ADDIS ABABA SCIENCE AND TECHNOLOGY UNVERSITY

COLLEGE OF ELECTRICAL AND MECHANICAL ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Course Name: ***Digital Logic Design (DLD)***

Project Title: ***Traffic Light Sequence Controller***

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Contents

1. Description of Project

In this project we want to design a traffic light controller system. In our day to day life we use traffic lights so traffic lights are the basic element in transport.

2. The working principle of the Traffic Light Control System

In the traffic light control system, the main controller, control circuit, counter, timer, decoder, clock signal generator, decoder drive circuit and digital display decoder drive circuit are needed to complete the whole process of controlling the traffic light.

The second pulse generator is the standard clock signal source of timer and controller in the system. The decoder outputs the control signals of two sets of traffic lights, which drive the traffic lights to work after passing through the driving circuit, namely controlling the change of green traffic light, red light signal and yellow traffic light; The controller is the main part of the system, which controls the work of timer and decoder.

And then the signals are passed by the clock signal generator to the main control circuit and counter, and then from counter to the decoder, finally revealed on the display. After the background is told the specific situations, signals are passed back to the main control circuit, and passed on to the traffic lights through the decoder, which are respectively displayed in the traffic lights on the main road and the secondary road.

However, according to different regional environments, the installation specifications and control system operating principles of the traffic light are also different. In particular, in the traffic light control system, the time and passage settings of traffic lights at different intersections in different regional environments are also different.

Sequential Circuits are used to count the numbers in the series. Coming to the working principle of Traffic Lights, the main IC is **4017 counter IC** which is used to glow the Red, yellow and green LED respectively. 555 timer acts as a pulse generator providing an input to the 4017 counter IC.

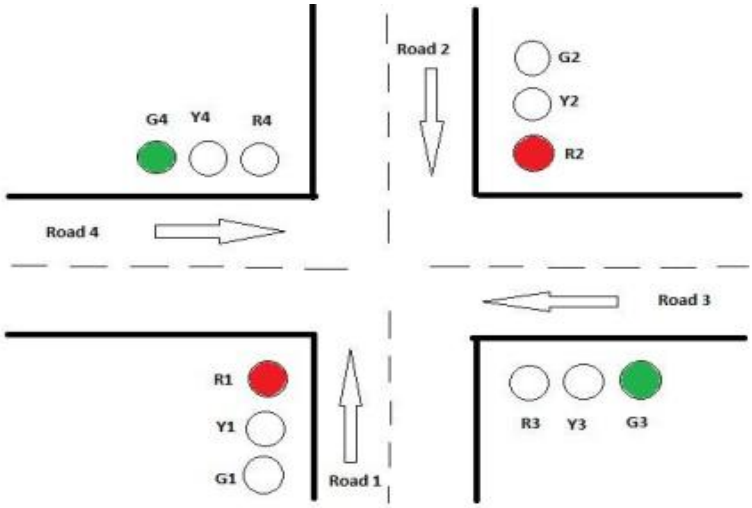


Figure 1: Traffic light controller with four ways

3. Component selection

Component	**Value**	**Price(**ETB**)**
CD4017BE counter IC	81977	75
Resistor	1k and 220Ω	5
Capacitor	10µF	5
Battery	9 V	150
NE555P timer		40
2 OR gate IC	7432	150
LED light	4 green, 4 yellow , 4 red	80
PCB board		100
Jumper wire		20
Total = 615 ETB		

3.1 CD4017BE Counter IC

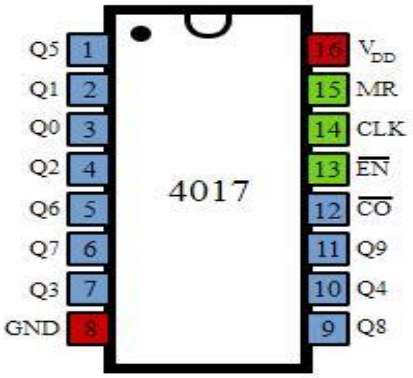


Figure 2: 4017 IC counter

It has 16 pins and the functionality of each pin is explained as follows:

- **Pin-1:** It is the output 5. It goes high when the counter reads 5 counts.
- **Pin-2:** It is the output 1. It goes high when the counter reads 0 counts.
- **Pin-3:** It is the output 0. It goes high when the counter reads 0 counts.
- **Pin-4:** It is the output 2. It goes high when the counter reads 2 counts.
- **Pin-5:** It is the output 6. It goes high when the counter reads 6 counts.
- **Pin-6:** It is the output 7. It goes high when the counter reads 7 counts.
- **Pin-7:** It is the output 3. It goes high when the counter reads 3 counts.
- **Pin-8:** It is the Ground pin that should be connected to a LOW voltage (0V).
- **Pin-9:** It is the output 8. It goes high when the counter reads 8 counts.
- **Pin-10:** It is the output 4. It goes high when the counter reads 4 counts.
- **Pin-11:** It is the output 9. It goes high when the counter reads 9 counts.
- **Pin-12:** This is divided by 10 output which is used to cascade the IC with another counter to enable counting greater than the range supported by a single IC 4017.
- **Pin-13:** This pin is the disabled pin. In the normal mode of operation, this is connected to ground or logic LOW voltage.
- **Pin-14:** This pin is the clock input. This is the pin from where we need to give the input clock pulses to the IC to advance the count. The count advances on the rising edge of the clock.
- **Pin-15:** This is the reset pin that should be kept LOW for normal operation. If you need to reset the IC, then you can connect this pin to HIGH voltage.

- **Pin-16:** This is the power supply (Vcc) pin. This should be given a HIGH voltage of 3V to 15V for the IC to function.

Application of CD4017BE Counter IC

- The most popular IC like CD4017 is extensively used in different applications which includes Decoder, Binary counter, Frequency division, Decade counter, etc.

- This IC is used in counting applications which can switch ON 10 outputs in sequence within a fixed time & reset the count otherwise hold it once necessary. It also indicates the counting status through the Carry pin that is used in LED chasers as well as other logical output projects.

3.2 NE 555P Timer

The 555 timer IC is an integrated circuit (chip) used in a variety of timer, delay, pulse generation, and oscillator applications. Derivatives provide two (556) or four (558) timing circuits in one package. Since then, numerous companies have made the original bipolar timers, as well as similar low-power CMOS timers. In 2017, it was said that over a billion 555 timers are produced annually by some estimates, and that the design was "probably the most popular integrated circuit ever made".

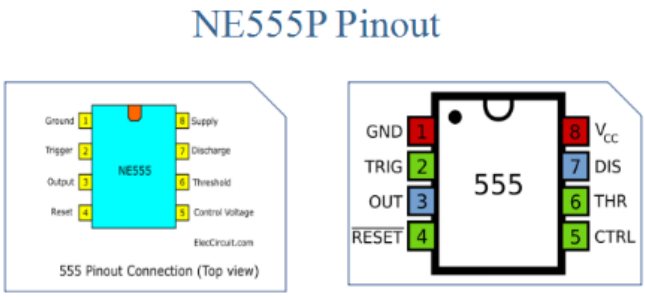


Figure 3: NE555P timer

- **Pin 1.** – **Ground**, The ground pin connects the 555 timer to the negative (0v) supply rail.
- **Pin 2.** – **Trigger**, The negative input to comparator No 1. A negative pulse on this pin "sets" the internal Flip-flop when the voltage drops below 1/3Vcc causing the output to switch from "LOW" to a "HIGH" state.

- **Pin 3.** – **Output**, The output pin can drive any TTL circuit and is capable of sourcing or sinking up to 200mA of current at an output voltage equal to approximately Vcc – 1.5V so small speakers, LEDs or motors can be connected directly to the output.
- **Pin 4.** – **Reset**, This pin is used to "reset" the internal Flip-flop controlling the state of the output, pin 3. This is an active-low input and is generally connected to a logic "1" level when not used to prevent any unwanted resetting of the output.
- **Pin 5.** – **Control Voltage**, This pin controls the timing of the 555 by overriding the 2/3Vcc level of the voltage divider network. By applying a voltage to this pin the width of the output signal can be varied independently of the RC timing network. When not used it is connected to ground via a 10nF capacitor to eliminate any noise.
- **Pin 6.** – **Threshold**, The positive input to comparator No 2. This pin is used to reset the Flip-flop when the voltage applied to it exceeds 2/3Vcc causing the output to switch from "HIGH" to "LOW" state. This pin connects directly to the RC timing circuit.
- **Pin 7.** – **Discharge**, The discharge pin is connected directly to the Collector of an internal PN transistor which is used to "discharge" the timing capacitor to ground when the output at pin 3 switches "LOW".
- **Pin 8.** – **Supply +Vcc**, This is the power supply pin and for general purpose TTL 555 timers is between 4.5V and 15V.

4. Truth Table

4.1 3-Bit Counter (0-5)

Q2	Q1	Q0	J2	K2	J1	K1	J0	K0
0	0	0	0	X	0	X	1	X
0	0	1	0	X	1	X	X	1
0	1	0	0	X	X	0	1	X
0	1	1	1	X	X	1	X	1
1	0	0	X	0	0	X	1	X
1	0	1	X	1	0	X	X	1

- J2 = Q0Q1
- K2 = Q0
- J1 = Q0
- K1 = Q0
- J0 = 1(High)
- K0 = 1(High)

4.2 4-Bit Counter (0-9)

Q3	Q2	Q1	Q0	J3	K3	J2	K2	J1	K1	J0	K0
0	0	0	0	0	X	0	X	0	X	1	X
0	0	0	1	0	X	0	X	1	X	X	1
0	0	1	0	0	X	0	X	X	0	1	X
0	0	1	1	0	X	1	X	X	1	X	1
0	1	0	0	0	X	X	0	0	X	1	X
0	1	0	1	0	X	X	0	1	X	X	1
0	1	1	0	0	X	X	0	X	0	1	X
0	1	1	1	1	X	X	1	X	1	X	1
1	0	0	0	X	0	0	X	0	X	1	X
1	0	0	1	X	1	0	X	0	X	X	1

- J3 = Q1Q2Q0
- K3 = Q0
- J2 = Q1Q0
- K2 = Q1Q0
- J1 =Q3’Q1
- K1 = Q0
- J0 = Q0’
- K0 = Q0

5. Circuit Diagram

Our original design was built using clock, the sequential digital circuit (JK Flip-flop) to make counter that counts from 0 up to 59 and combinational digital circuit to connect the output of the counter with the LEDs.

But the JK Flip-flop and clock (pulse generator) was unavailable on the market. Therefore, we designed a new traffic light control system using a timer instead of pulse generator and decade counter instead of the counter.

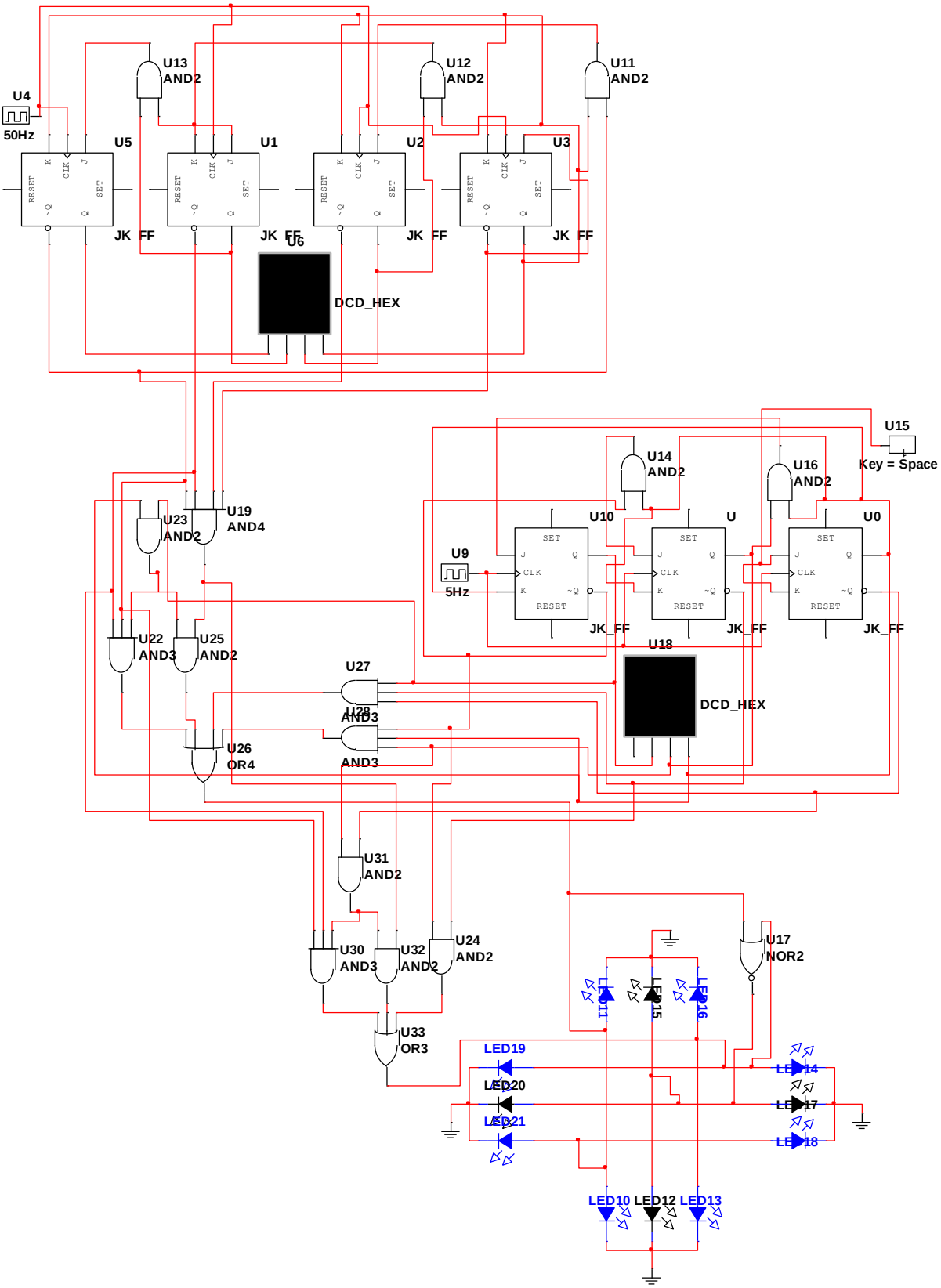


Figure 4: circuit diagram with flip fop

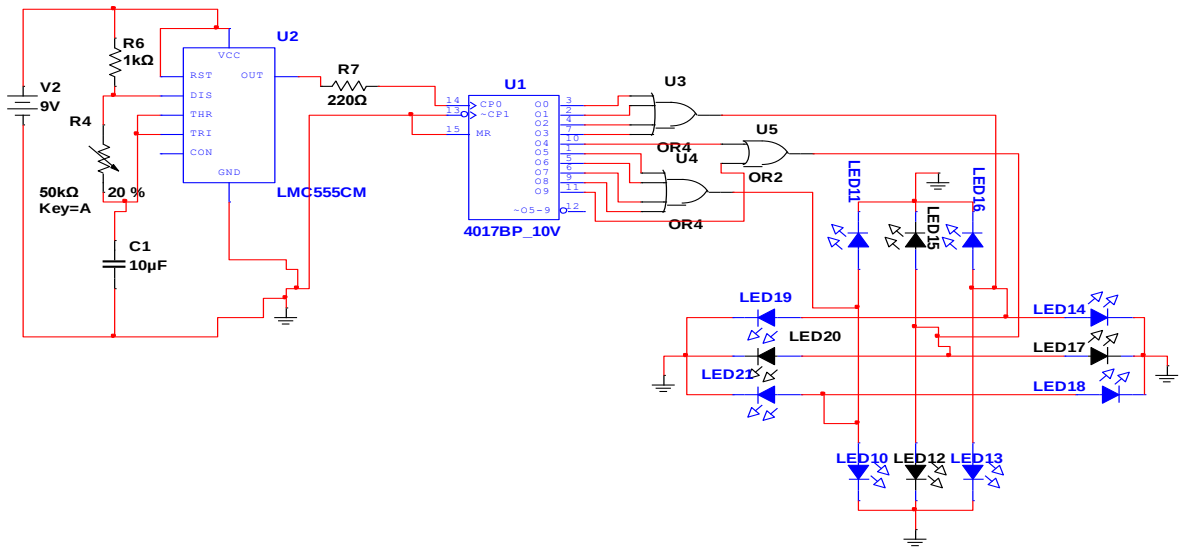
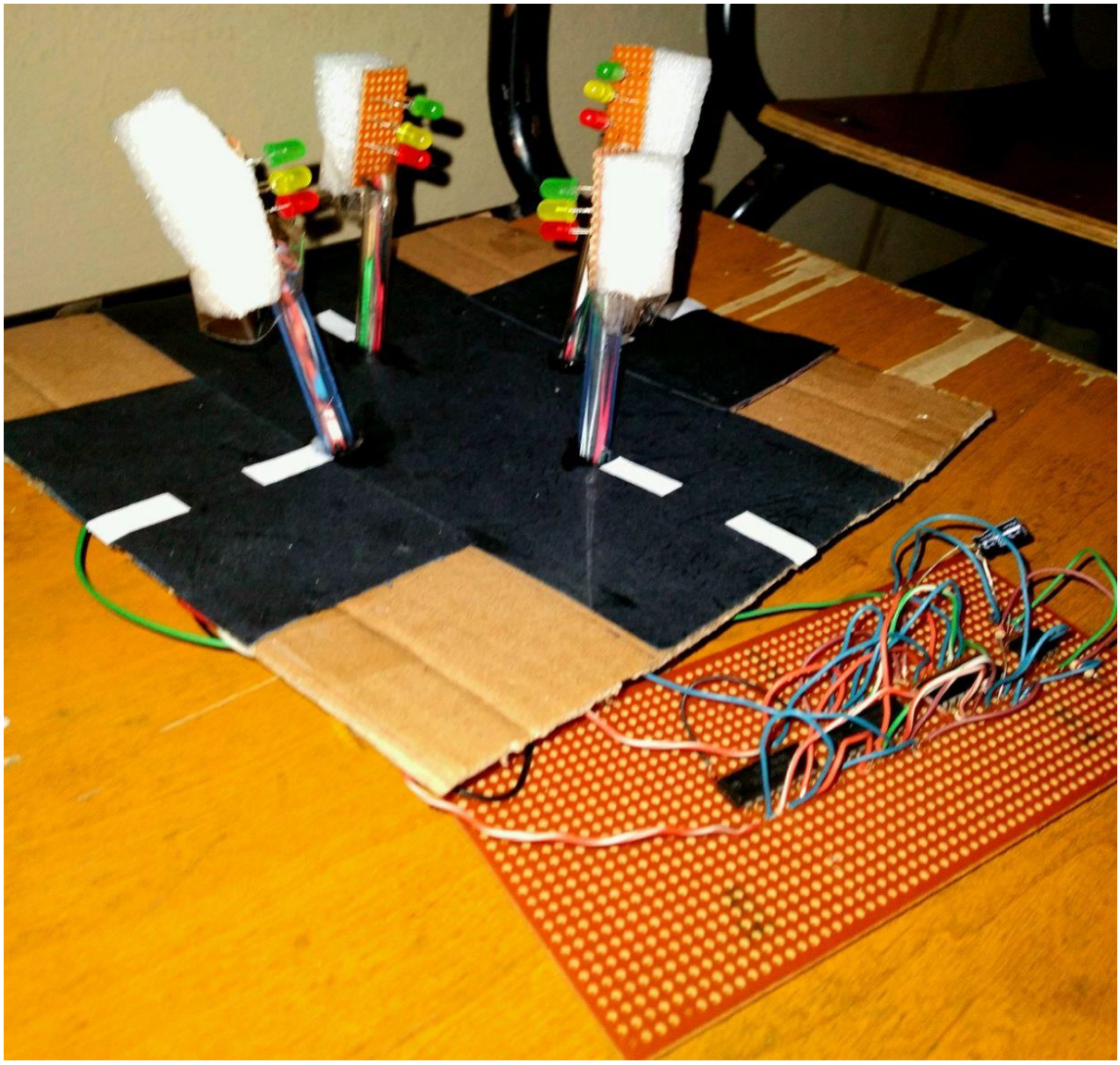


Figure 4: Circuit diagram of traffic light sequence control.



6. Specific Application of Project

The application of our project is to decrease the accident, crowdedness of cars, time wasting and to provide simple and fast traffic light system.

To reduce traffic jam we can take steps such as:

- ✓ Have a good public transport system so people would use it
- ✓ Install modern and good traffic controller system
- ✓ Keep continuous repair and maintenance of traffic controller and signalling system
- ✓ Good traffic system
- ✓ Good lane system
- ✓ Traffic police should do their duty properly
- ✓ Use zebra cross and foot over bridge
- ✓ Respect the law