AMERICAN INTERNATIONAL UNIVERSITY BANGLADESH

Faculty of Engineering

Laboratory Report Cover Sheet

Students must complete all details except the faculty use part.

Please submit all reports to your subject supervisor or the office of the concerned faculty.

Laboratory Title: Design and Implementation of Astable Multivibrator using 555 Timer

Experiment Number: 08 Due Date: 21-04-24 Semester: Spring 23-24

Subject Code: 0067 Subject Name: **Digital Logic And Circuits Lab** Section: R

Course Instructor: Md. Ashiquzzaman Degree Program: CSE

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Faculty comments

Title: Design and implementation of multivibrators using Timer IC

Introduction:

The name of the timer comes from the three 5 kΩ resistors which are embedded in it [1]. This IC gives precise time at the output which is must in the time related circuits. One of its basic operations is to produce clock pulses with predefined frequency as an astable mutivibrator. Another operation is to work like a stopwatch which is done in monostable mode. We will see these two operations in this experiment. The following figure is the layout of the 555 Timer IC as which allows us to focus on the functions of the circuit.

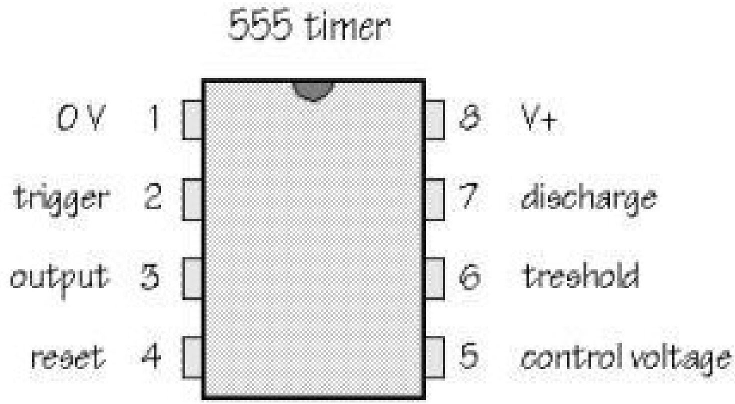

Figure 1: Pin configuration of the 555 timer IC.

Theory and Methodology:

Astable Multivibrator: It is also called free running sinusoidal oscillator. An astable multivibrator is simply and oscillator. The astable multivibrator generates a continuous stream of rectangular off-on pulses that switch between two voltage levels. The frequency of the pulses and their duty cycle are dependent upon the RC network values.

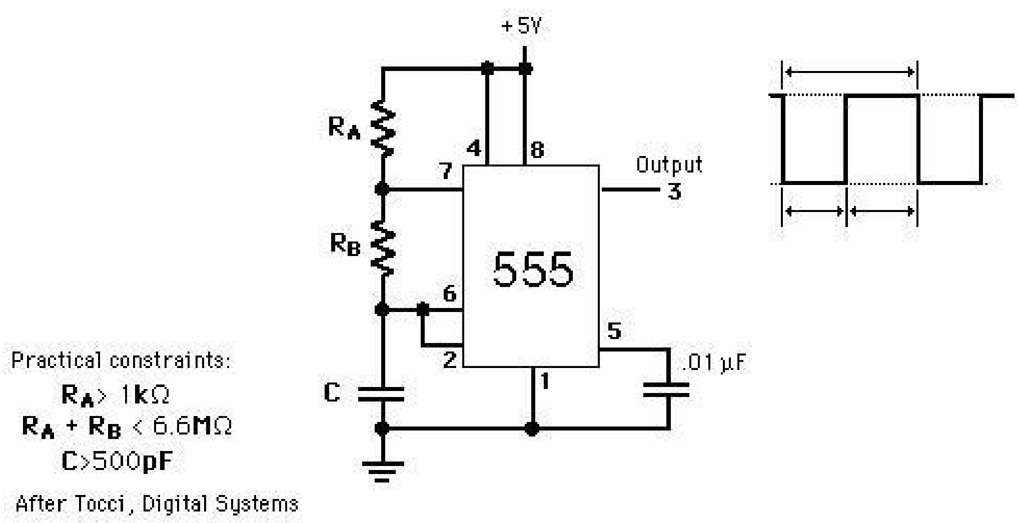

Figure 2: 555 timer connected as an astable multivibrator

The time that the output is high, T_L is how long it takes C to discharge from 1/3 of Vcc to 2/3 of Vcc. It is expressed as

$T_H = 0.7(R_A + R_B)\, C$

The time that the output is low, T_H is how long it takes C to charge from 2/3 of Vcc to 1/3 of Vcc. It is expressed as

$T_L = 0.7 R_B C$

The time period, $T = T_H + T_L = 0.7(R_A + 2R_B)\, C$

Frequency of Oscillation, $f = 1/T = 1.44 / (R_A + 2R_B)\, C$

Duty cycle, $D = T_H / T = (R_A + R_B) / (R_A + 2R_B) \times 100\%$.

One shot multivibrator: In the one-shot mode, the 555 acts like a monostable multivibrator. A monostable is said to have a single stable state--that is the off state. Whenever it is triggered by an input pulse, the monostable switches to its temporary state. It remains in that state for a period of time determined by an RC network. It then returns to its stable state. In other words, the monostable circuit generates a single pulse of fixed time duration each time it receives and input trigger pulse. Thus, the name becomes one-shot. One-shot multivibrators are used for turning some circuit or external component on or off for a specific length of time. It is also used to generate delays. When multiple one-shots are cascaded, a variety of sequential timing pulses can be generated. Those pulses will allow you to time and sequence a number of related operations.

Pulse width of the output is given by T= 1.1 RC (in seconds)

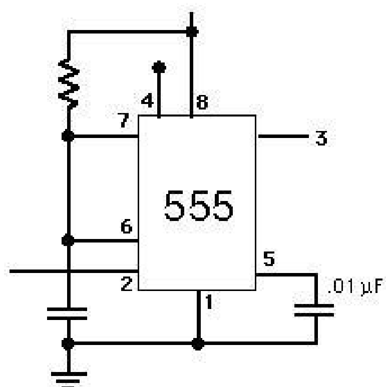

Figure 3: 555 timer connected as a one shot multivibrator

Apparatus:

SL	Apparatus	Picture	Quantity	Remarks
1.	Digital trainer board.		1	Good condition
2.	Resistor 1 k ohm (Color band: brown-black-red). 15 k ohm (Color band: brown-black-green).	 	1 1	Good condition
3.	Capacitor 0.1 µF 10 µF	 	1 1	Good condition
4.	555 Timer IC		1	Good condition
5.	Connecting wires		multiple	Good condition

Experimental Procedure:

The setups for the astable multivibrator and monostable multivibrator are given in the following figures.

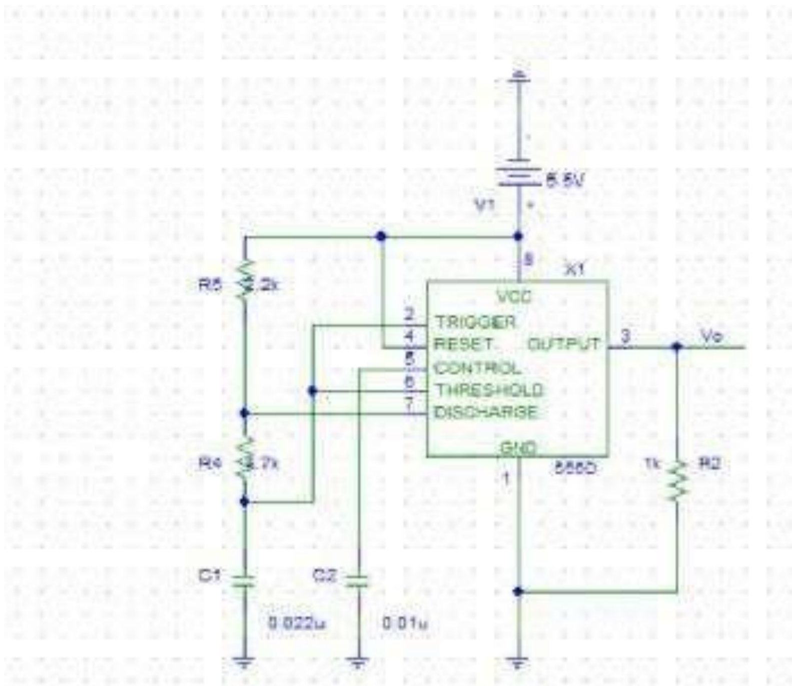

Figure 4: Experimental setup for astable multivibrator.

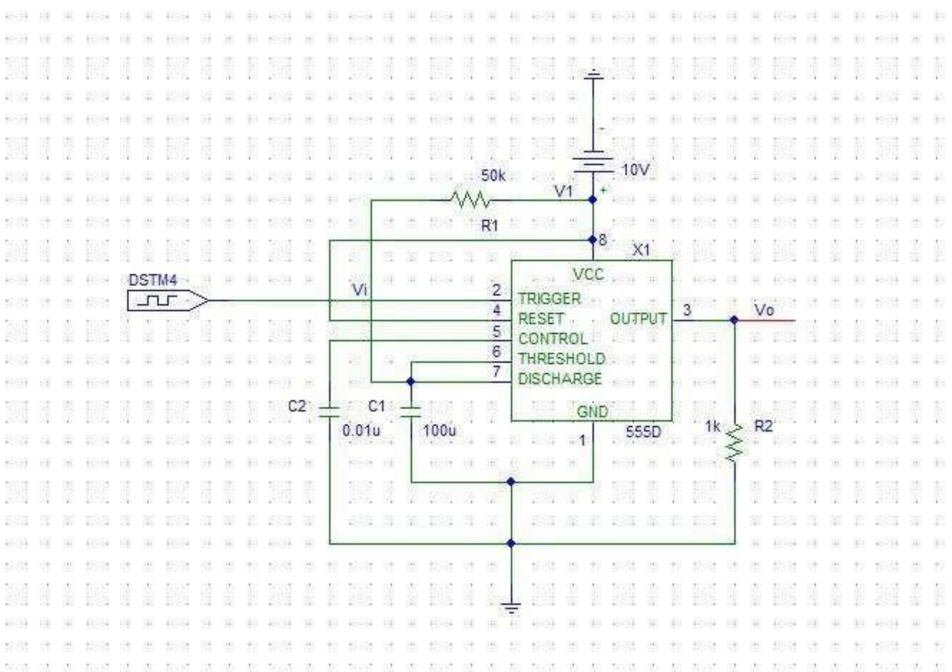

Figure 5: Experimental setup of the monostable multivibrator.

Experimental Setup:

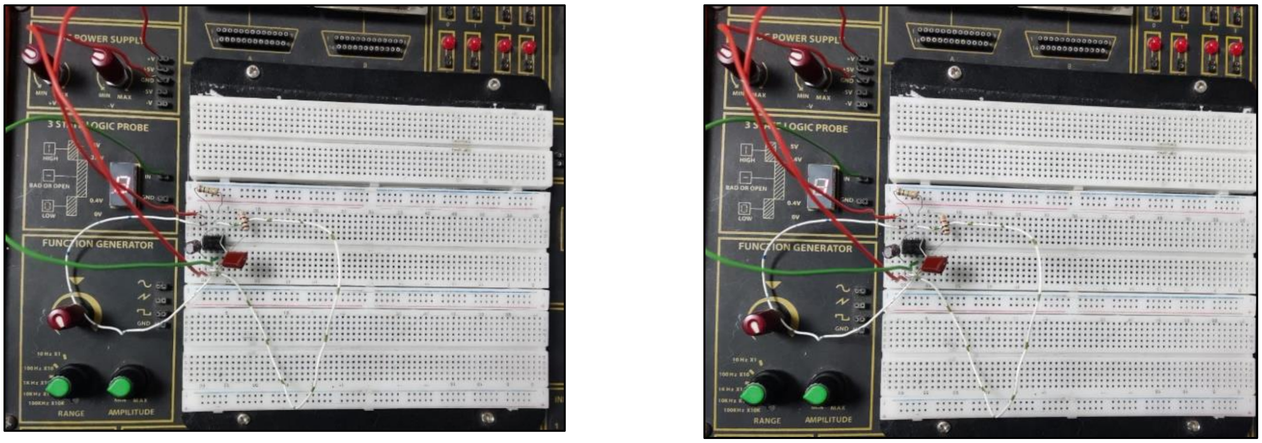

Figure 6: Implementation of astable multivibrator.

Figure 7: Implementation of monostable multivibrator.

Simulations:

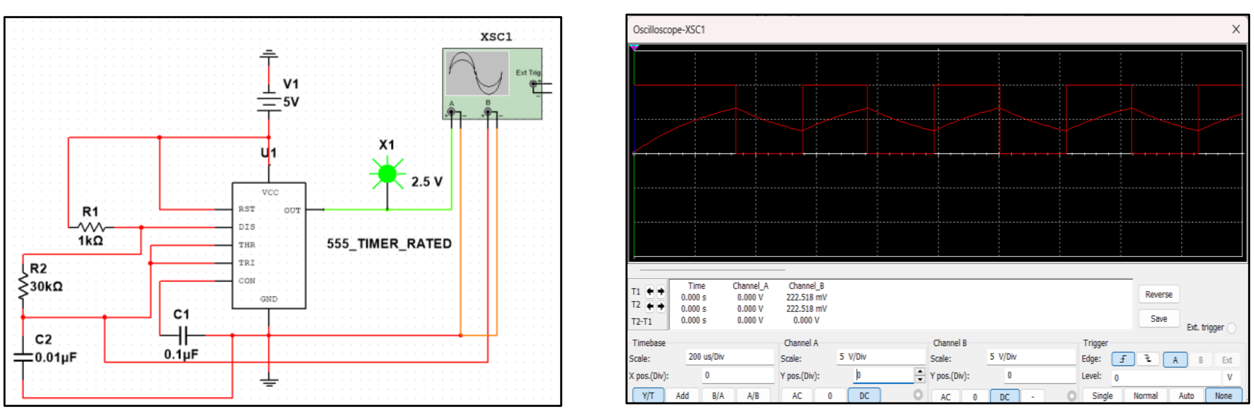

Figure 8: Simulation of astable multivibrator

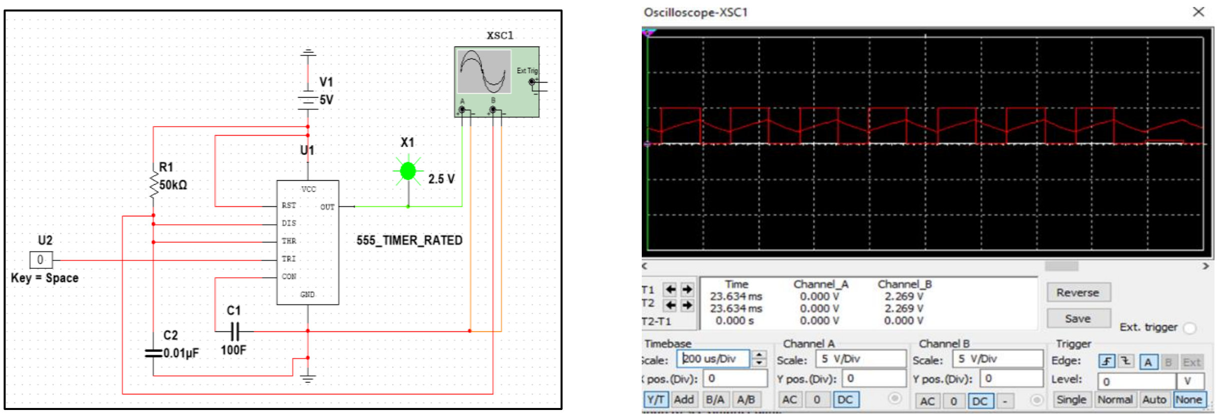

Figure 9: Simulation of monostable multivibrator

Result and Findings:

For Astable Multivibrator,

$T_H = 0.7(R_A + R_B)\,C = 0.7(10^3+10^6)10 \times 10^{-6} = 7.007$ s

$T_L = 0.7R_BC = 0.7 \times 10^6 \times 10 \times 10^{-6} = 7$ s

The time period, $T_{formulae} = T_H + T_L = 0.7(R_A + 2R_B)\,C$

$$= 0.7(10^3 + 2 \times 10^6) \times 10 \times 10^{-6}$$

$$= 14.007 \text{ s}$$

Frequency of Oscillation, $f = 1/T = 1.44 / (R_A + 2R_B)\,C$

$$=1.4/(10^3 + 2 \times 10^6) \times 10 \times 10^{-6}$$

$$= 0.072\ hz$$

Duty cycle, $D = T_H/ T = (R_A + R_B)/ (R_A + 2R_B) \times 100\%$.

$$= \frac{(10^3+10^6)}{(10^3+2\times10^6)} \times 100\%$$

$$= 50\%$$

Time period from experiment, $T_{experimental} = 14\ \ s$

For Monostable Multivibrator,

$$T = 1.1\ RC = 1.1 \times 10^{6} \times 10 \times 10^{-6}$$
$$= 11\ s$$

Discussion: The main objectives of this experiment were to be familiar with Astable and monostable multivibrator and how to implement it using 555 timer. At first, the basic theory was discussed about Astable multivibrator using 555 timer. After that we implemented two circuit: Astable and monostable multivibrator and observed the outputs of the two operations. For simulation, we have used NI Multisim version -14.2. and were run and matched the output with the experimental results. No error was found in the output.

Conclusion: This experiment has contributed valuable insights into the practical application of Timer ICs in the construction of multivibrators, specifically focusing on astable configurations. Termed as a free-running sinusoidal oscillator, the astable multivibrator autonomously generates a continuous sequence of rectangular off-on pulses, where the frequency and duty cycle are contingent upon the values within the RC network. This hands-on experience has enriched our comprehension of oscillator circuits and their significance in electronic systems.

Reference(s):

[1] Boylestad, Robert L., and Louis Nashelsky. *Electronic Devices And Circuit Theory*, 2006,Pearson Prentice Hall.

[2] American International University–Bangladesh (AIUB) Digital Logic And Circuits Lab Manual.

[3] Thomas L. Floyd, *Digital Fundamentals*, 9th Edition, 2006, Prentice Hall.

[4] “Astable Multivibrator using 555 Timer” Source:

https://www.electronicshub.org/astable-multivibrator-using-555-timer/