Electronic Devices and Circuits (EE-215)

DE-43 Mechatronics

Syndicate – A

Project Report

Four Way Traffic Light Control System

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Contents

Abstract:

In this project, We have made a four way traffic light control system using 555 timer ic, counter IC, BJTs, resistors, diodes and LEDS. The circuit is fist assembled on bread board And Proteus is used for simulation of the circuit. PCB design is also made on Proteus. Finally Finished PCB is made after printing, etching process and soldering of final PCB circuit. In the end a working four way traffic light control system PCB circuit is made.

Introduction:

Traffic Light Systems are used to regulate vehicle traffic on public roads and streets. They are required for smooth traffic flow in order to avoid traffic congestion and accidents.

The traffic signal has three lights, each with a distinct message for vehicles. The red light instructs the vehicle to yield at the junction, the green light grants the motorist free passage at the intersection, and the yellow light instructs the driver to wait if the next light is red or to be ready to proceed / start the engine if the next light is green. Traffic lights have shown to be an incredible technique to prevent vehicular crashes, reduce traffic bottlenecks, and direct traffic in smooth lanes.

Working Principle:

To regulate the switching of traffic lights, a 4-way traffic control system circuit may be created utilizing transistors. Here is a simple example of how such a circuit would function:

1. Basic Circuit Setup: It consists of four sets of traffic lights, one for each approach at the junction. Each set usually consists of three lights: red, yellow, and green. A sufficient power supply powers the circuit.
2. Transistor Switching: Transistors are employed as switches to regulate the flow of electricity to traffic lights. This may be accomplished with NPN transistors.
3. Signal Timing: A timing mechanism, such as a timer or a microcontroller, controls the timing of the traffic lights by generating suitable control signals for the transistors. The timing system guarantees that the traffic lights turn on and off at regular intervals. Output of 555 timer IC is giving the clock input for 4017 Counter IC
4. Control Signals: Output of Counter IC which are control signals are linked to the transistors' base terminals. When a control signal is active, current flows via the transistor's collector-emitter channel, powering the associated traffic light.
5. Right-of-Way Control: The timing mechanism is configured to send the proper control signals to allow the right-of-way for each approach. For example, one approach may be given a green light while the other approaches are given red signals, suggesting that they should stop or surrender.

6. Synchronization: To coordinate traffic flow, the timing system guarantees that traffic lights are switched in a synchronized way. The time intervals can be changed based on the desired traffic patterns and congestion levels.

Discussion:

1. Basic Construction Design:

This traffic light circuit is built around a counter IC, which is commonly used in sequential circuits where the numbers in the series are counted. This is referred to as a sequential traffic signal system.

The primary IC in the traffic lights control circuit is a 4017 counter IC, which is used to light the Red, Yellow, and Green LEDs, respectively. The 555 timer serves as a pulse generator, sending pulses to the 4017 counter IC.

The glowing time of various LED lights is completely dependent on the 555 timer's pulse, which we can regulate via the potentiometer, so if you want to adjust the time of glow for a specific LED, you can do so by varying the potentiometer, which is used to manage the timing duration setting.

Because the LEDs are not directly linked to the 4017 counter, the lights will not be steady all of the time. As a result, we employed a mix of 1N4148 diodes and LEDs to provide the necessary output illumination signals.

2. Hardware:

- C945 Transistor
- 4017 Counter IC
- 4148 Diodes
- Multiple LEDs (Red, Yellow, Green, Blue)
- 100 µF Capacitor
- 100 kΩ Variable Resistor (Potentiometer)
- 10 kΩ Resistors
- 1 kΩ Resistors
- 100 Ω Resistors
- Battery 9V
- PCB sheet double side
- $FeCl_3$ solution

- **C945 Transistor:**

  C945 BJT is often used in electrical circuits that require a high-speed, low-current transistor composed of three semiconductor regions: emitter, base, and collector. Because the C-945 is a bipolar junction transistor, its base is doped with positive or P-type semiconducting material.

Fig. 1: C945 Transistor

- **4017 Counter IC:**
  The CD4017 IC is a ten-digit decade counter. It has ten outputs that correspond to the numbers 0 through 9. Every rising clock pulse adds one to the counter. When the counter reaches 9, the next clock pulse resets it to zero.

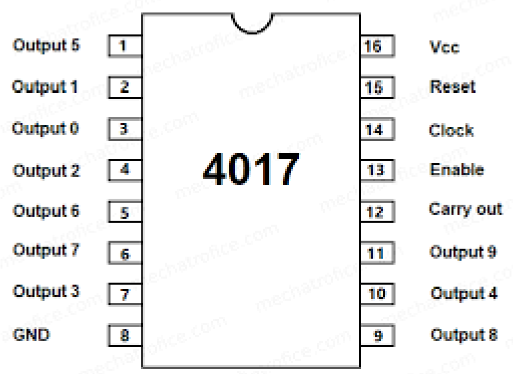

Fig. 2: Pin Layout of 4017 Counter IC

- **4148 Diodes:**
  The 1N4148 is a common silicon switching signal diode. Because of its consistent specs and inexpensive cost, it is one of the most popular and long-lasting switching diodes. The 1N4148 is suitable for switching applications up to 100 MHz, with a reverse recovery time of no more than 4 ns.

Fig. 3: A standard 1N4148 diode

3. Software:

We used Proteus for making the circuit and the simulation as well as the PCB design.

4. Circuit on Breadboard:

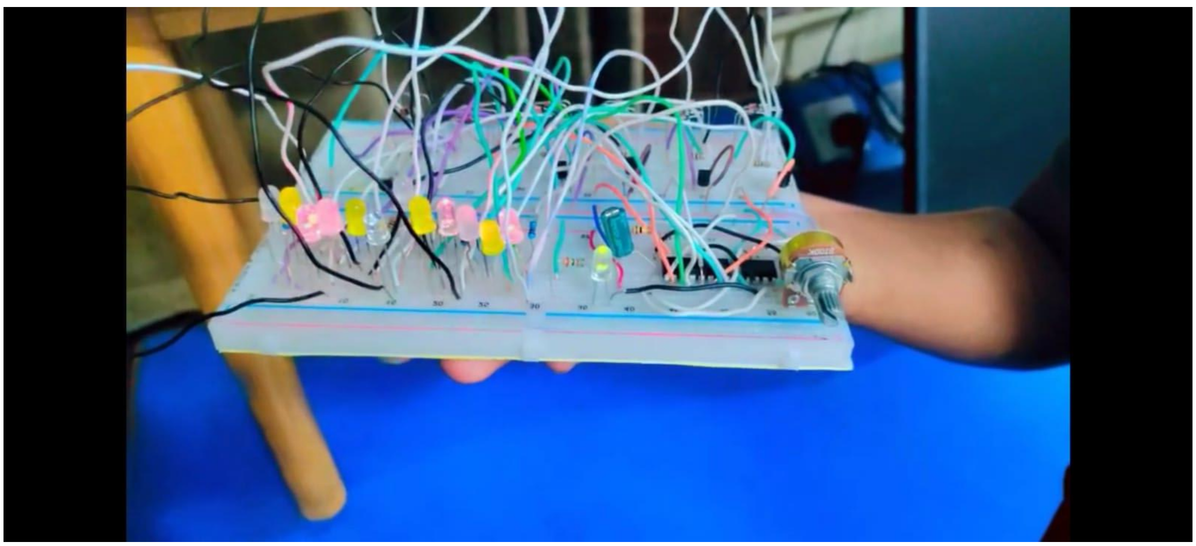

Fig. 4: Circuit on Breadboard

5. Schematics:

We created our final circuit on Proteus and ran the simulation for testing. Below is the picture of the complete circuit made in Proteus.

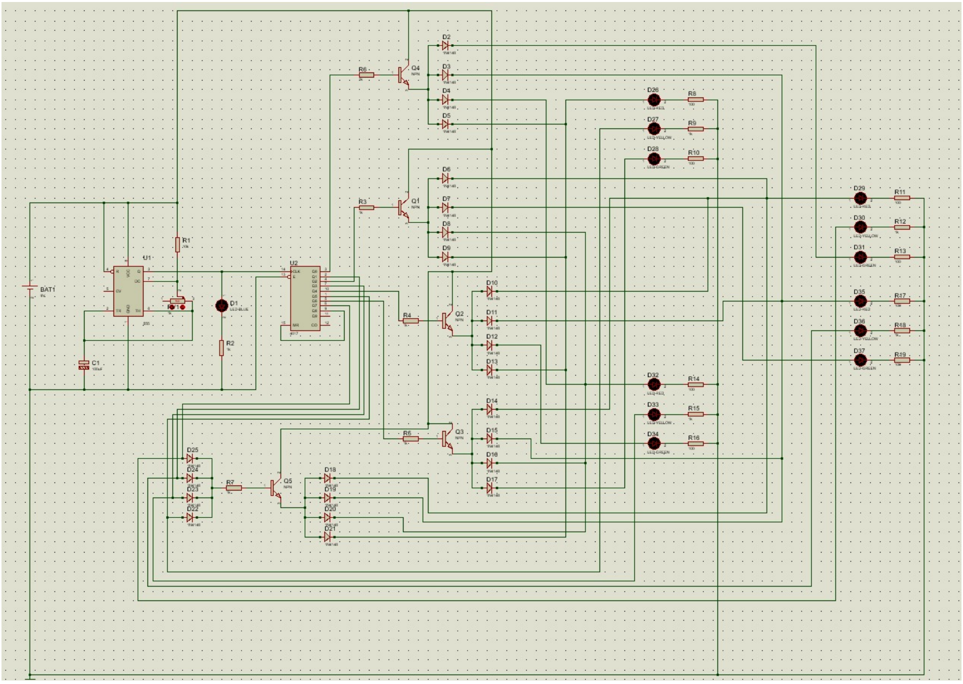

Fig. 5: Circuit Design in Proteus

6. PCB Design:

The PCB layout was created using Proteus and our circuits. After creating the layout, we printed it on butter paper and then glued and ironed it onto the PCB. After that, we immersed the PCB in $FeCl_3$ solution and etched it. Then we drilled holes on the PCB before inserting our components and soldered them together. Figure below depicts the PCB layout.

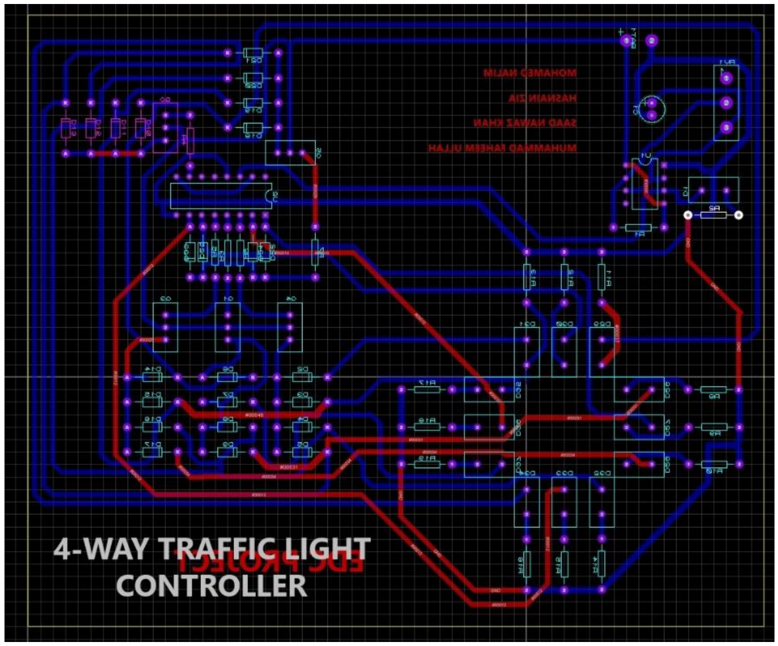

Fig. 6: PCB Circuit Design

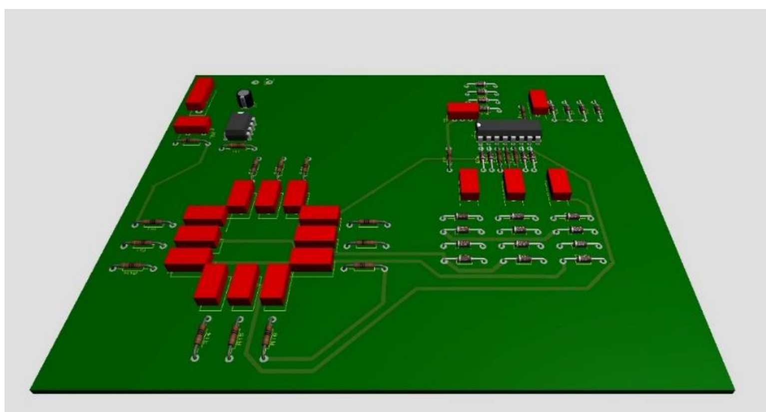

Fig. 7: Top Side of 3D PCB

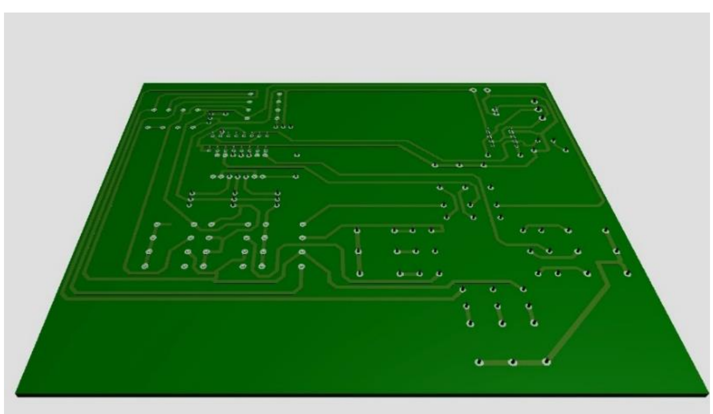

Fig. 8: Bottom Side of 3D PCB

Practical Circuit:

After the PCB was ready, we installed our components on it and soldered them together to finish our project.

Fig. 9: Top Side of finished PCB

Fig. 10: Bottom Side of finished PCB

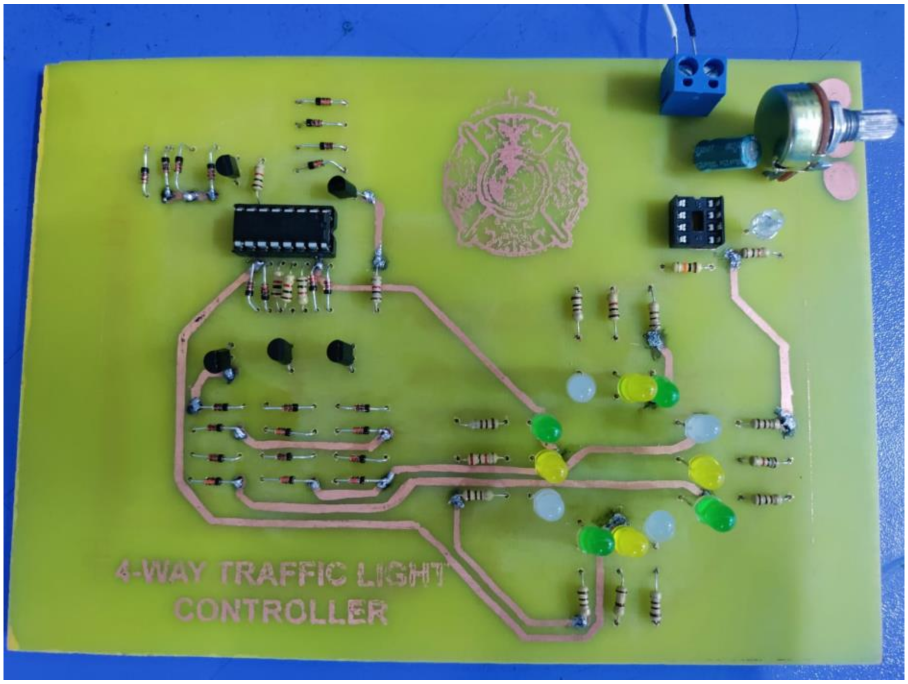

Fig. 11: Final view of PCB with components attached

Conclusion:

The circuit is fist assembled on bread board And Proteus is used for simulation of the circuit. PCB design is also made on Proteus. Finally Finished PCB is made after printing, etching process and soldering of final PCB circuit. In the end a working four way traffic light control system PCB circuit is made.

References:

[1] https://www.electricaltechnology.org/2014/10/traffic-light-control-electronic-project.html

[2] https://youtu.be/nAykBXr1IH0