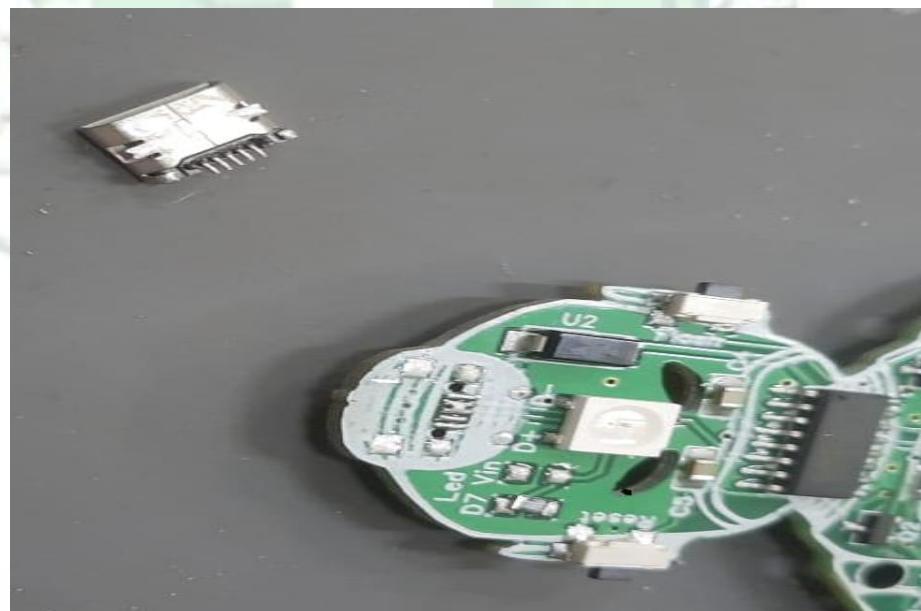




- **Hot Testing:**

- ✓ Hot testing, also known as thermal testing or thermal cycling, hot testing is essential for evaluating the reliability, durability, and performance of electronic components and systems under elevated temperature conditions.
- ✓ It helps manufacturers identify weaknesses, improve product quality, and ensure compliance with industry standards and regulations.

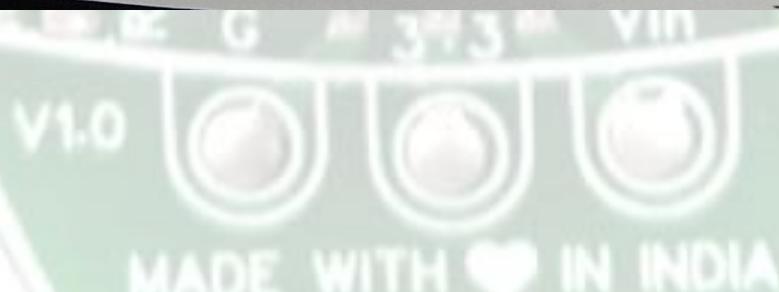
Before hot test



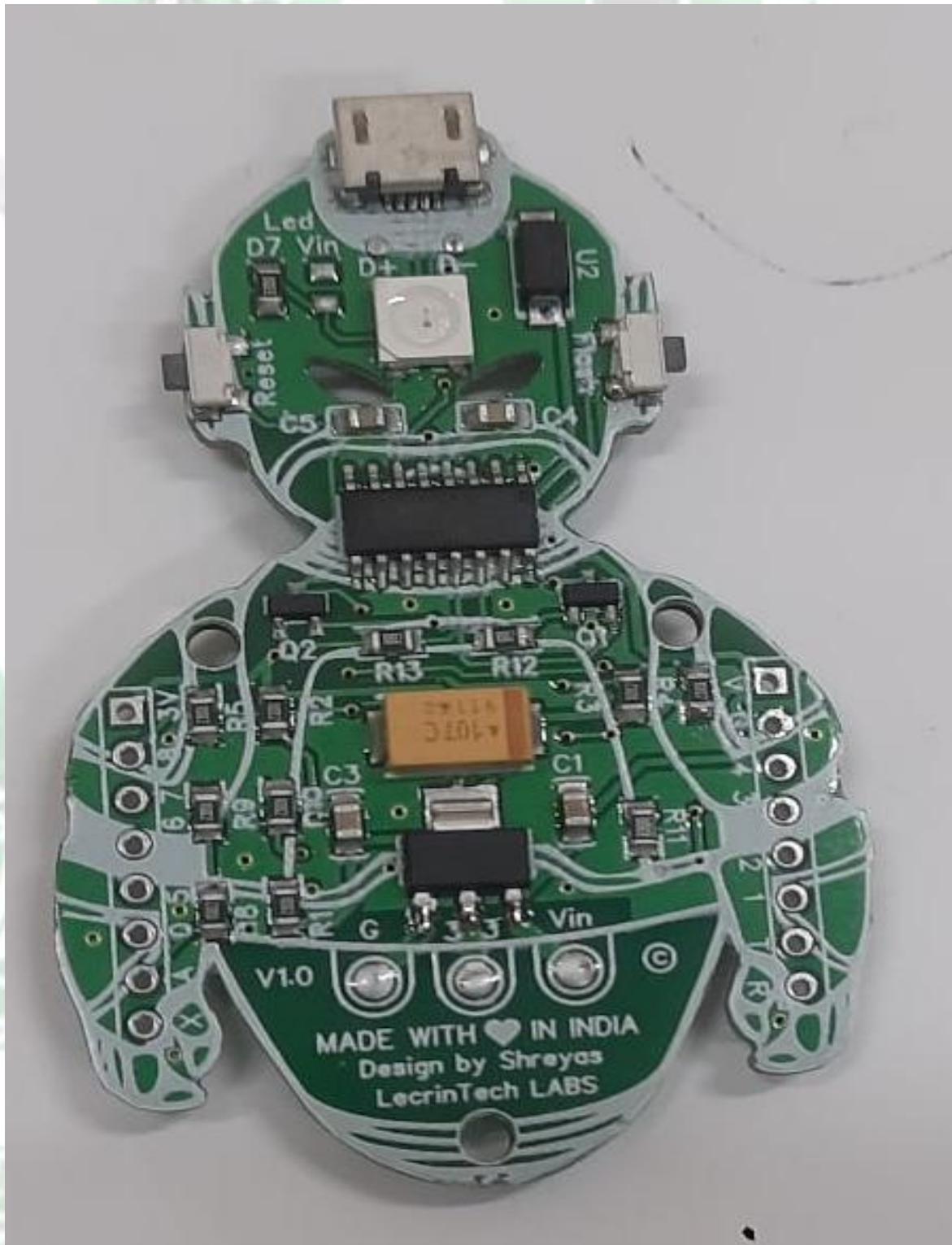
Hot Testing

component	voltage	OK
Vin wrt GND	5v	4.25 V
3.3 wrt GND	3.3v	3.27 V

Hot Testing is Done

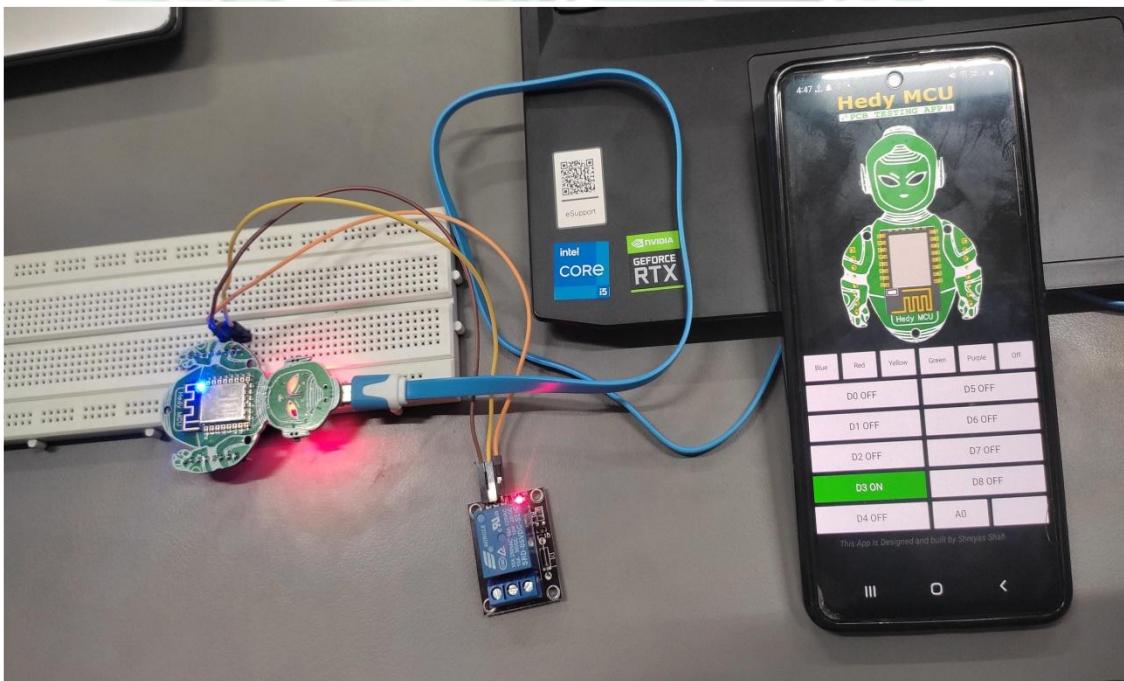


- **FINAL RESULT AS BELOW AFTER COMPLETING THE BOTH OF PROCESS:**



DAY 4- MINI PROJECT

HEDYMCU BASED DIGITAL AGRICULTURAL PUMP CONTROLLER



- Remotely controlled agricultural pumps can be a low-cost solution that helps farmers avoid long-distance travel to pump sites.
- They can also help farmers avoid having to stay on site for long periods of time to turn off the pump when irrigation is complete.
- Remotely controlled pumps can be controlled and monitored using a mobile phone or smartphone.
- Allow the farmer to forcefully turn on the pump by sending an ON message to the controller

➤ Components Used:

- ✓ HedyMCU ESP8266
- ✓ Breadboard
- ✓ Relay Control
- ✓ Male to Female Jumper Wires
- ✓ Type-A USB Cable
- ✓ LED

➤ **Code :**

```
#include <ESP8266WiFi.h>
const char WiFiPassword[] = "namune456";
const char AP_NameChar[] = "Water pump";

WiFiServer server(80);

String request = "";

int PUMP = D3;

#include <FastLED.h>
#define LED_PIN      D7
#define NUM_LEDS     4 //1
#define BRIGHTNESS   200
#define LED_TYPE     WS2812B
#define COLOR_ORDER  GRB
CRGB leds[NUM_LEDS];

void setup()
{
    Serial.begin(115200);
    pinMode(PUMP, OUTPUT);

    WiFi.disconnect();
    boolean conn = WiFi.softAP(AP_NameChar, WiFiPassword);
    server.begin();

    FastLED.addLeds<LED_TYPE, LED_PIN, COLOR_ORDER>(leds,
NUM_LEDS).setCorrection( TypicalLEDStrip );
    FastLED.setBrightness( BRIGHTNESS );

}

void loop()
{
    // Check if a client has connected
    WiFiClient client = server.available();
    if (!client) {
        return;
    }

    // Read the first line of the request
    request = client.readStringUntil('\r');
```

```
if( request.indexOf("D3HIGH") > 0 )
{
    digitalWrite(PUMP, HIGH);
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
    Serial.println("Pump ON");
}
if ( request.indexOf("D3LOW") > 0 )
{
    digitalWrite(PUMP, LOW);
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
    Serial.println("Pump OFF");
}
///////////////////////////////
```

```
//////////leds//////////
```

```
if ( request.indexOf("BLUE") > 0 )
{
    leds[0] =CRGB::Blue;
    FastLED.show();
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
}
if ( request.indexOf("RED") > 0 )
{
    leds[0] =CRGB::Red;
    FastLED.show();
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
}
if ( request.indexOf("GREEN") > 0 )
{
    leds[0] =CRGB::Green;
    FastLED.show();
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
}
if ( request.indexOf("YELLOW") > 0 )
{
    leds[0] =CRGB::Yellow;
    FastLED.show();
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
}
```

```

if  ( request.indexOf("PURPLE") > 0 )
{
    leds[0] =CRGB::Purple;
    FastLED.show();
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
}
if  ( request.indexOf("OFF") > 0 )
{
    leds[0] =CRGB::Black;
    FastLED.show();
    client.println("HTTP/1.1 200 OK\r\n");
    client.flush();
}

delay(5);

}

```

➤ Output:

