AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)

Faculty of Engineering

Department of Electrical and Electronic Engineering

DIGITAL LOGIC & CIRCUITS LAB

FALL 2023-2024

Section: L Group: 06

FINAL TERM OEL REPORT ON

TRAFFIC LIGHT CONTROLLER CIRCUIT WITH 555 TIMER ICs

Supervised By

NUZAT NUARY ALAM

Submitted By:

NAME	ID
MD. SHOHANUR RAHMAN SHOHAN	22-46013-1
RUDRO SHINE DATTA	22-46723-1
A. H. M. TANVIR	22-47034-1
ABIR BOKHTIAR	22-47038-1
A. F. M. RAFIUL HASSAN	22-47048-1

American International University-Bangladesh (AIUB)
Department of Electrical and Electronic Engineering
EEE3102: Digital Logic and Circuits Laboratory

Title: Open-Ended Laboratory Experiment on Sequential Logic Circuit Design

Objectives:
Using the information learned regarding different Flip-Flops, Counters, MOSFET logic gates, 555 Timer etc. the students will design a sequential logic circuit using an appropriate circuit design tool.

Equipment:

Hardware components: logic ICs, DC power supply, switches, clock signals, measuring instrument, wires, LEDs, etc.

Task:

Your experiment should be designed.
- To design a sequential logic circuit using various logic ICs to perform some specific tasks.
- To design a clock signal generating circuit for the logic circuit
- To simulate the designed circuit
- To investigate and analyze the different logic operations of the designed sequential logic circuit.
- To comment on the limitations of the designed circuit

Lab Report

Your lab report should include the following sections:

Purpose
This is a summary statement of the work to be accomplished in this experiment. An overall direction for laboratory investigation, the obtained results, and summary of conclusions must be provided.

Equipment
A list of all the apparatus used in the experiment should be included.

Procedures
Explain step-by-step procedures in a numbered sequence so that other learners can comprehend the experiment and be able to reproduce the experiment by reading your procedure.

Results and Data analysis
- Show all the data/results obtained in the experiment in the tabular format and images.
- Analyze data using appropriate graphs, if needed.

Discussions and Conclusions
This section should be based on the information described in the report and is the closure of your report. Any advantages or limitations of the experiment should be included here. Any problems encountered while performing a particular step in the experiment can be mentioned here also.

Marking Rubrics (to be filled by Faculty)

	Objectives	Unsatisfactory (0-1)	Good (2-3)	Excellent (4-5)	Marks
Reports (10)	**Identify experiment goals**	Cannot identify goals	Can identify some goals but unable to draw adequate hypothesis	Can identify necessary and sufficient goals	
	Setup of experiment	Cannot setup experiment without support	Can setup some of the portions of experiment without support	Can setup the whole experiment without support	
	Take organized and accurate measurement	Cannot take measurements	Can take measurements but inaccurately	Can take organized and accurate measurements	
	Summarize findings and compare actual to expected results	Cannot summarize or compare findings to expected results	Summarize finding in an incomplete way	Summarize finding in a complete way	
Demonstration (10)	**Observation 1**	Cannot explain hardware related to the experimental setup	Can answer some of the hardware related questions	Can answer most or all the questions	
	Observation 2	Cannot demonstrate the experimental operation and data collection	Can show some of the experiments	Can answer most or all the operations	
	Observation 3	Unexpected experimental outcome between calculated, simulated, and experimented data	Somewhat unexpected experiment outcome but percentage errors are too high without any specific reason	Accurate data collected from the hardware and simulation and matches with the calculated data, percentage of errors are minimum	
	Observation 4	Can’t draw a conclusion	Somewhat draw a conclusion	Can explain the conclusion	
	Assessed by (Name, Sign, and Date)		**Total:**	**Comments**	

Group Members

Sl #	ID Number	Name	Contribution	Marks in Demonstration	Marks in Report
1.	22-46013-1	MD. SHOHANUR RAHMAN SHOHAN	Procedure		
2.	22-46723-1	RUDRO SHINE DATTA	Hardware		
3.	22-47034-1	A. H. M. TANVIR	Purpose		
4.	22-47038-1	ABIR BOKHTIAR	Simulation		
5.	22-47048-1	A. F. M. RAFIUL HASSAN	Discussion & Conclusion		

Title: Traffic Light Controller Circuit With 555 Timer ICs.

Introduction:

Sequential logic circuits are fundamental to digital electronics, enabling the construction of systems that execute tasks in a step-by-step fashion. This lab report explores the application of 555 Timer ICs in crafting a model traffic lights circuit. Leveraging two astable circuits, the sequence of Red, Yellow, and Green LEDs is orchestrated to simulate a traffic control system. By delving into the mechanics of the circuit, this experiment offers a hands-on understanding of sequential logic and the practical versatility of the 555 Timer IC in electronic designs.

Objectives:

- Design a sequential logic circuit using 555 Timer ICs to perform desired tasks.
- Design a clock signal generating circuit for the logic circuit.
- Simulate the designed circuit.
- Investigate and analyze different logic operations of the designed sequential logic circuit.
- Comment on the limitations of the designed circuit.

Purpose:

The purpose of this experiment is to design and analyze a model traffic lights circuit using 555 Timer ICs, offering a practical exploration of sequential logic circuits and electronic circuit design principles. By employing two astable circuits, the experiment aims to simulate the sequential operation of Red, Yellow, and Green LEDs, akin to a traffic lights system. The circuit's functionality, reminiscent of a familiar LED blinker circuit, involves a dynamic interplay between two 555 Timer ICs, where the first astable circuit powers the second. This sequential process, guided by precise control mechanisms, triggers the illumination of different LEDs at specific voltage thresholds and discharge states. Through this experiment, participants gain insights into the application of astable circuits, the manipulation of LED states, and the power cascading concept, contributing to a comprehensive understanding of sequential logic in electronic circuits. Additionally, the experiment encourages students to simulate the circuit, investigate its logic operations, and critically assess any limitations or challenges encountered during the design and implementation phases.

Equipment:

1. Breadboard.
2. Connecting Wires.
3. DC Power Supply(5V)
4. Red LEDs 1[pcs]
5. Yellow LEDs 1[pcs]
6. Green LEDs 1[pcs]
7. 555 Times ICs 2[pcs]
8. Resistors 100K 1[pcs]
9. Resistors 47K 1[pcs]
10. Resistors 330 Ω 2[pcs]
11. Resistors 180 Ω 1[pcs]
12. Capacitor 100 μF 2[pcs]

Procedures:

1. Collect the necessary components, including 2 x 555 Timer ICs, 1 Red LED, 1 Yellow LED, 1 Green LED, resistors (100K, 47K, 2 x 330Ω, 180Ω), capacitors (2 x 100µF), a breadboard, a few breadboard connectors, and a power supply(5V).

2. Place the 555 Timer ICs on the breadboard, ensuring correct orientation. Use resistors and capacitors to configure two astable circuits, with the first powering the second.

3. Connect the Red LED to the output of the first 555 Timer IC, ensuring it illuminates only when the output is at 0V. Attach the Yellow LED to activate during the discharge mode of the second 555 Timer IC, and connect the Green LED to illuminate when the output of the second IC is at a positive voltage.

4. Connect the power supply (5V) to the breadboard, observing correct polarity.

5. Turn on the power supply. Initially, the output of the first 555 Timer IC should be ON, lighting up the Green LED due to the voltage at PIN-3 (Trigger Pin) being less than 1/3rd of the supply voltage.

6. Observe the gradual charging of the capacitor in the second 555 Timer IC. When it reaches 2/3rd of the supply voltage (Threshold Voltage), the output of the second IC turns OFF, activating the Yellow LED due to the discharge pin.

7. Note the sequence where the Yellow LED turns ON for the same time as the Green LED. Before the capacitor of the second 555 Timer IC reaches 1/3rd of the supply voltage, the voltage across the capacitor of the first IC reaches 2/3rds of the supply voltage, causing the Red LED to turn ON and the Yellow LED to turn OFF.

8. Confirm that this cycle repeats continuously, simulating a traffic lights system.

9. Use simulation tools (Multisim) to validate the functionality of the circuit under practical conditions.

10. Analyze the logic operations of the designed sequential logic circuit, emphasizing the role of PIN-3 voltage, capacitor charging, and discharge mechanisms.

11. Comment on possible limitations or challenges encountered during the experiment, providing insights into the practical aspects of circuit design at Discussion and Conclusion section.

Results and Data Analysis:

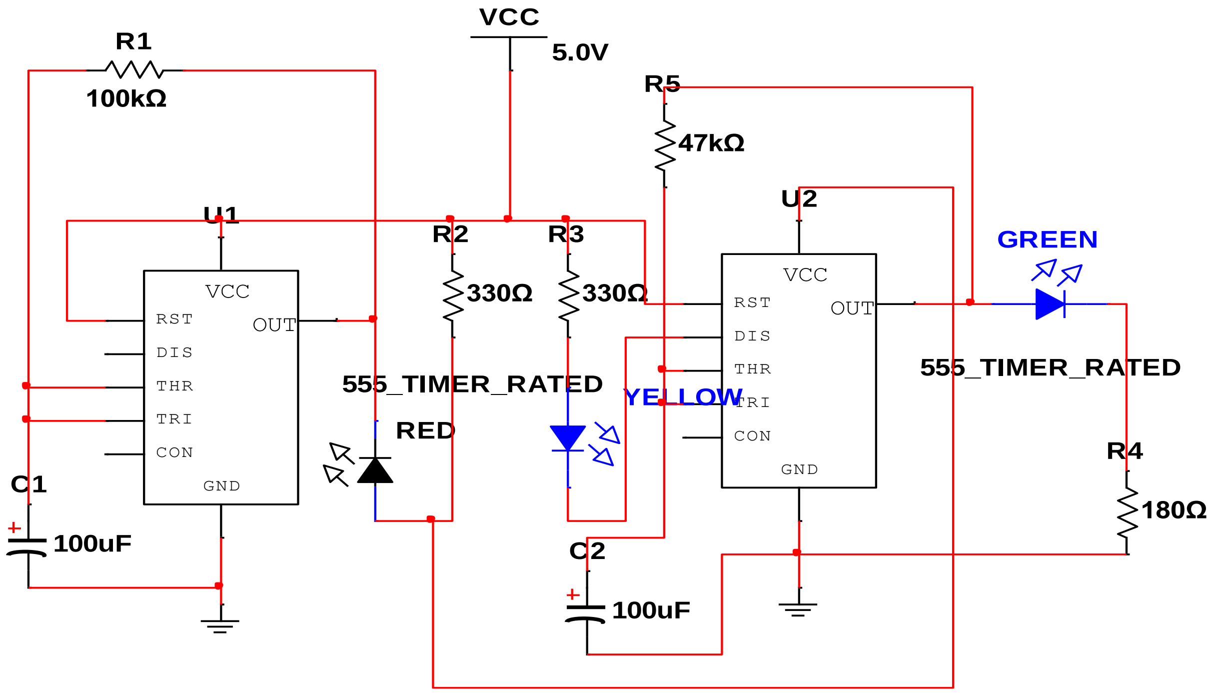
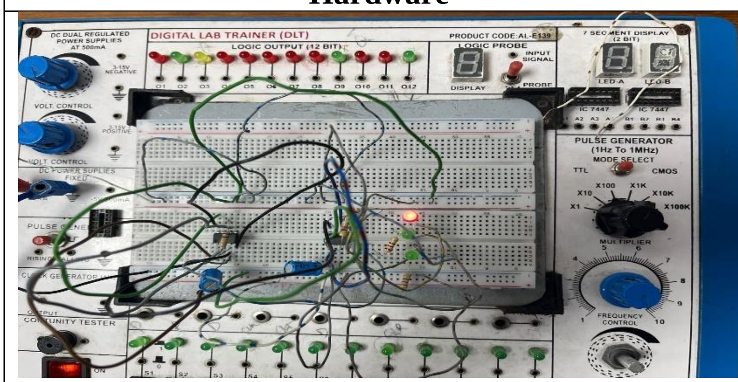
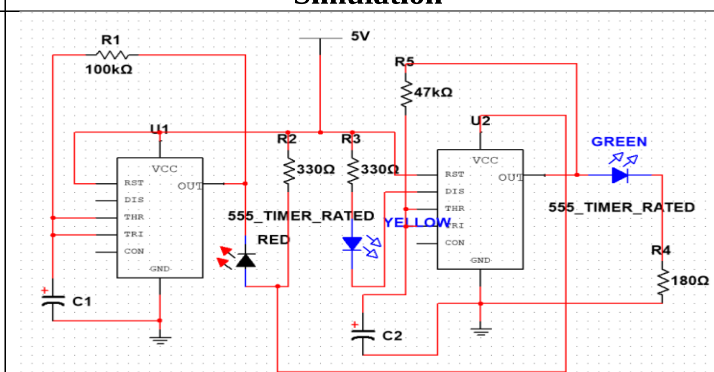
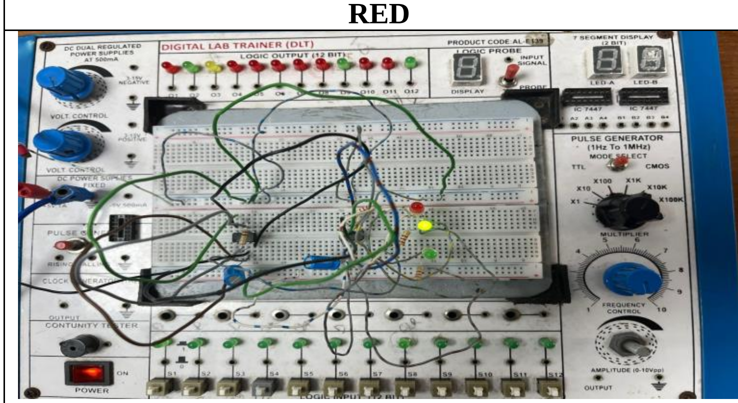
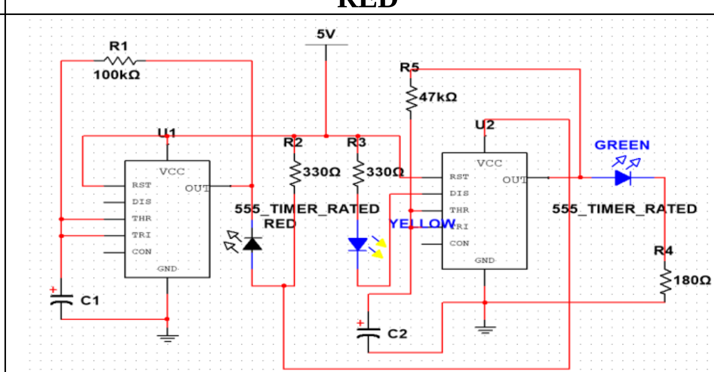


Fig-1: Traffic Light Controller Circuit

Simulation & Measurement:

Hardware	Simulation
 RED	 RED
 YELLOW	 YELLOW

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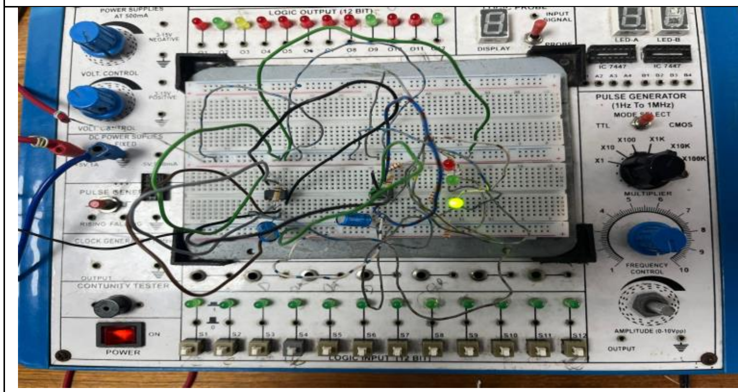
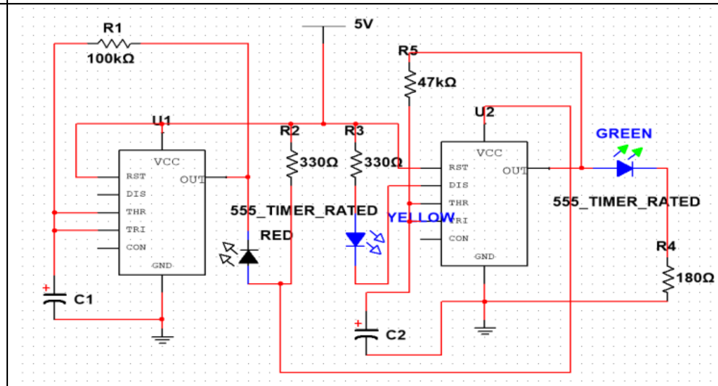
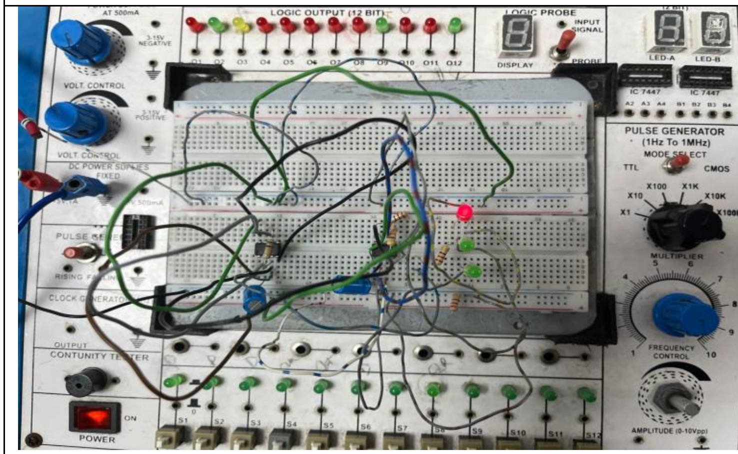
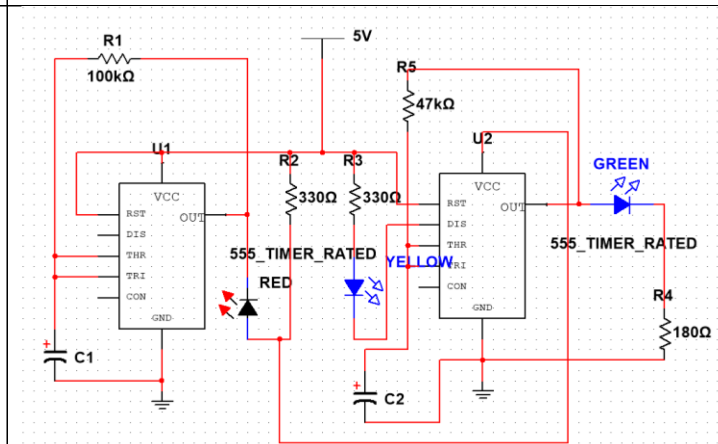
<tr><td>
GREEN</td><td>

GREEN</td></tr>
<tr><td>
RED</td><td>

RED</td></tr>
</table>

Discussion & Conclusion:

Discussion:

The traffic lights circuit designed with two 555 Timer ICs showcases an intricate interplay of astable circuits to create a simulated traffic light sequence. In essence, it builds upon the principles of the LED blinker circuit, employing two astable circuits where the first one acts as the master timer, controlling the power supply to the second one. This hierarchical arrangement ensures that the second 555 timer IC is powered only when the output of the first timer is in the ON state. The circuit utilizes three LEDs—red, yellow, and green—each associated with specific states in the operation of the timers.

Upon initial power-up, the output of the first 555 timer IC is in the ON state due to the voltage at PIN-3 (Trigger Pin) being less than 1/3rd of the supply voltage. Consequently, the second 555 timer IC is powered, and the green LED lights up. As the capacitor of the second timer gradually charges, it reaches 2/3rd of the supply voltage (Threshold Voltage), causing the output of the second timer to switch OFF. This activates the discharge mode, leading to the illumination of the yellow LED.

An interesting feature of the circuit is the careful timing mechanism that results in the yellow LED turning off and the red LED turning on before the capacitor of the second timer reaches 1/3rd of the supply voltage. This precise timing emulates the behavior of a real traffic light sequence. The cyclical nature of the circuit ensures a continuous and realistic simulation.

Conclusion:

In conclusion, the traffic lights circuit utilizing 555 Timer ICs successfully demonstrates the capabilities of astable circuits in generating controlled timing sequences. By incorporating principles from the LED blinker circuit, this project offers a hands-on approach to learning about sequential LED control. To validate the circuit's functionality, a simulation in Multisim was conducted, and the results were compared with practical readings. This simulation and matching process enhances the understanding of electronic circuit behavior.

However, it is crucial to acknowledge certain **limitations**. The circuit's timing may be susceptible to variations in component tolerances, and adjustments may be required for optimal performance. Power efficiency considerations and the need for fine-tuning based on specific application requirements should be considered. While the circuit provides a valuable learning experience, users should be aware of these limitations and consider them in practical applications.

Reference(s):

1. Boylestad, Robert L., and Louis Nashelsky. Electronic Devices And Circuit Theory, 2006, Pearson Prentice Hall.
2. Thomas L. Floyd, Digital Fundamentals, 9th Edition, 2006, Prentice Hall.
3. https://www.instructables.com/How-ToMake-a-Traffic-Control-System-Project-Using-/