CONTENTS

ABSTRACT

In many electronic circuit applications a delay of a few seconds or minutes becomes a crucial requirement for ensuring correct operation of the circuit. Without the specified delay the circuit could malfunction or even get damaged.

Delay timer (relay driver) for home electrical application has been successfully designed, constructed and tested. The result shows the timer can keep an appliance working for a time period between 2 and 40 minutes. And in the delay off mode the timer can work for several hours. It can conveniently be use to run a load of 2,500W.

In this 555 timer project, in our project we have shown that how to make a time delay relay circuit using 555 timer IC to automatically turn Off the switch after a predefined delay.

You can also adjust the off delay time up to 20 minutes with a 1M POT.We have shared the required components, complete circuit diagram, and all other details for this simple 555 timer project.

Key words: Delay timer, 555 timer, home electrical appliances.

Chapter – 1
Introduction

The making of simple delay timers using very ordinary components like transistors, capacitors and diodes. All these circuits will produce delay ON or delay OFF time intervals at the output for a predetermined period, from a few seconds to many minutes. All the designs are fully adjustable.

1.1 What is a Time Delay Relay?

A time delay relay is a type of relay that has a built-in time delay function. This means the relay will not immediately activate when it is energized but will wait for a set amount of time before doing so. This can be useful for applications requiring delays before the relay activates, such as industrial automation or security systems.
There are many different types of time delay relays available, each with unique features and capabilities. Some relays have adjustable time delays, while others have preset time delays that cannot be changed. Additionally, some relays have multiple time ranges that can be selected, while others are limited to a single range

1.2 Where are Timing Relays Used?

Timing relays are commonly used in a variety of industrial and commercial applications. Some common applications include machines, buildings, water segments, HVAC, and other applications.

Machine Control
They are often used in machine control applications to provide cyclic machinery switching. This can help to prevent equipment from sticking or becoming damaged.

Lighting Control
Timing relays can be used to delay switching multiple rows of lamps in production facilities or greenhouses. This can help to save energy by preventing lights from being turned on when they are not needed.

Water segments
Pump controls and irrigation systems are common applications for timing relays in the water segment.

HVAC Control

It can be used in HVAC systems to control fans and centralized water systems. This can help to save energy and keep buildings comfortable.

Alarm Triggering

Timing relays can be used to trigger alarms after a set amount of time has elapsed. This can be useful for security applications or for monitoring purposes.

1.3 Types of Time Delay Relay

ON-Delay Timers

An ON-delay timer is a type of time delay relay used to control the activation of a circuit by delaying the initiation of current flow. ON-delay timers are typically used in applications where it is important to ensure that a circuit is not activated until after a certain amount of time has elapsed. This can help prevent accidental circuit activation or allow time for a system to stabilize before it is activated.

OFF-Delay Timers

OFF-delay timers are a type of time delay relay that opens or closes the circuit as soon as power is removed. The contacts will not return to their normal position until the preset time delay has elapsed, at which point the load is de-energized. OFF-delay timers are often referred to as “delay on break” timers.

If you were to close the control switch again during timing, it would reset the time delay; however, most OFF-delay timers automatically reset when power is lost, but some models allow for manual resetting.

One Shot Timers

One-shot timers are a time delay relay used to activate a circuit after a set amount of time has passed. They are also called single shot timers, single shot interval timers, and single pulse timers. One-shot timers are activated by power. As soon as power is applied, the contacts move to a different position.

They stay in this new position for the time previously set and then return to their original spot. The timer starts over when the previous cycle is completed, and the switch controlling it is turned off. One-shot timers are often used in industrial settings, such as operating machinery start/stop buttons.

Interval Timers

Interval timers are a time delay relay used to control the length of time an electrical load is energized. They are also called pulse shaping timers, bypass timing timers, interval delay timers, and delay on energization with instantaneous transfer timers.

These kinds of timers work by delaying the application of power to an electrical load until a specific time has elapsed. Once the timer has elapsed, the power is applied and remains on until the timer expires. At this point, power is removed from the load and remains off until power is reapplied.

Recycle Timers

Recycle timers are a type of time delay relay used to control a load's on and off cycling. They are also called duty cycling or cycle timers. These timers conserve energy by turning a load off and on at regular intervals. They can also be used to create a flashing effect. Recycle timers are either single-function or multi-function devices.

Chapter – 2
Objective

2.1 The objective of this work is to design and construct a simple device that can be used to monitor or time the usage of some home electrical appliances.

Semiconductors are materials whose electronic properties are intermediate between those of metals and insulators. These intermediate properties are determined by crystal structure bonding characteristics and electronic energy band. Unlike metals, semiconductor has both positive
(holes) and negative (electron) carriers of electricity whose densities can be controlled by dopping the pure semiconductor with chemical impurities during crystal growth

Semiconductors are indispensable in modern technology primarily because their properties are fundamental to the operation of photovoltaic devices such as solar cell, transistors, and related devices. According to quantum mechanics, electrons, in isolated atom can have only specific discrete energy levels. When atoms are brought close together as in a lattice of a crystal, the electronic energies of the individual atoms are grouped in energy bands.

The valence band is the highest filled band, which corresponds to the ground state of the outermost or valence electrons in the atom. There is the conduction band which is the lowest energy band. The conduction band is separated from the valence band by an energy gap or forbidden band. The electrical characteristics of a material are determined by the position of the
electrons in the allowed bands. The nature of the band and energy gap varies with the type of materials.

Electrons in crystals are arranged in energy bands separated by regions in energy where no wave like electron orbital exists. Such forbidden regions are called energy gaps or band gaps, and result from the interaction of the conduction electron waves with the ion core of the crystal. The crystal behaves as a metal if one or more bands are partly filled and as a semiconductor or a semimetal if all the bands are entirely filled.

Metals are characterized by high electrical conductivity and a large number of the electrons in a metal must be free to move about, usually one or two per atom called conduction electrons. Electrical properties of metals are determined by the shape of the Fermi surface. The Fermi surface is defined as the surface of constant energy Ef in K space. It separates the unfilled orbital from the filled ones at absolute zero.

2.2 MATERIALS AND METHODS

We used the 8-pin 555 timer wonder chip that can be used to build many circuits with just few external components. A box is used for the circuit symbol for the 555 with its pins arranged to suit the circuit diagram. The 555 chips come in different manufacturer names.

A popular version of the 555 timer is the **NE555** produced by Fairchild. Others include **LM555C** (National), **CA555**
(RCA), **LC7555** (Sanyo), **HA17555** (Harris) etc.

The chip was operated with a voltage supply +Vcc or Vs in the range of 4.5 to 15V and a maximum of 18V. The timer chip can be operated in three distinct modes. The Astable, produce a square wave, while Monostable, produced a single pulse when triggered and the Bistable which is a simple memory that can be set and reset. **Some of the applications of the timer chip (555) include lamp flasher, relay driver (delay timer), metronome etc.** The monostabe mode of operation was used in this work and the relay driver application was tested.

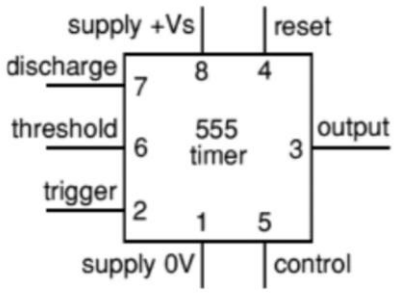


Fig.1 circuit symbol / pinout diagram for the 555 chip

Figure 1, shows the circuit symbol of the 555 chip. The circuit build up operates in the monostable mode. Timing period starts when the trigger input pin 2 is less than V3 of the supply voltage +Vcc. This is achieved by momentarily pressing switch S1. Hence the output pin3 becomes high and the capacitor C1 begins to charge through the resistor R1. C1 is a combination of capacitors arranged parallel to each other. Any further trigger impulse at pin2 is ignored once
the time period is in progress.

Pin 6, is the threshold input that monitors the voltage across the charging capacitor C1 and once this is over the output becomes low. Immediately the discharge pin7 is connected to ground, thus discharging the capacitor and ready for the next trigger.

During the time period when the output pin3 is high, the signal is fed to the base of transistor Q1 through resistor R3 which biases the transistor to switch on and hence the relay is energized connecting the load to the mains supply 230Vac. When the time period is over, the transistor switches off, de-energizing the relay which in turn cuts off the load from the mains. When timing is in progress diode D1 is on. The output voltage at pin3 is approximately equal to the supply voltage. The reset input pin4 overrides all other input, which implies that the timing may be cancelled at any point in time by connecting reset switch S2 to ground.

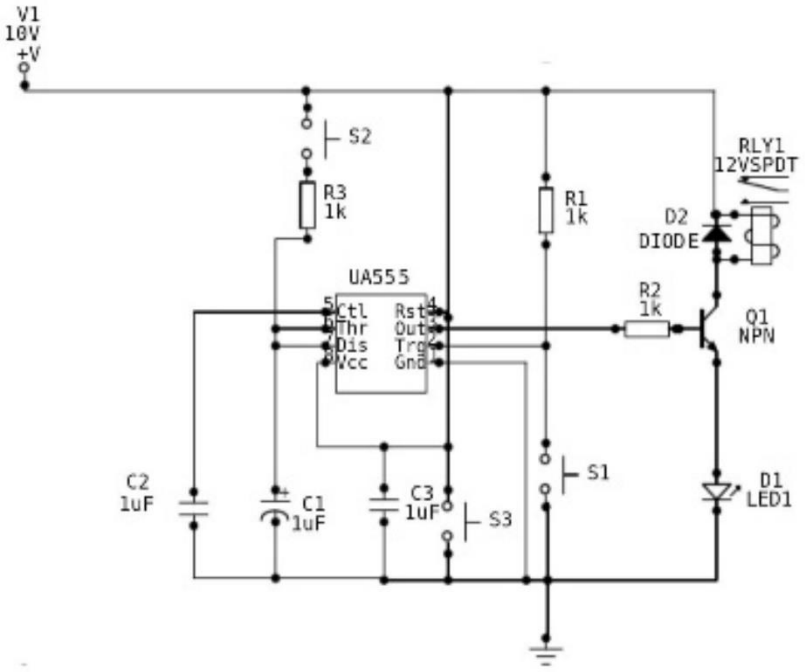


Fig.2: circuit diagram for the delay timer.

Fig.2: circuit diagram for the delay timer.

A monostable circuit produces just a single pulse when triggered. It is called MONOstable because it is only stable in just one state; that is LOW output. The HIGH output is only temporarily stable.

The duration of the pulse is known as the time period T. This was determined by the values of the resistor R1 and capacitor C1. This time period is given by the relation

$$T = 1.1*R1*C1$$

where T is the time period in seconds, R1 is the resistance in ohms while C1 is the capacitance in farad.C1, is a combination of capacitors in parallel arrangement to give the different timing range. A rotary switch is used to select the different time range.

The range of time period is only an approximation for each of the stages. With perfect components the maximum time period for each of the stages is as shown in table 1. But due to problem of charge leakage exhibited by

electrolytic capacitors, their actual value may vary by as much as ± 30% of their rated value. Hence there is an extension in the time range.

For example, a capacitor whose rated value is 100μF theoretically may have its practical value between 70 μF and 130 μF. This will give a time period of 143 seconds instead of 120 seconds. **The device can also be used to keep an electrical or electronic appliance working for an extended time period of hours. This ability was obtained in the delay off mode, which is achieved by opening the switch S3.**

2.3 RESULTS AND DISCUSSION

Table.1 Expected time period for different stages using equation 5.

STAGE	C1(μF)	R1(MΩ)	TIME PERIOD(S)	TIME PERIOD(min)
1	100	1	110	2
2	200	1	220	4
3	538	1	592	10
4	1100	1	1210	20
5	2200	1	2420	40

Table. 2 Obtained time period for different stages

STAGE	C1(μF)	R1(MΩ)	TIME PERIOD(S)	TIME PERIOD(min)
1	100	1	99	1.65
2	200	1	211	3.52
3	538	1	600	10.00
4	1100	1	1265	21.00
5	2200	1	2310	38.50

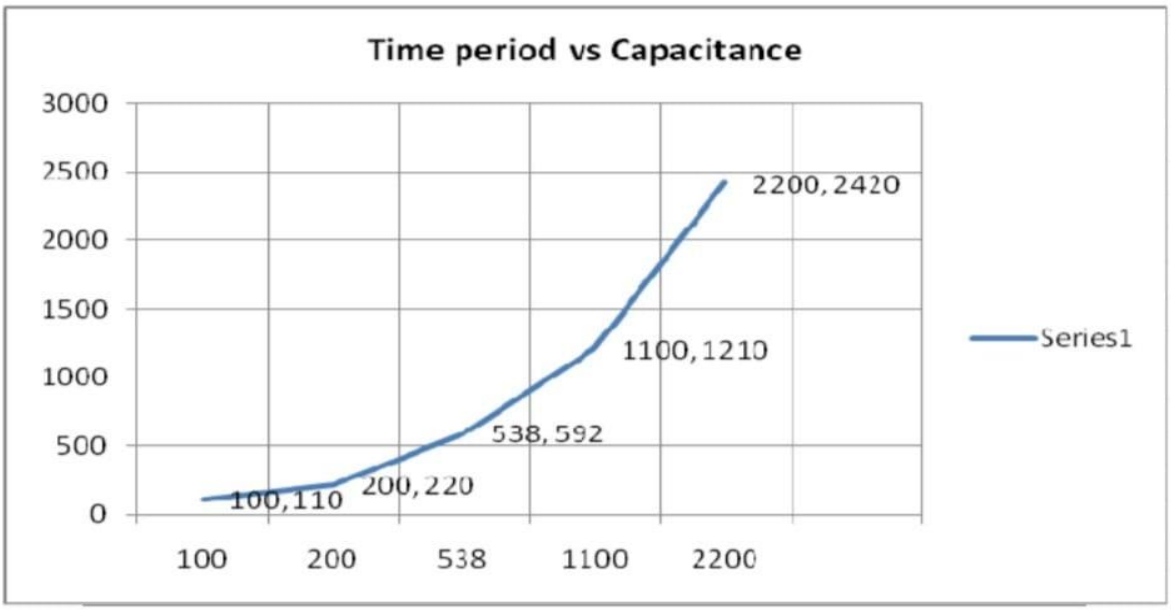


Fig.3: Graph representing expected time delay.

This device can easily be used to time electrical appliances like pressing iron, boiling ring, room warmer, electric cooker and other electrical appliance which ordinarily are not fitted with a timing circuit. The electrical load that the device can control via the relay depends on the load the relay can conveniently accommodate. The choice of relay used can accommodate a maximum load of 2,500W.

Table 2 is the actual representation of how the device works. It shows slight variations from the expected delay period shown in Table.1 and fig.3 for all the stages. This variation is due to charge leakage exhibited by electrolytic capacitors.

2.4 Need of Time Delay Circuit

1. The need to create a time delay circuit arises when timing plays a crucial role in an electronic system or when a delay is required for signal processing.
2. Time delay circuits are essential in applications such as sequential control, signal conditioning, motor control, safety circuits, and audio/video processing.

3. A time delay circuit is used to enhance the precision of timing in any electronic system so that the right signal can be outputted at the right time.

4. Additionally, time delay circuits are used for signal filtering, in which a delay is introduced between the input signal and the output signal to allow time for conditioning and filtering.

5. Overall, the need to create a time delay circuit arises in any electronic system where timing is critical.

6. It is widely used in applications such as motor control, safety circuits, sequential control, and audio/video processing.

7. LED flashers are semiconductor integrated circuits used to turn on and off groups of light emitting diodes either sequentially or according to a programmed pattern.

8. They are found in circuits used as indicators and controllers, as well as in home-built projects.

9. This 555 timer LED flasher project can help you a lot. They are also used for sending emergency signals (SOS). The lights are available in different colors, but all red colors are used universally because it has a high wavelength and can be spotted easily.

Chapter – 3

Components Description and their uses

Components Description on Simulator

Component List

Name	Quantity	Component
D1 D2 D3 D4	4	Blue LED
D5 D6 D7 D8	4	Green LED
U1	1	Timer
C1	1	10 uF, 25 V Polarized Capacitor
R2 R3	2	150 Ω Resistor
BAT1	1	9V Battery
Rpot1	1	100 kΩ Potentiometer

3.1 Table.(1)

Components used:

1. 8 LEDs (2 different colors)
2. 1 Timer (NE555)
3. Polarized Capacitor (10 microfarad, 25 V)
4. Resistor (150 ohm)
5. Battery (9 V)
6. Potentiometer or Variable Resistor (100 kohm)

3.1 LED

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and blocks the current in the reverse direction.

Light-emitting diodes are heavily doped p-n junctions. Based on the semiconductor material used and the amount of doping, an LED will emit coloured light at a particular spectral wavelength when forward biased. As

shown in the figure, an LED is encapsulated with a transparent cover so that emitted light can come out.

Uses of LED

1 used as indicator

2 used in remote control

3 Lighting decoration

4 flashlights

5 used in traffic lights

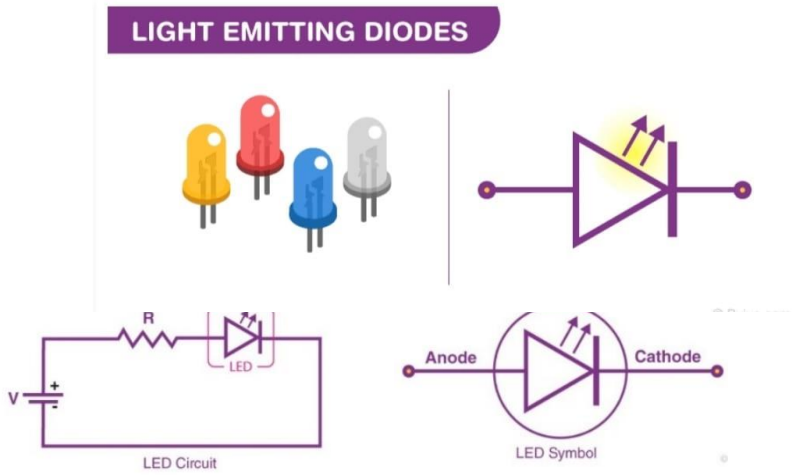


Fig.3.1(a)

3.2 NE555 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.

NE555 timer uses –

1. The standard 555 timer IC is used in a variety of timer, pulse generation, and oscillator applications.
2. It can be used to provide time delays as oscillators and as flip-flop elements.

Fig.3.2

3. The 555 timer IC is an integral part of electronics projects.

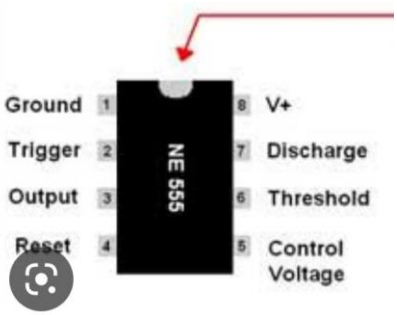


Fig.3.3

3.3 Capacitor

A capacitor is a two-terminal electrical device that can store energy in the form of an electric charge. It consists of two electrical conductors that are separated by a distance. The space between the conductors may be filled by vacuum or with an insulating material known as a dielectric. The ability of the capacitor to store charges is known as capacitance.

Capacitors store energy by holding apart pairs of opposite charges. The simplest design for a capacitor is a parallel plate, which consists of two metal plates with a gap between them. But, different types of capacitors are manufactured in many forms, styles, lengths, girths, and materials.

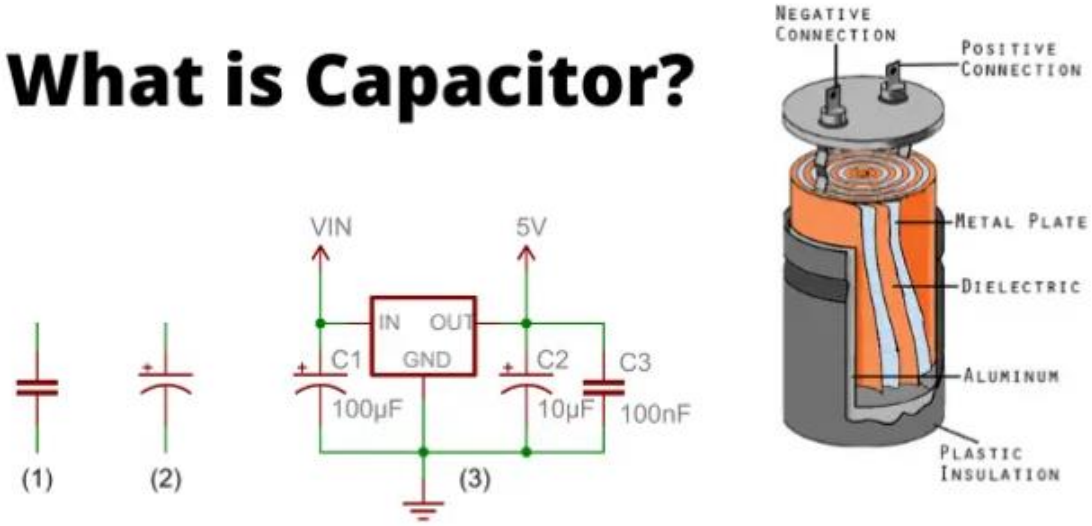


Fig.3.4

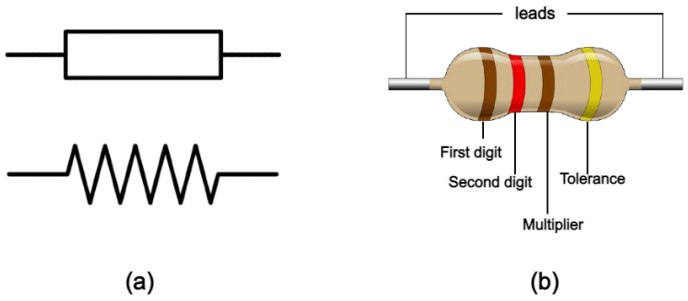
Uses of capacitor -

1. Capacitors allow only AC signals to pass when they are charged blocking DC signals.
2. The main components of filters are capacitors.
3. Capacitors have the ability to connect one circuit segment to another.
4. Capacitors are used by Dynamic Random Access Memory (DRAM) devices to represent binary information as bits.

3.4 Resistor

A passive electrical component with two terminals that are used for either limiting or regulating the flow of electric current in electrical circuits.

The main purpose of resistor is to reduce the current flow and to lower the voltage in any particular portion of the circuit. It is made of copper wires which are coiled around a ceramic rod and the outer part of the resistor is coated with an insulating paint.



(a) Representation of resistor in circuit diagram
(b) Resistor with color strips

Fig.3.5

Uses of Resistor -

1. Circuit functions
2. Dividing voltage
3. Heating
4. Frequency and timing
5. LEDs and transistor

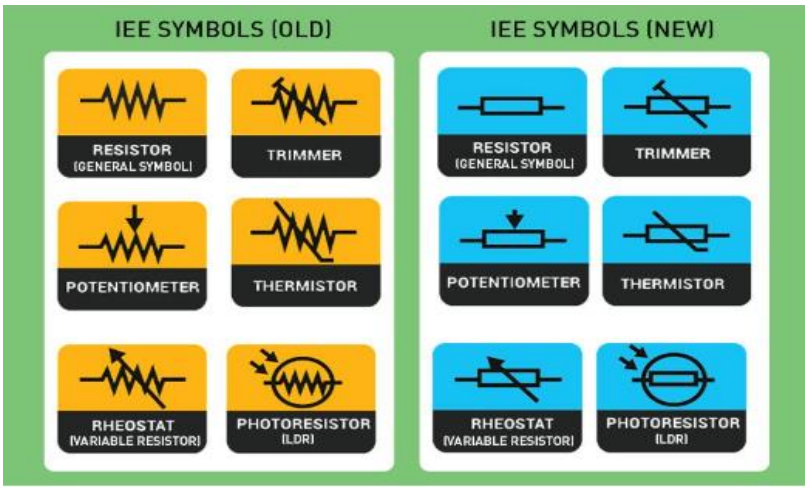


Fig.3.6

3.5 Potentiometer

The potentiometer is an instrument used for measuring the unknown voltage by comparing it with the known voltage. It can be used to determine the emf and internal resistance of the given cell and also used to compare the emf of different cells. The comparative method is used by the potentiometer. The reading is more accurate in a potentiometer.

Fig.3.7

Uses of Potentiometer -

1. Voltage divider- use as a voltage divider to change the output voltage of a voltage supply.
2. Audio control- Sliding potentiometer are commonly used in modem low power audio systems as audio control devices.
3. To determine cell's internal resistance.

3.6 Batteries

A **battery** is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices.

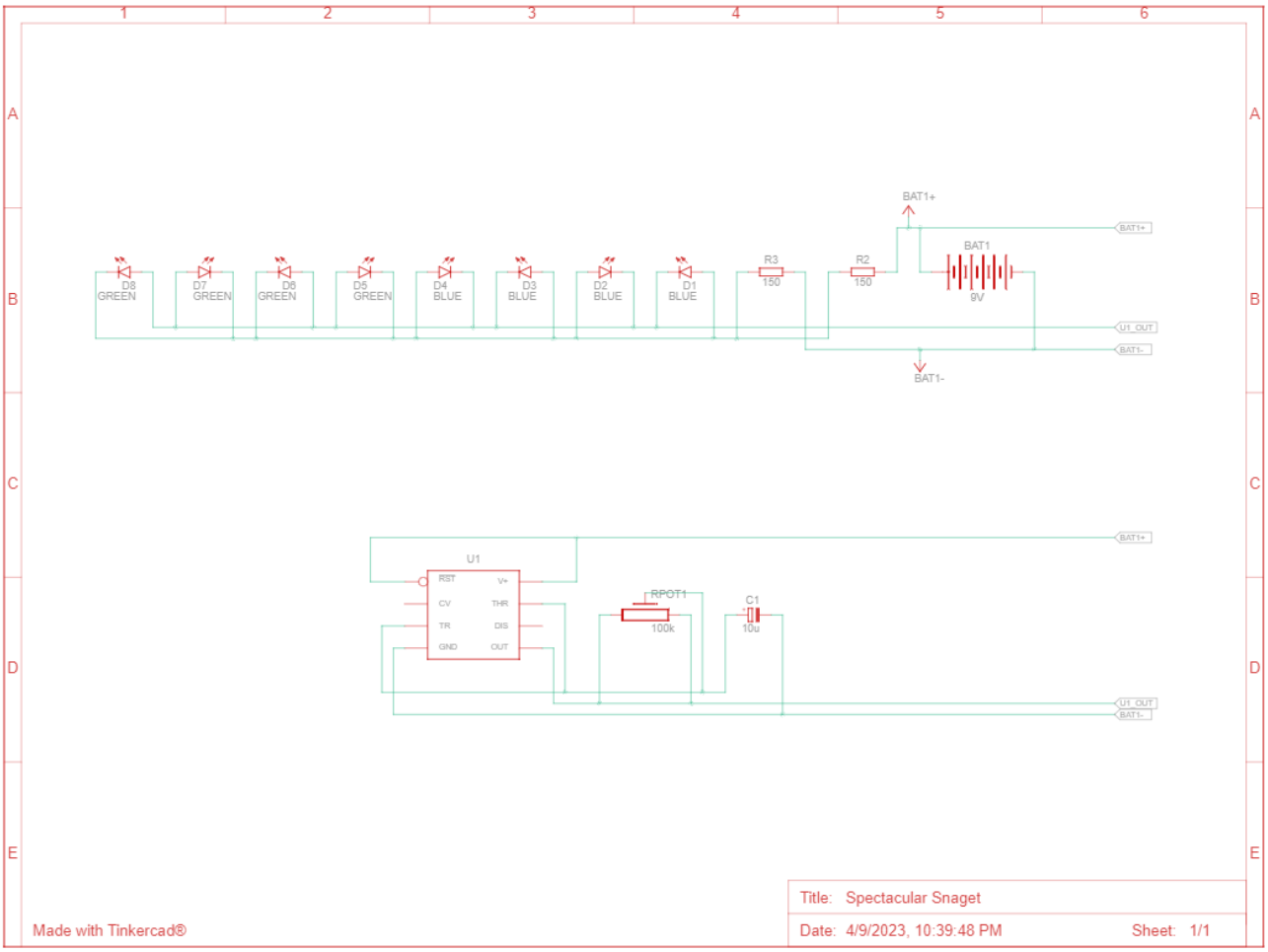
Uses of Batteries –

1. Used in Health Instruments.
2. Used in Medical Sector.
3. Used in Logistics and Construction.
4. Used in Firefighting and Emergency Response.
5. Used in Military Operations.
6. Used in Vehicle.

Fig.3.8

Chapter – 4
Circuit on Simulator

Circuit on Simulator



4.1 Fig.1(a) Circuit Diagram on Simulator

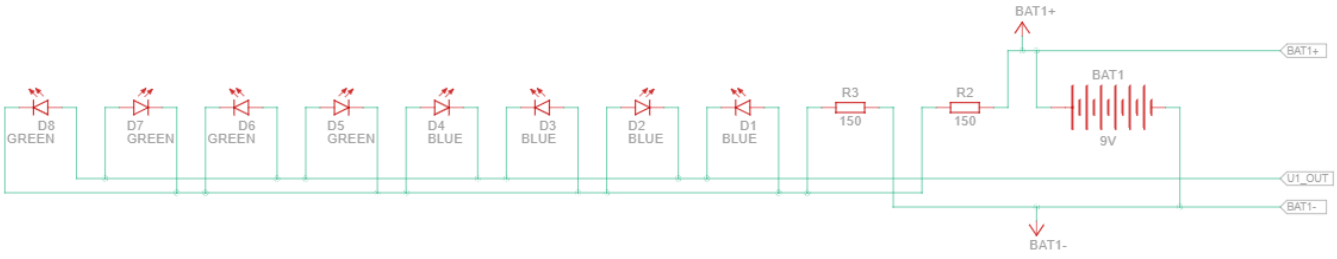


Fig.1(b)

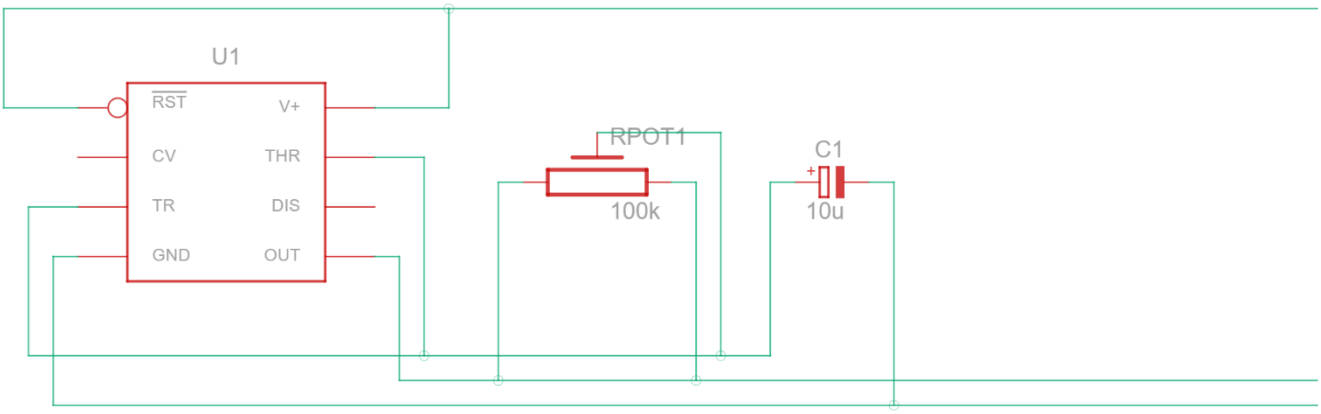
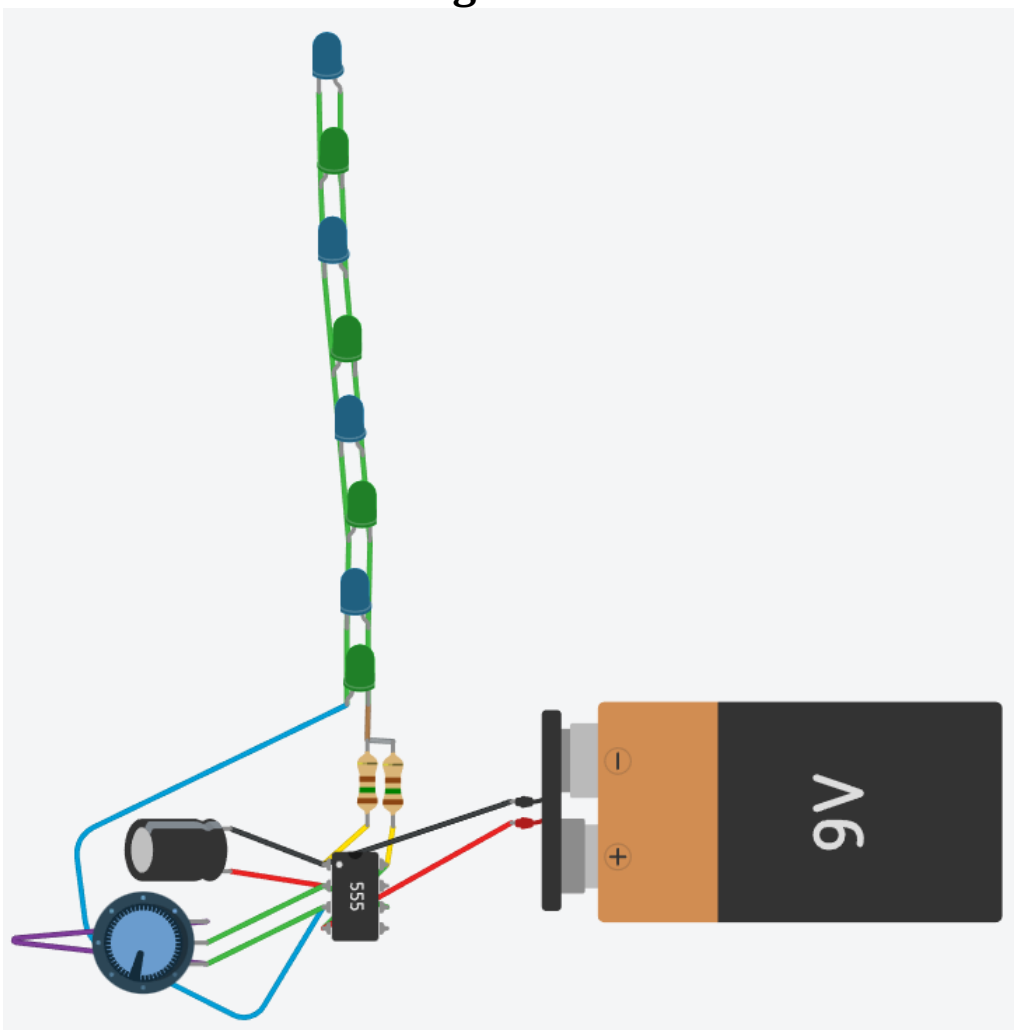


Fig. 1(c)

4.2 Fig. 2 Circuit



Chapter – 5
Working Principle of Circuit

Working

1. The NE555 IC is configured as an astable multivibrator, which means that it generates a continuous square wave output at its output pin.

2. The capacitor and resistor connected to the NE555 IC determine the frequency of the square wave output.

3. In this circuit, the 10 μF capacitor and the 100k ohm potentiometer are used to adjust the frequency of the output.

4. The output of the NE555 IC is connected to a decade counter IC, which divides the input frequency by 10 and distributes the output to its 10 output pins.

5. The output pins of the decade counter are connected to transistors, which act as switches for the LED bulbs.

6. When a transistor is switched on by a pulse from the decade counter, the corresponding LED bulb connected to it lights up.

7. The LED bulbs light up one after another, creating a flashing effect.

8. The cycle repeats as the NE555 IC generates another pulse, triggering the decade counter and switching on the next LED bulb.

9. The 150 ohm resistor is used to limit the current flowing through the LED bulbs to a safe level. The 9V battery is used to provide power to the circuit.

10. The 100k ohm potentiometer can be adjusted to change the frequency of the flashing effect. This circuit can be modified to include more LED bulbs or different components to create different effects.

Chapter – 6

Advantages, Disadvantages & Application

6.1 Advantages

1. Allows electrical separation between small and large currents.
2. With this device, it is possible to manage the different variables such as voltage, power, and control voltages.
3. It is possible to control the relay from a remote station
4. Time delay relays are useful for implementing control logic with PLCs or DCS systems.
5. A time delay relay is useful for scheduling the start or stop of the machinery.
6. Time delay relay allows delaying time setting from a few seconds to even hours.
7. With time delay relays it is possible to save energy.

6.2 Disadvantages

1. 555 is not really able to create very square 50% square waves without a lot of external circuitry or a divider circuit.

2. The 555 can be modulated for frequency, but only in a narrow range. It can't even come close to sweeping over the full audio range, and has trouble even doing a 2:1 frequency ratio. Frequency modulation is not very linear either.

3. The 555 is not very accurate with temperature changes. It has been designed to reduce changes from the power supply voltage, but it still has an effect on timing accuracy.

4. The 555 cannot handle frequencies much above 1 MHz or so. Something like a 32 MHz clock is completely out of the question.

5. Pulse width modulation can be done with the resistors, but can't handle the full range from 1 to 99%. At best it can only do about 1% to 50% modulation - and that's at lower frequencies.

6. The 555 in normal wiring has a fixed output pulse polarity. We have to play some tricky wiring in order to create an inverted output timing pulse.

7. The trigger input for mono-stable timing is fixed to a negative pulse input. It can't accept a positive pulse input directly.

8. The timing capacitor input is not high impedance. This reduces it's usefulness for accurate very long time durations. An op-amp can improve that a lot.

9. The 555 does not use a current regulator for capacitor charging or discharging. That would require external circuitry. Therefore the voltage waveform on the timing capacitor is exponential, not linear. If it was linear, we could use that voltage as a ramp, sawtooth, or triangle waveform output with suitable buffering.

6.3 Application

1. Automatic Control
2. Time delay helps in remote control operations.
3. Communication
4. Helpful in delay in automatic on/off of electronic equipment

Chapter – 7
Futuristic Improvement

Futuristic Improvement Ideas in the Circuit

1. One improvement could be to replace the decade counter IC with a programmable microcontroller, such as an Arduino or Raspberry Pi. This would allow for more flexibility in the flashing The patterns of the LED bulbs, as the microcontroller can be programmed to create custom patterns and sequences.
2. Additionally, a microcontroller can be programmed to respond to external inputs, such as sound or light, to create more dynamic and interactive effects.
3. Another improvement could be to use more energy-efficient components, such as high-efficiency LEDs and low-power microcontrollers. This would reduce the power consumption of the circuit and make it more environmentally friendly.
4. Additionally, the circuit could be made wireless by adding Bluetooth or Wi-Fi connectivity, allowing the user to control the flashing patterns of the LED bulbs from a mobile device or computer. This would add a level of convenience and interactivity to the circuit.
5. Add sensors: By adding sensors, such as motion or temperature sensors, the circuit could be programmed to respond to changes in the environment. For example, the circuit could be set up to flash the LEDs faster in response to motion, or change color in response to changes in temperature. This could make the circuit more interactive and responsive to its surroundings.
6. Use RGB LEDs: Instead of using single-colored LEDs, RGB (red-green-blue) LEDs could be used. This would allow the circuit to create a wider range of colors and effects, as each LED can be controlled individually to create different colors and color patterns.
7. Add sound: By adding a small speaker or buzzer to the circuit, it could be programmed to create sound effects or play music in addition to flashing the LEDs. This could make the circuit more entertaining and engaging.

Chapter – 8
Conclusion

1. The NE555 IC project with 8 LED bulbs, a timer, a 10 microfarad (μF) polarized capacitor, a 150 ohm resistor, a 9V battery, and a 100k ohm potentiometer is a simple yet effective LED flasher circuit that can create a flashing effect using multiple LEDs.

2. The NE555 IC is configured as an astable multivibrator and generates a continuous square wave output that is used to trigger the decade counter IC.

3. The decade counter IC divides the input frequency by 10 and distributes the output to its 10 output pins.

4. The output pins of the decade counter are connected to transistors, which act as switches for the LED bulbs.

5. The 150 ohm resistor is used to limit the current flowing through the LED bulbs to a safe level, and the 10 μF capacitor and the 100k ohm potentiometer are used to adjust the frequency of the flashing effect.

6. This project is a great way to learn about the NE555 IC and how it can be used to create different electronic circuits.

7. It also demonstrates the use of a decade counter IC, which is commonly used in electronic circuits to divide the frequency of a signal.

Overall, this project is a fun and educational way to learn about electronics and can be a great starting point for further exploration and experimentation with different components and circuits.

Chapter – 9
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