Design a timer circuit that will produce a 10ms pulse when a negative going triggering pulse is applied to it. Design a timer circuit which will produce +5V output for 60sec when START button is pressed. The time period is to be aborted when stop button is pressed.

Project Report submitted for

ELECTRICAL AND ELECTRONIC MEASUREMENT
(EET 3001)

Submitted by

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Declaration

We, Meghanjana Biswal, Bhabani Sankar Das, and Srishti Choubey [(2241035)], students of B. Tech. of Electronics and Communication Engineering hereby declare that we own the full responsibility for the information, results etc. provided in this PROJECT titled "**(**Design a timer circuit that will produce a 10ms pulse when a negative going triggering pulse is applied to it. Design a timer circuit which will produce +5V output for 60sec when START button is pressed. The time period is to be aborted when pressed. stop button is pressed**)**" submitted to **Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar** for the partial fulfillment of the subject **ELECTRICAL AND ELECTRONIC MEASUREMENT (EET 3001)**. We have taken care in all respect to honor the intellectual property right and have acknowledged the contribution of others for using them in academic purpose and further declare that in case of any violation of intellectual property right or copyright we, as the candidate(s), will be fully responsible for the same.

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Abstract

This project involves the design and development of two distinct timer circuits aimed at providing precise timing and control functionalities for various electronic applications. The first circuit employs the widely used 555 timer IC configured in monostable mode to generate a stable 10 ms output pulse in response to a negative-going trigger input. This configuration is particularly useful for pulse generation, signal conditioning, debouncing switches, and triggering other digital systems with accurate timing control. The second timer circuit is designed to deliver a regulated +5V output continuously for a duration of 60 seconds when a START push button is pressed. The timing sequence initiated by this action can be interrupted or aborted immediately through the use of a STOP button, offering the user enhanced operational flexibility and control. This feature is realized either by implementing an extended monostable configuration using the 555 timer or by integrating a digital counter/timer IC along with external control logic to manage the timing and abort functionality. Together, these circuits showcase the practical application of timing principles using standard integrated circuits, illustrating their reliability and adaptability in a range of real-world scenarios such as automation control systems, safety devices, industrial timers, and other time-dependent electronic processes. The project also emphasizes component selection, circuit stability, and ease of user interaction, making it an effective solution for both educational purposes and practical implementations.

Contents

1. Introduction

Timer circuits are essential building blocks in modern electronic systems, used extensively for generating accurate time delays, triggering events, and controlling processes. These circuits are particularly valuable in automation, control systems, signal processing, and safety applications. The aim of this project is to design and implement two timer circuits using the versatile 555 timer IC, along with basic electronic components and control logic.

The first timer circuit is configured in **monostable mode** to generate a **10ms output pulse** when a **negative-going trigger signal** is applied. This circuit provides a precise and reliable short-duration pulse that can be used to initiate other actions or serve as a timing reference in digital systems. It is especially useful for debouncing mechanical switches or generating fixed-width control signals.

The second timer circuit is designed to activate a **+5V output for a duration of 60 seconds** when a **START button** is pressed. In addition to starting the timer, a **STOP button** is included to **abort the countdown at any time**, immediately turning off the output. This feature introduces manual control, making the circuit suitable for applications such as timed motor operation, lighting systems, or process delays in industrial and consumer electronics.

Overall, the project demonstrates how basic timer principles can be applied to create functional, user-interactive circuits that offer both short and long-duration timing capabilities. It highlights the importance of combining timing ICs with user control mechanisms to develop reliable and efficient time-based electronic systems.

Timer circuits are an essential part of electronic systems and are used to generate time delays, create pulses, and schedule the operation of devices. The most commonly used integrated circuit for timing applications is the **555 timer IC**, introduced by Signetics in 1972. Due to its simplicity, low cost, and versatility, it remains one of the most popular ICs in both analog and digital timing applications.

2. Problem Statement

In various electronic applications, precise control over timing operations is critical. Systems often require specific time-based responses to input events, such as generating a pulse for signal processing or enabling a device for a fixed duration. Achieving this functionality using a cost-effective and simple circuit, while ensuring reliability and user control, presents both a design and implementation challenge.

I. Explanation of the Problem with Input and Output Variables:

This project involves the design of two distinct timer circuits with the following functional requirements:

1. **Timer Circuit 1 – Pulse Generator**
   - **Objective:** To generate a **fixed 10-millisecond output pulse** upon detecting a **negative-going input trigger**.
   - **Input Variable:** A falling-edge trigger signal.
   - **Output Variable:** A single +5V pulse lasting 10ms.
   - **Application:** Useful in digital systems for clocking, triggering, or debouncing.
2. **Timer Circuit 2 – Delay Timer with Manual Control**
   - **Objective:** To produce a **+5V output for 60 seconds** when a **START button** is pressed, and to **terminate** the output immediately when a **STOP button** is pressed.
   - **Input Variables:**
   - Manual input from the **START** button.
   - Manual input from the **STOP** button.
   - **Output Variable:** +5V output signal that stays HIGH for up to 60 seconds or until interrupted.
   - **Application:** Suitable for timed operations such as delayed switching, safety controls, or user-driven timed processes.

II. Constraints:

- **Timing Accuracy:** The circuits must maintain accurate delay times (10ms and 60s) with minimal drift or variation, considering resistor and capacitor tolerances.
- **Component Selection:** The design should use readily available, low-cost components such as the 555 timer IC, basic switches, resistors, and capacitors.
- **Manual Control Reliability:** The START and STOP buttons must be responsive and reliable, requiring **debounce handling** to avoid false triggering.
- **Power Supply Constraint:** Both circuits must operate on a standard **+5V DC power supply**.
- **Reset Functionality:** The STOP button must be able to **immediately interrupt** the ongoing 60-second timing operation without delay.
- **Noise Immunity:** The circuit should be resistant to electrical noise and avoid multiple outputs due to bouncing or spurious signals.

3. Methodology

The methodology for designing this dual-function timer circuit involves understanding both theoretical concepts and selecting suitable components for each function. The first function is to generate a 10ms output pulse when a negative-going triggering signal is applied. This can be achieved using a **monostable multivibrator** circuit built around the **IC 555 timer**. In this configuration, the 555 timer stays in a stable LOW state until it receives a negative trigger at its input (pin 2), which causes the output to go HIGH for a fixed time determined by the resistor (R) and capacitor (C) connected externally. The pulse width is calculated using the formula $T=1.1\times R\times C$. For a 10ms pulse, typical values could be $R=10k\Omega$ and $C=1\mu F$, giving approximately 11ms, which is close to the desired pulse width. This simple configuration makes the IC 555 a reliable choice for short-duration timing applications.

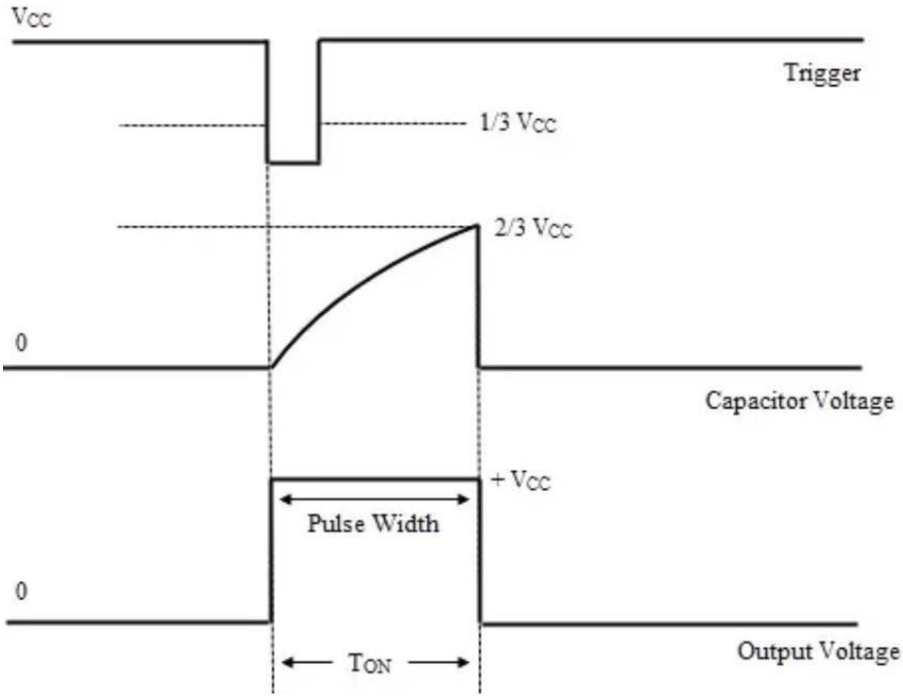
The second function involves designing a timer circuit that produces a +5V output for 60 seconds when a START button is pressed and stops the timing when a STOP button is activated. This can be implemented using two possible approaches: one with discrete components and the 555 timer, and another using a microcontroller such as an Arduino. In the first approach, the 555 timer is again configured in monostable mode, but with a much larger time constant. To achieve a 60-second pulse, the resistor and capacitor values are significantly increased. For example, using a 1.2MΩ resistor and a 47μF capacitor yields a pulse duration close to 60 seconds. The START button is used to trigger the timer, while the STOP button can be connected to a transistor (e.g., BC547) which discharges the capacitor when pressed, thereby aborting the timing prematurely. This method requires careful selection of component values and proper circuit logic to ensure reliable operation.

The selection of components for both circuits is crucial. For the 10ms timer, the necessary parts include an IC 555 timer, a 10kΩ resistor, a 1μF capacitor, a push button for triggering, an LED or other output indicator, and a 5V or 9V DC power supply. For the 60-second timer using the IC 555, required components include the timer IC, a 1.2MΩ resistor, a 47μF or 100μF capacitor, two push buttons (for START and STOP), a transistor for reset control, diodes for circuit protection, pull-down resistors for input stability, and a relay or LED to indicate output. If the microcontroller-based approach is adopted, the essential components include an Arduino board, two push buttons, pull-down resistors, and an output load such as an LED. Power is supplied via a regulated 5V source, either through USB or a suitable DC adapter.

To summarize, the 10ms timer operates by temporarily setting the output HIGH for a precise short interval upon receiving a negative trigger. The 60-second timer extends this concept to a much longer duration and introduces manual control via START and STOP buttons. Both circuits rely on the reliable operation of the 555 timer in monostable mode, but more advanced control can be achieved using a microcontroller, which allows for improved accuracy and flexible response to user inputs.

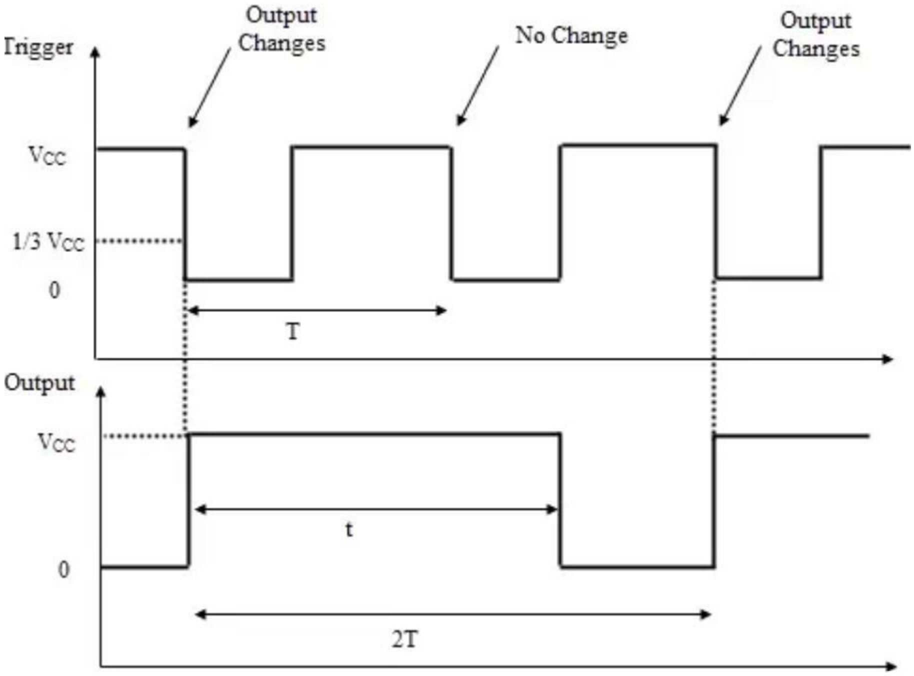
THEORETICAL BACKGROUND:

```
           +Vcc (5V or 9V)
             |
            [R = 1MΩ]
             |
Trigger ---->| 555 Timer IC
           | (Pin 2 = Trigger)
           |
      (Pin 3 = Output) ----->|-----> [LED] ---> [330Ω]--- > GND
```



When the IC 555 is used as a monostable multivibrator, a positive going rectangular pulse is available at the output when a negative going pulse of short duration is applied at the trigger input. By adjusting the time interval t of the charging or timing circuit the device can be made to work as a Frequency Divider circuit.

The circuit will trigger for the first negative pulse of the trigger input. As a result, the output will go to high state. The output will remain high for the time interval t. During this interval, even if a second negative going trigger pulse is applied, the output will not be affected and continues to remain high as the timing interval is greater than the time period of the trigger pulse. On the third negative going trigger pulse, the circuit is retriggered.
So the circuit will trigger on every alternate negative going trigger pulse i.e. there is one output pulse for every two input pulses and hence it is a divide–by–two circuit. By adjusting the timing interval, a monostable circuit can be made to produce integral fractions of the input frequency.



Calculation:

In monostable mode, the output pulse width T is given by:
$T=1.1\times R\times C$
Where:

- T = pulse width (in seconds)
- R = resistance in ohms (Ω)
- C = capacitance in farads (F)

We want a 10ms pulse:
T=10 ms = 0.01s
Let's assume a capacitor value:
C= 1μF = 1×10^{-6} F
Now, $R=\frac{T}{1.1\times C}=\frac{0.01}{1.1\times10^{-6}}\approx 9.09k\Omega$
So, we have taken R = 10kΩ
T is coming 11ms for c = 1μF and 1.1ms for c = 100 μF
Here, to get 60s, we have used 1MΩ resistor and 100 μF capacitor.
For the key formula: $T=1.1\times R\times C=60s$(approx)

555 Timer Pin Configuration:

Pin	Name	Function
1	GND	Ground
2	Trigger	Activated by LOW (<1/3 Vcc)
3	Output	High for T seconds
4	Reset	Connected to Vcc
5	Control	Connected to Ground
6	Threshold	Connected to capacitor
7	Discharge	Connected to resistor
8	Vcc	Power Supply

Working:

- Press the push button: It sends a LOW signal to Pin 2 (Trigger).
- The 555 output (Pin 3) goes **HIGH**.
- LED turns **ON** for approximately **60 seconds**.
- After 60 seconds, output goes **LOW**, turning LED **OFF**.

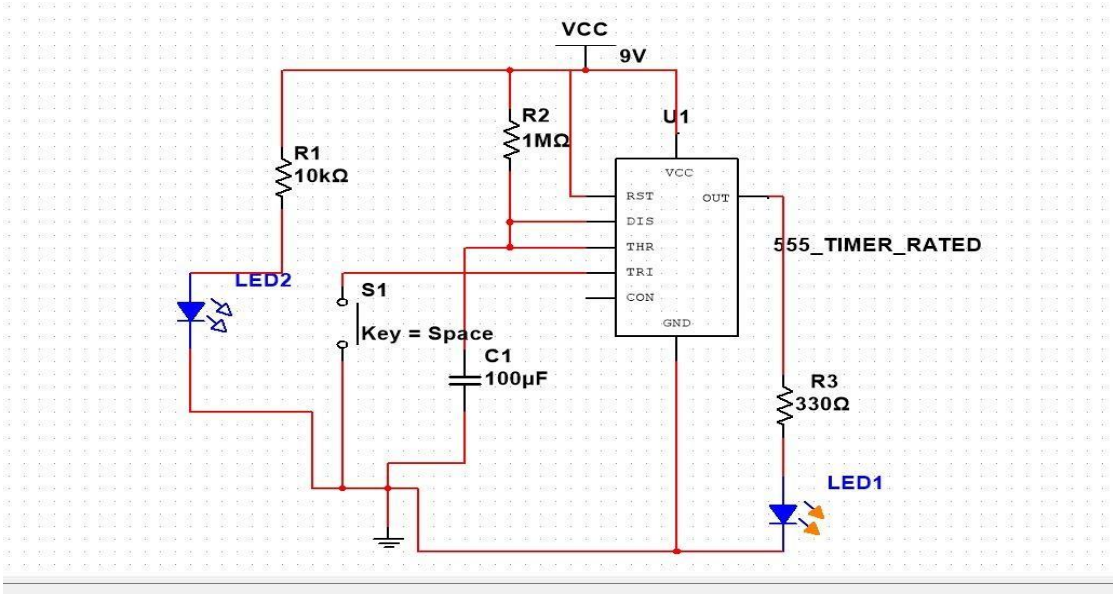
Applications:

- Delay Timers
- Automatic Lights
- Alarms
- Timed Relays

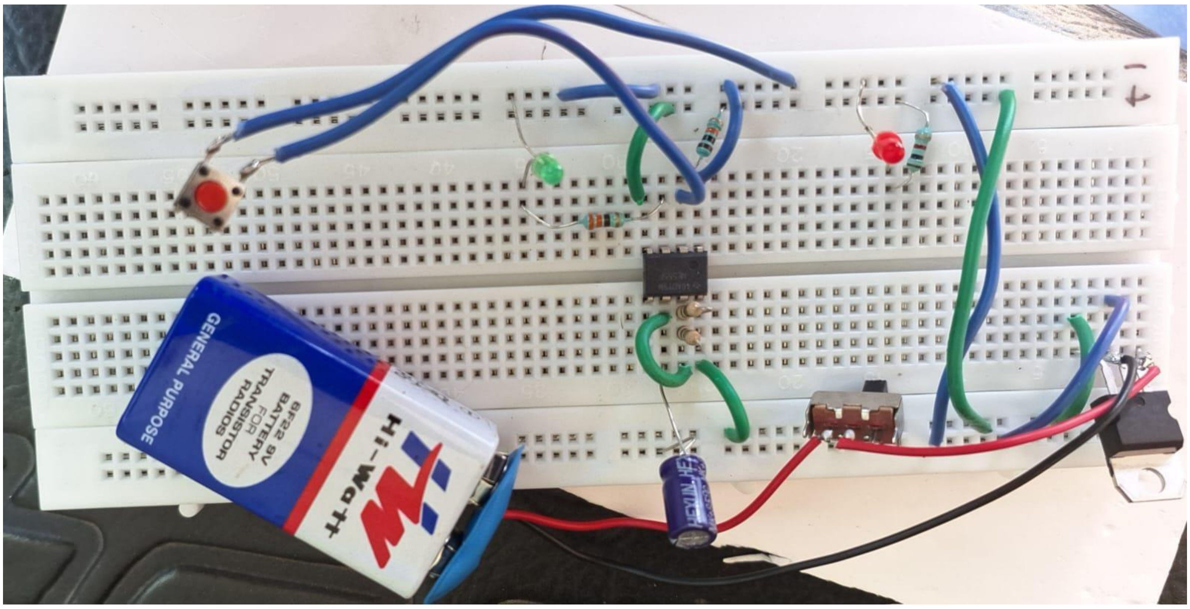
Components Used:-

Sl No.	NAME	SPECIFICATIONS	QUANTITY
1	555 Timer IC	NE555P	1
2	Resistors	500kΩ,10kΩ,330Ω	2,1,1
3	Capacitors	100µF	1
4	LED	5mm(red), 5mm(green)	1
5	Push Button	SPST	1
6	Power Supply	5V	1
7	Connecting Wires	23SWG	As per req

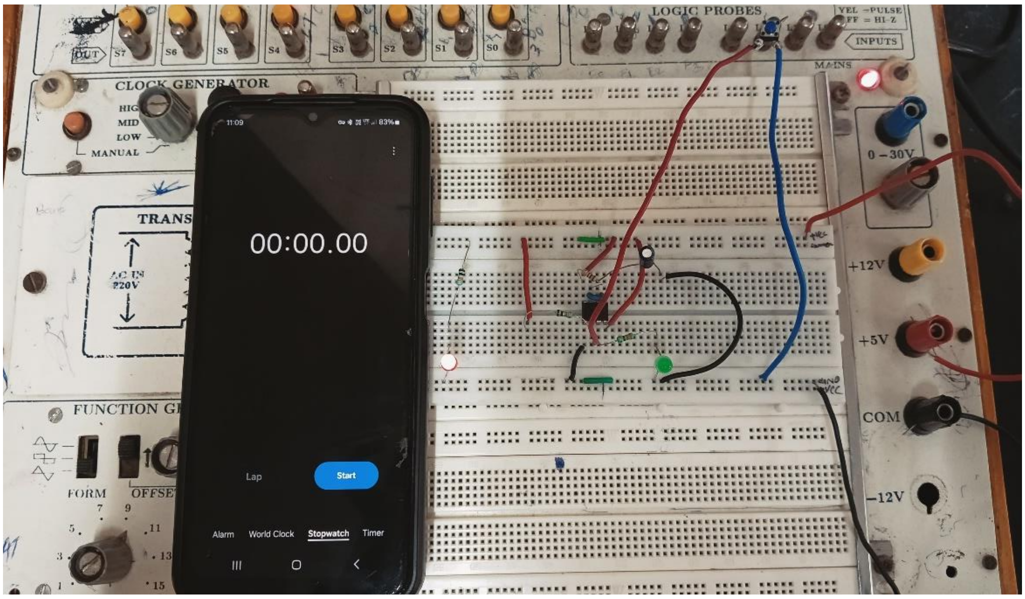
4.Validation



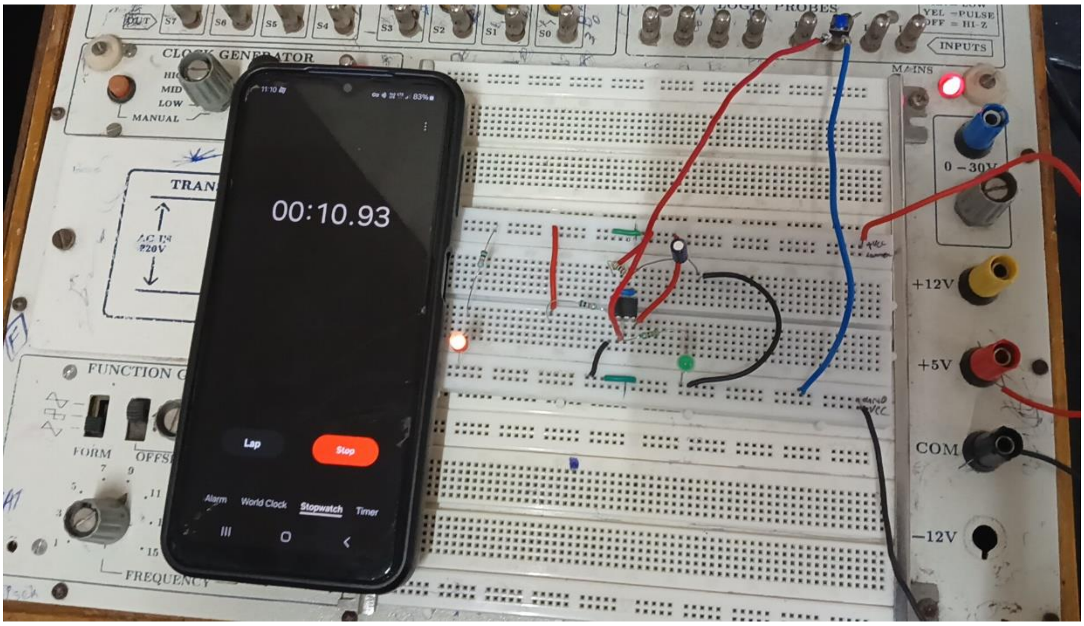
5.Implementation

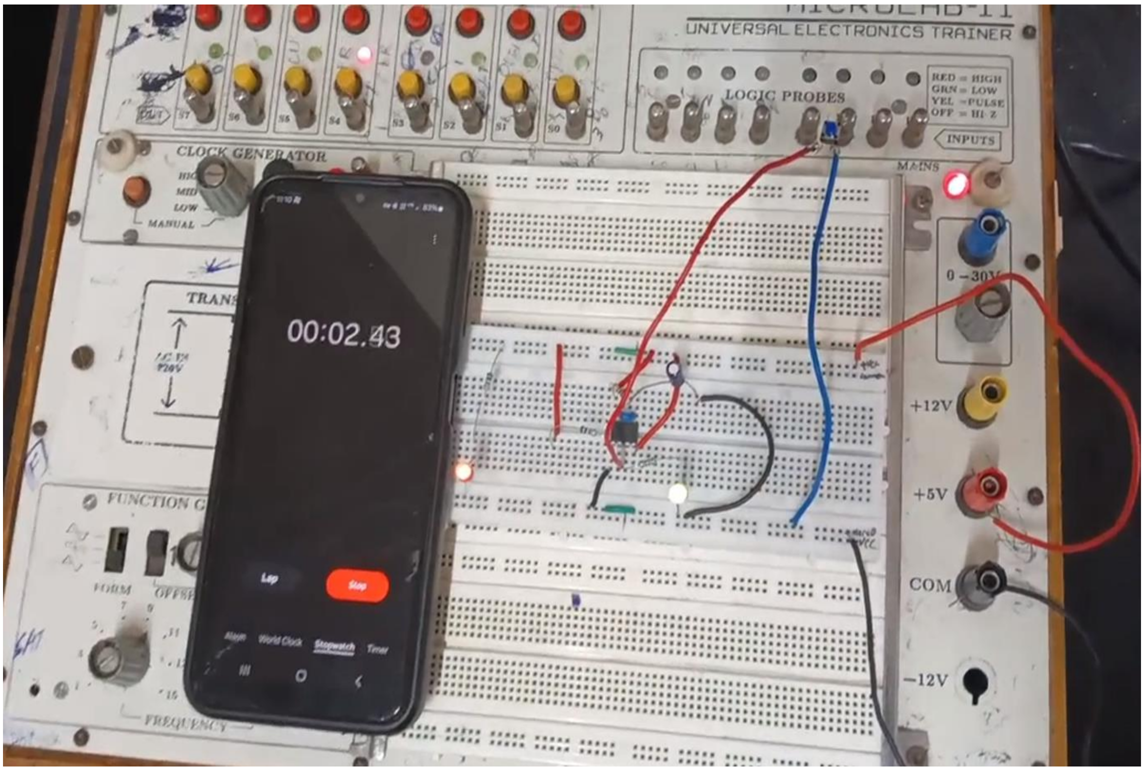


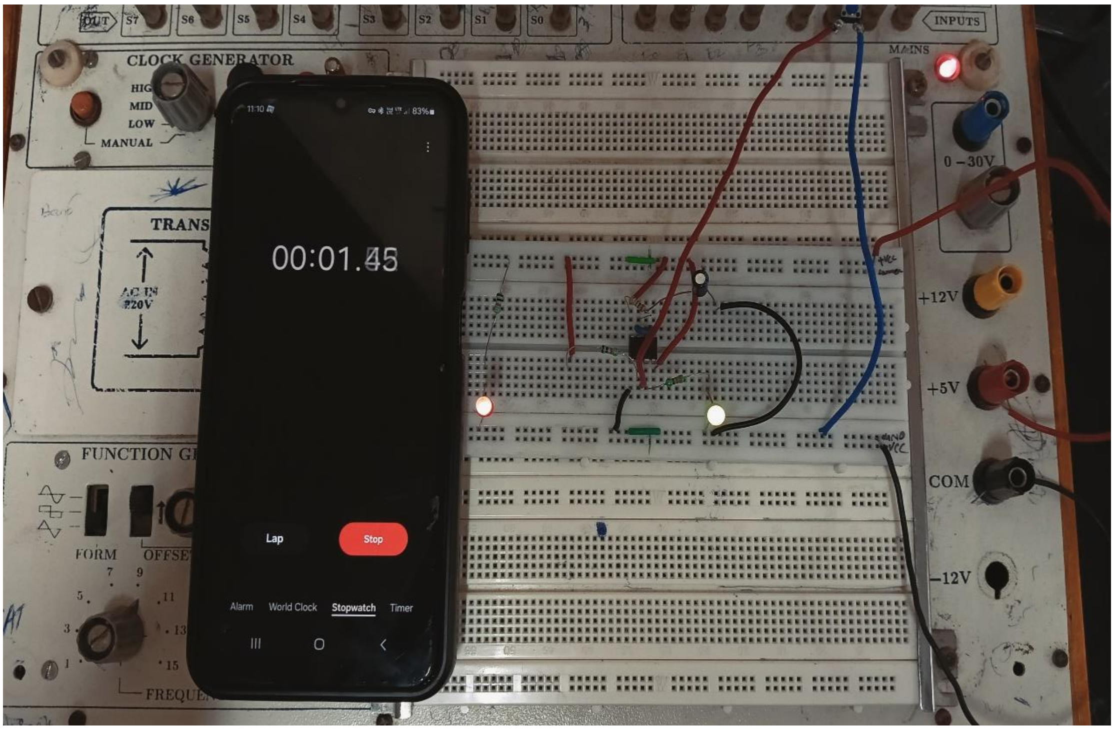
6. Results & Interpretation



The circuit is in ideal condition and it has not got any power supply yet.




UNIVERSAL ELECTRONICS TRAINER
LOGIC PROBES
INPUTS
CLOCK GENERATOR
MANUAL
MAINS
00:02.43
Lap
Stop
+12V
+5V
COM
-12V


CLOCK GENERATOR
MANUAL
INPUTS
MAINS
00:01.45
Lap
Stop
Alarm
World Clock
Stopwatch
Timer
FORM
+12V
+5V
COM
-12V

7. Conclusion

This project successfully demonstrates the design and implementation of two timer circuits using the 555 Timer IC in monostable mode. The first circuit was designed to generate a short 10ms pulse in response to a negative-going trigger signal, while the second circuit produces a 5V output for 60 seconds upon pressing a START button, with an option to abort the timing using a STOP button. Both circuits were developed using calculated resistor-capacitor values and implemented effectively with accurate results.

The 555 Timer IC was selected due to its reliability, simplicity, and flexibility. It enabled precise control over output pulse durations through straightforward mathematical formulas and component choices. The project utilized commonly available components such as resistors, capacitors, transistors, and push buttons, making the design not only cost-effective but also easy to understand and replicate.

Adding manual controls like START and STOP buttons enhanced the practical usability of the system, showcasing how even basic electronic components can be used to build interactive and functional circuits. The STOP feature, achieved using a transistor to quickly discharge the timing capacitor, introduced real-world considerations such as circuit interruption and safety, which are essential in industrial or consumer applications.

Overall, the project strengthened understanding of timing principles, RC time constant behavior, and the functional versatility of the 555 Timer IC. It also provided hands-on experience in designing, calculating, and testing time-based electronic systems. This forms a strong foundation for further development in areas such as automation, digital timing, and microcontroller-based control systems.

By combining theory with practical implementation, this project serves as a solid example of how fundamental electronic components can be used to build effective, real-time control circuits.

8. References

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  — In-depth reference on analog ICs and timing circuits.

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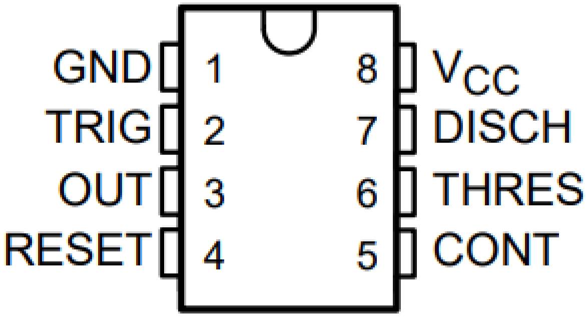
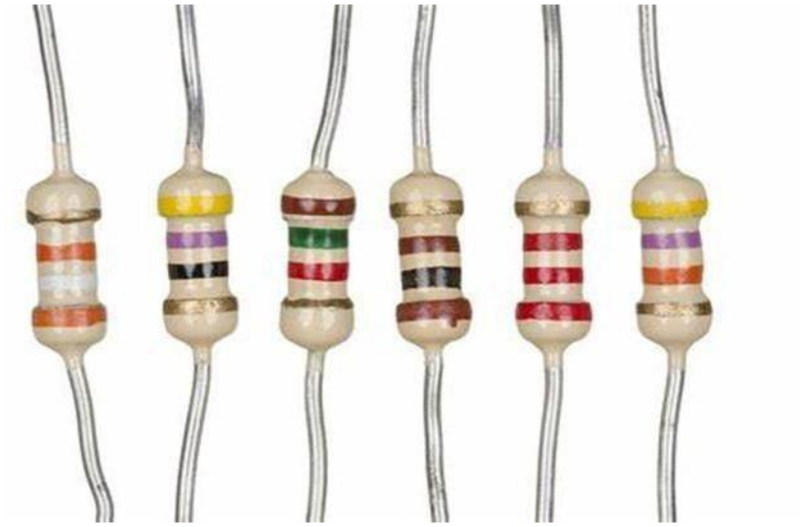
9. Appendices

1. **OPAMP**



The **NE555 timer IC** is one of the most widely used integrated circuits in electronics. It was originally designed by **Hans R. Camenzind in 1972** for Signetics (now part of ON Semiconductor), and has since become a standard component in analog circuit design due to its simplicity, versatility, and reliability. The **555 Timer IC** is a popular and versatile integrated circuit used for generating precise time delays and oscillations. It operates between 4.5V and 16V and can provide an output current of up to 200mA. The IC contains comparators, a flip-flop, a discharge transistor, and a voltage divider to control timing. It has three main modes: **monostable** (single pulse output), **astable** (continuous square wave), and **bistable** (flip-flop operation). Timing intervals depend on external resistors and capacitors. Due to its simplicity, reliability, and flexibility, the 555 timer is widely used in timers, pulse generation, and oscillator circuits.

2. RESISTOR



A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators.

3. CAPACITORS

A capacitor is a device that stores electrical energy in an electric field by virtue of accumulating electric charges on two close surfaces insulated from each other. It is a passive electronic component with two terminals. The effect of a capacitor is known as capacitance. While some capacitance capacitor is a component designed to add capacitance to a circuit.

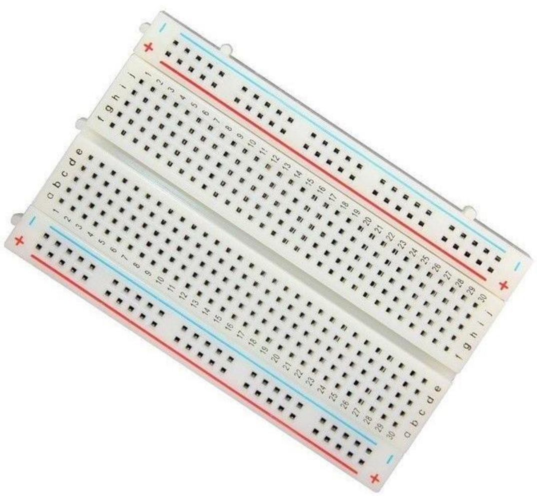
4. SPST SWITCH

An **SPST push switch** (Single Pole Single Throw) is a simple type of **momentary contact switch** used to control the flow of current in a circuit. It has **two terminals** and acts like a simple ON/OFF switch. When the switch is **not pressed**, the circuit remains **open**, and no current flows When the switch is **pressed**, it **closes** the circuit, allowing current to flow between the two terminals.

5. LED

An **LED (Light Emitting Diode)** is a semiconductor device that emits light when an electric current passes through it. It is a special type of diode that **glows when forward biased**, converting electrical energy directly into visible light through a process called **electroluminescence**. When a **forward voltage** is applied across the LED (typically 1.8V–3.3V), electrons and holes recombine at the junction, releasing energy in the form of photons (light). LEDs allow current to flow in **only one direction**, like regular diodes.

6. BREAD BOARD



A breadboard is a reusable, solderless platform used for prototyping electronic circuits. It allows components such as resistors, ICs, capacitors, and LEDs to be easily inserted and connected without permanent soldering.

DATA SHEET:

www.fairchildsemi.com

LM555/NE555

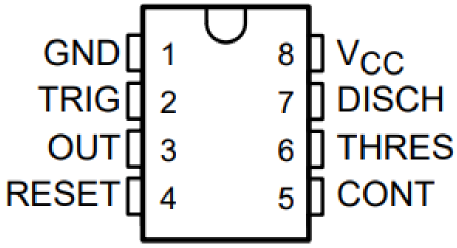
Single Timer

Features

- High Current Drive Capability (200mA)
- Adjustable Duty Cycle
- Temperature Stability of 0.005%/°C
- Timing From µSec To Hours
- Turn Off Time Less Than 2µSec

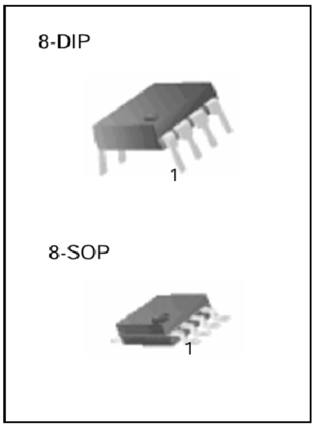
Applications

- Precision Timing
- Pulse Generation
- Time Delay Generation
- Sequential Timing

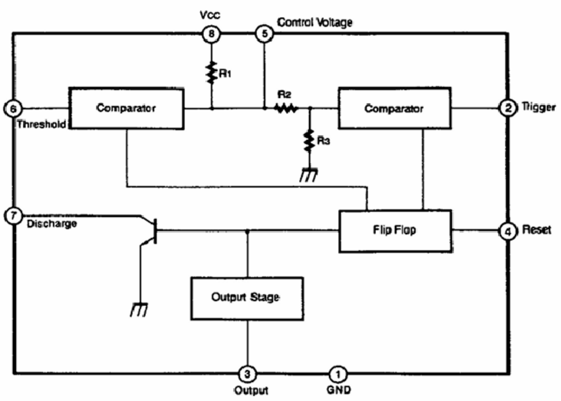


Description

LM555/NE555 is a highly stable controller capable of producing accurate timing pulses. With monostable operation, the time delay is controlled by one external and one capacitor. With astable operation, the frequency and duty cycle are accurately controlled with two external resistors and one capacitor.



Internal Block Diagram



Absolute Maximum Ratings (T_A = 25°C)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	16	V
Lead Temperature (soldering 10sec)	T_{LEAD}	300	°C
Power Dissipation	P_D	600	mW
Operating Temperature Range LM555/NE555	T_{OPR}	0 ~+ 70	°C
Storage Temperature Range	T_{STG}	- 65 ~ + 150	°C