Emergency/Flashing Light Using Timer IC 555 And IC CD4017

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ABSTRACT: Police lights are flashing lights which are type of emergency vehicle lighting. You can also find similar flashing lights in ambulances, fire department, military vehicles etc. they visually captivating and often convey the state of urgency of their task to the other road users. In this project we will just take visual aspect of the police light and implement then in our own way. The circuit uses 555 timer and the decade counter IC CD4017. Here, the 555 timer runs in astable mode. Decade counter 4017 counts the incoming pulses and activate its output i.e., for the first pulse Q0 becomes high and for the second pulse Q1 becomes high and so on. Again for tenth pulse Q0 state becomes high. This paper presents an emergency lighting system integrated into a compact lamp using high-brightness LEDs. These devices have high luminous efficacy, long useful life and small size. Besides, they work with low voltage and current values and they do not need ignition process. These features make these devices attractive to use in emergency lighting. The proposed circuit is simple and has low cost. Its main characteristic is the easiness of installation with the simple replacement of incandescent and compact fluorescent lamps by the LED lamp. The proposed circuit supplies the LEDs in two ways. In the first way, the lamp is supplied by mains (220VAC) using a circuit called voltage regulator in DC. In the second situation, in the emergency mode, the circuit supplies the LED by a Ni-MH battery without the need of converters. The Brazilian standard (NBR 10898) and IEEE standard (IEEE Std 446-1995) for emergency lighting systems are attended by the proposed topology. The proposed circuit was implemented and the experimental results show a satisfactory behaviour of the Lamp

Key Words: Timer IC 555, IC CD4017, LED, Capacitor, Decade Counter, Flip Flop, Astable Multi vibrator, Bi stable Multi vibrator

1.INTRODUCTION In the late nineteenth century lamps supplied by electricity, based on heating of a carbon or tungsten filament which became incandescent inside a bulb, were developed [1]. This kind of lamp still has been used in some applications. However, due to the low efficiency presented by incandescent lamps and the growing concern about energy saving, new products have been emerging and have become popular [2]. Among them are compact fluorescent lamps, which provide superior performance compared to incandescent lamps. Around the 60's, the emission of light by recombination of electrons and holes in semiconductors materials was reported and called electroluminescence, emerging the Light Emitting Diode (LED) [3]. This device presents higher luminous efficiency and long useful life compared to the fluorescent lamps [4]. Currently, the LED can be considered the major challenge in the lighting industry in which technological innovations emerge at every stage [5]. Emergency lighting system is used to maintain the lighting in a possible failure of the normal energy source. It is mandatory in places such as buildings and public areas, ensuring safety, preventing accidents and indicating routes of escape. The traditional models of emergency lighting systems use fluorescent lamps that require batteries with high energy capacity which had considerable weight and size. When light sources with high luminous efficacy and low voltage level are applied in this equipment, the battery used can be reduced and the system becomes compact. Thus, this work develops an emergency lighting system integrated into a compact lamp using high-brightness LEDs, allowing the use of the emergency lighting system also in the daily activities supplied by mains. Besides, it has the advantage of easy installation of the equipment, with the simple replacement of incandescent and compact fluorescent lamp by LED without any change in the electrical installation. One characteristic of the proposed circuit is the output current control without switch-mode DC-to-DC converters when supplied by mains or by battery. A voltage regulator based on a capacitor with a full-wave rectifier is used to supply the LEDs, and to charge the battery by mains. When a mains' failure happens, two LEDs are supplied directly by battery A considerable portion of the energy consumed in the electrical system in the world today is converted to artificial lighting. Light is essential to harmony between the activities of people in the contemporary world. With the increase in the energy consumption

by different segments in relation to the difficulty of generation, it is possible to see the importance of efficient ways of lighting.

The proposed idea in this paper presents characteristics of a permanent and non-permanent lighting system, and therefore must complies with the standard. Moreover, the system is considered an autonomous unit because the light source (LEDs), the battery and its charger and other circuits required for system operation are presented in the same equipment.

2. MATERIALS AND METHODS

2.1 COMPONENTES:

» 555 Timer IC
»IC CD4017-Decade counter model
» Transistor: BC547 NPN
» Electrolytic capacitor- 2.2µF
» Diodes:
» D1, D2, D3, D4, D5, D6: 1N4148
» Resistor:
» R1: 22kΩ
» R2: 1kΩ
» R3, R4, R5, R6, R7, R8, R9, R10: 470Ω
» LED-5mm (Red and Blue)
» Bettery-9V
» Connecting wires

2.2 TIMER IC NE555

The NE555 IC is a highly stable controller and capable of producing accurate timing pulses. With an astable operation, the frequency and duty cycle are accurate controlled by two external resistors and one capacitor. Which monostable operation, the time delay is controlled by one external resistor and one capacitor.

PIN DIAGRAM

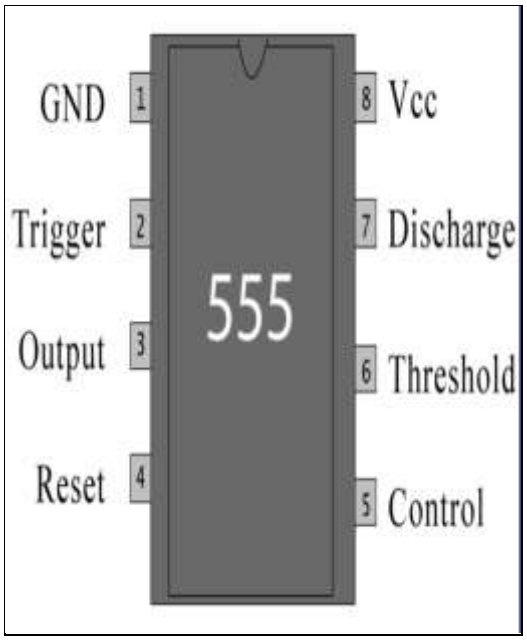


Fig.1 Pin diagram of Timer IC 555

BLOCK DIAGRAM

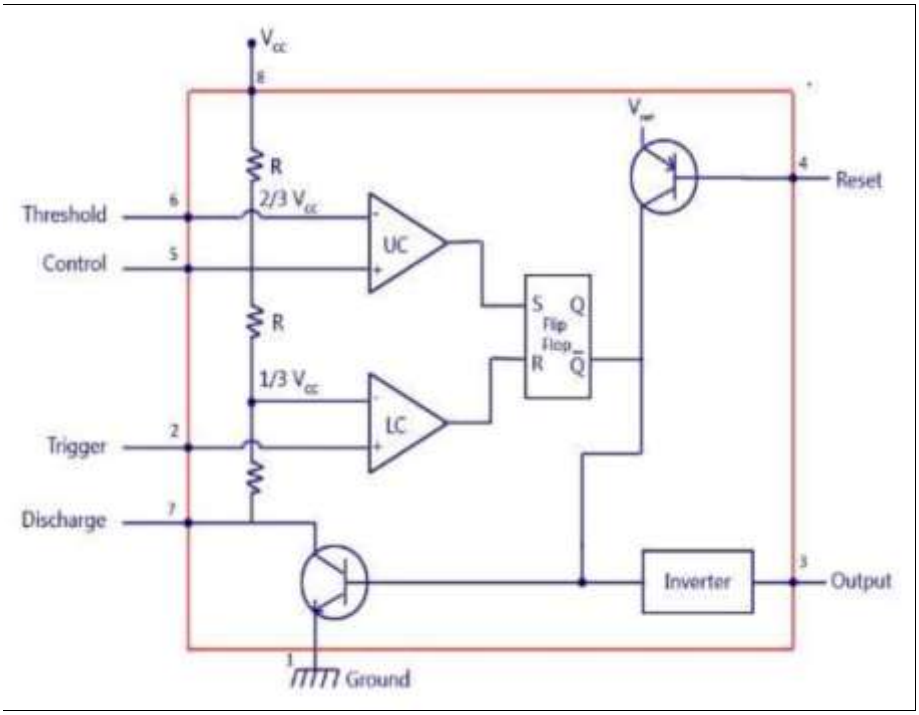


Fig.2 Block diagram of IC 555

PIN DISCRIPTION

Pin 1: **Grounded Terminal:** All the voltages are measured with respect to the Ground terminal.
Pin 2: Trigger Terminal: The trigger pin is used to feed the trigger input hen the 555 IC is set up as a monostable multi vibrator. This pin is an inverting input of a comparator and is responsible for the transition of flip-flop from set to reset. The output of the timer depends on the amplitude of the external trigger pulse
applied to this pin. A negative pulse with a dc level greater than Vcc/3 is applied to this terminal. In the negative edge, as the trigger passes through Vcc/3, the output of the lower comparator becomes high and the complimentary of Q becomes zero. Thus the 555 IC output gets a high voltage, and thus a quasi-stable state.
Pin 3: Output Terminal: Output of the timer is available at this pin. There are two ways in which a load can be connected to the output terminal. One way is to connect between output pin (pin 3) and ground pin (pin 1) or between pin 3 and supply pin (pin 8). The load connected between output and ground supply pin is called the *normally on load* and that connected between output and ground pin is called the *normally off load.*
Pin 4: Reset Terminal: Whenever the timer IC is to be reset or disabled, a negative pulse is applied to pin 4, and thus is named as reset terminal. The output is reset irrespective of the input condition. When this pin is not to be used for reset purpose, it should be connected to + VCC to avoid any possibility of false triggering.
Pin 5: Control Voltage Terminal: The threshold and trigger levels are controlled using this pin. The pulse width of the output waveform is determined by connecting a POT or bringing in an external voltage to this pin. The external voltage applied to this pin can also be used to modulate the output waveform. Thus, the amount of voltage applied in this terminal will decide when the comparator is to be switched, and thus changes the pulse width of the output. When this pin is not used, it should be bypassed to ground through a 0.01 micro Farad to avoid any noise problem.
Pin 6: **Threshold Terminal:** This is the non-inverting input terminal of comparator 1, which compares the voltage applied to the terminal with a reference voltage of 2/3 VCC. The amplitude of voltage applied to this terminal is responsible for the set state of flip-flop. When the voltage applied in this terminal is greater than 2/3Vcc, the upper comparator switches to +Vsat and the output gets reset.
Pin 7: **Discharge Terminal:** This pin is connected internally to the collector of transistor and mostly a capacitor is connected between this terminal and ground. It is called discharge terminal because when transistor saturates, capacitor discharges through the transistor. When the transistor is cut-off, the capacitor charges at a rate determined by the external resistor and capacitor.
Pin 8: Supply Terminal: A supply voltage of + 5 V to + 18 V is applied to this terminal with respect to ground (pin 1).

SOME IMPORTANT FEATURES OF 555 TIMER

IC 555 timer is used in almost every electronic circuit today. For IC 555 timer working as a flip-flop or as a multi-vibrator, it has a particular set of configurations. Some of the major features of the IC 555 timer would be,

» It operates from a wide range of power ranging from +5 Volts to +18 Volts supply voltage.
» Sinking or sourcing 200 mA of load current.
» The external components should be selected properly so that the timing intervals can be made into several minutes along with the frequencies exceeding several hundred kilohertz.
» The output of a 555 timer can drive a transistor-transistor logic (TTL) due to its high current output.
» It has a temperature stability of 50 parts per million (ppm) per degree Celsius change in temperature which is equivalent to 0.005 %/ °C.
» The duty cycle of the timer is adjustable Also, the maximum power dissipation per package is 600 mW and its trigger and reset inputs have logic compatibility

ASTABLE MODE

This means there will be no stable level at the output. So the output will be swinging between high and low. This character of unstable output is used as a clock or square wave output for many applications.

2.3 IC CD4017 – DECADE COUNTER MODEL

Let us now introduce a new IC named IC-CD4017. It is a CMOS decade counter cum decoder circuit. This can work out of the box for most of our low range counting applications. It can count from zero to ten and its outputs are decoded. This saves a lot of board space and time required to build our circuit when our application demands using a counter followed by a decode IC. This IC also simplifies the design and makes debugging easy.

This IC is very useful and also user friendly. To use the IC just connect it according the specifications described below in the pin configuration and give the pulses you need to count to the pin 14 of the IC. Then you can collect the outputs at respective output pins. When the count is zero, pin- 3 is HIGH. When the count is 1, pin-2 is HIGH and so on.

The output states (Q0, Q2,Q4) are configured to flash the blue LEDs three times and the states(Q5,Q7,Q9)are configured to flash the red LEDs three times.

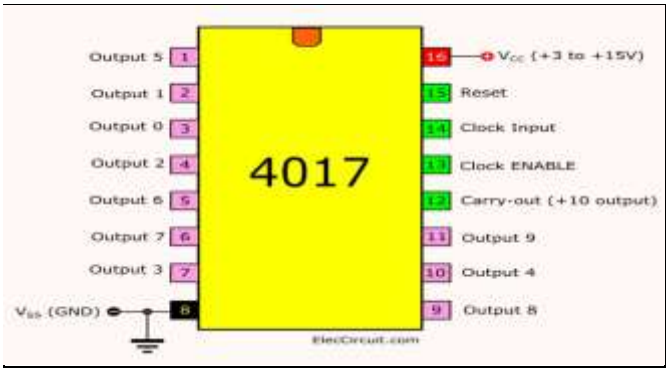
Based on the outputs of the 4017 IC, two transistors switch the LEDs ON and OFF

Resistor R3, R4, R5, R6 are used to protect LEDs from high voltage.

FEATURES:

» High speed 16 pin CMOS decade counter.
» Wide supply voltage ranges from 3V to 15V.
» TTL compatible.
» Maximum clock frequency: 5.5MHz.
» Available in 16 pin PDIP.

PINOUT DIAGRAM OF IC 4017



PINS DISCRIPTION:

· 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 1 count.
· Pin-3: It is the output 0. It goes high when the counter reads 0 count.
· 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 which 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 outputs which are used to cascade the IC with another counter so as to enable counting greater than the range supported by a single IC 4017. By cascading with another 4017 IC, we can count up to 20 numbers. We can increase and increase the range of counting by cascading it with more and more IC 4017s. Each additional cascaded IC will increase the counting range by 10.14
· Pin-13: This pin is the disable pin. In normal mode of operation, this is connected to ground or logic LOW voltage. If this pin is connected to logic HIGH voltage, then the circuit will stop receiving pulses and so it will not advance the count irrespective of number of pulses received from the clock.
· 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 in order to advance the count. The count advances on the rising edge of the clock.
· Pin-15: This is the reset pin which 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.

INTERNAL BLOCK DIAGRAM:

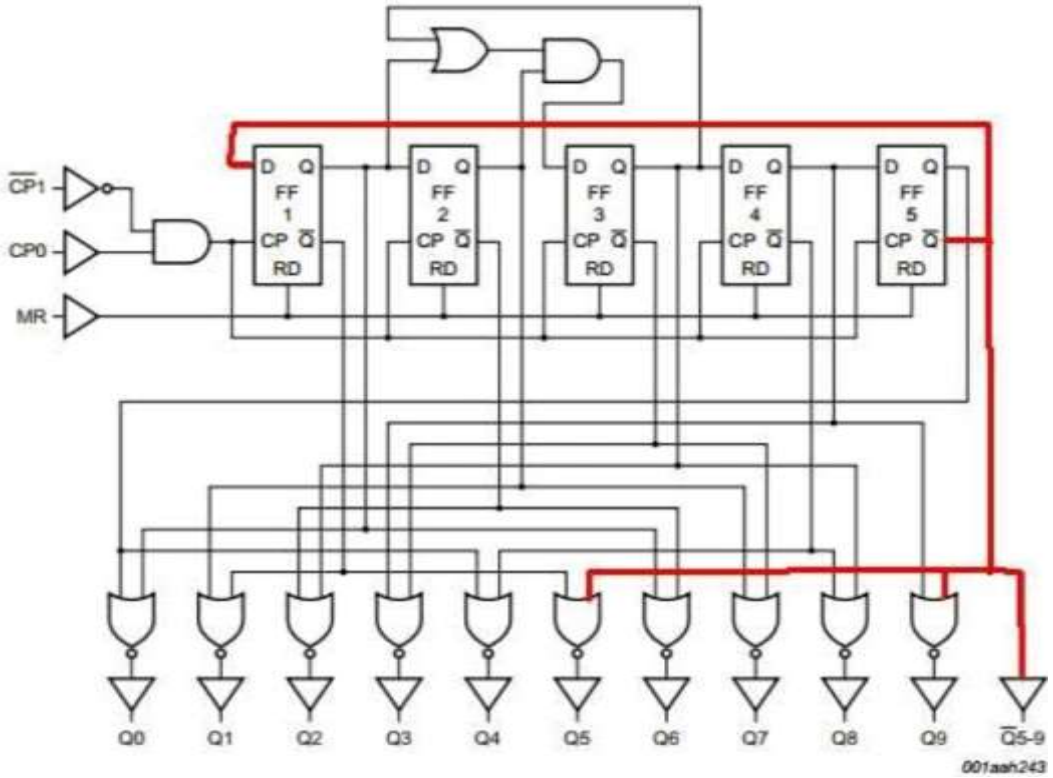
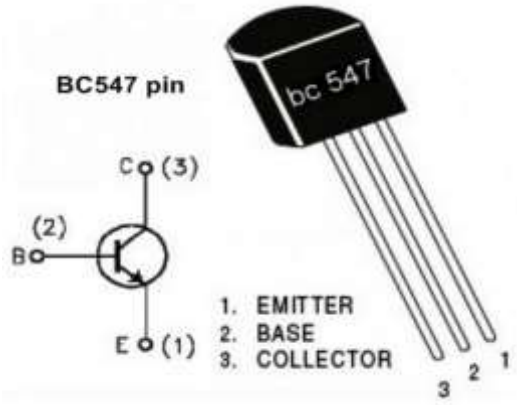


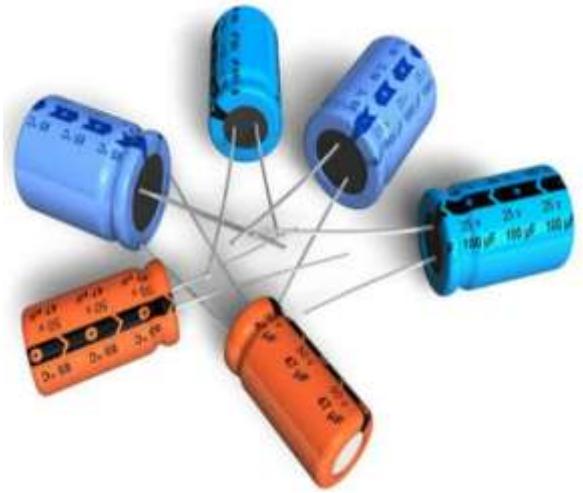
Fig.3 Internal block diagram of IC CD4017

TRANSISTOR: BC547 (NPN)



BC547 is an NPN bipolar junction transfers of resistance current at its base controls a larger current at collector and emitter terminals. BC547 is mainly use for amplification and switching purposes. It has a maximum current gain of 800. Its equivalent transistors are BC548 & BC549. The transistor terminals required a fixed DC desired region of the characteristic curves. This is known as amplification applications the transistor is biased such that it is partly on for all input condition. The input signal at base is amplified and taken at the emitter. BC547 is used in common emitter configuration for amplifiers. For switching applications transistor is biased so that is remains fully ON, if there is signal at its base. In the absence of base signal. It gets completely OFF.

CAPACITOR:



Capacitor is a passive component used to store charge. The charge stored in a capacitor is the product of its capacitance(C) value and the voltage (V) applied to it. Capacitors offer infinite reactance to zero frequency so they are used for blocking DC components or bypassing the AC signal. The capacitor undergoes through recursive cycle of charging and discharging in AC circuits where the voltage and current across it depends on the RC time constant. For this reason, capacitors are used for smoothing power supply variations. Capacitors may be non-polarized/polarized and fixed /variable. Electrolytic capacitors are polarized while ceramic and paper capacitors are examples of non-polarized capacitors. Since capacitors store charge, they must be carefully discharged before troubleshooting the circuits. The maximum voltage rating of the capacitors used must always be greater than the supply voltage.

DIODE:

A diode is a two terminal electronic component that conducts current primarily in one direction. A semiconductor diode the most common type is a crystalline piece of semiconductor material with a p-n junction connected to two terminals. Diode is used for switching purpose. The most common function of a diode is to allow an electric current to pass in one direction (called the diode's forward direction) while blocking it in the opposite direction (the reverse direction). The unidirectional behaviour is called rectification and is used to convert AC to DC.

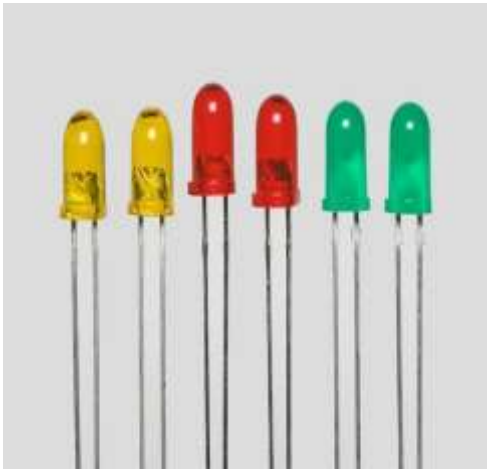
Diode 1N4148

The 1N4148 is standard silicon switching signal diode. It is one of the most popular and long-lived switching diodes because of its dependable specifications and low cost.

RESISTOR:

Resistor is a passive component used to control current in a circuit. Its resistance is given by the ratio of voltage applied across its terminals to the current passing through it. Thus a particular value of resistor for
fixed voltage, limits the current through it. Resistors can be either fixed or variable. The low power resistors are comparatively smaller in size then high power resistors. The resistance of a resistor cab be estimated by their colour codes or can be measured by a multi meter. The different values of resistances are used to limit the current or get the desired voltage drop according to the current voltage rating of the device to be connected in the circuit. For example, if an LED of rating 2.3 V and 6mA is to be connect with a supply of 5 V, a voltage drop of 2.7 V (5V-2.3V) and limiting current of 6mA is required. This can be achieved by providing a resistor of 450Ω connected in a series with the LED.

LED:



The LED works on electroluminescence principle which can be defined as the emission of light from a semiconductor under the influence of an electric field. Light emitting diodes (LEDs) are semiconductor light sources. The light emitted from LEDs varies from visible to infra-red and ultra violet regions. The operate on low voltage and power. LEDs are one of the most common electronic components and are mostly used as indicators in circuit. They are also used for luminance and optoelectronic applications. Based on semiconductor diode, LEDs emit photons when electrons recombine with holes on forward biasing. The two terminals of LEDs are anode (+) and cathode (-) can be identified by their size. The longer leg is the positive terminal and shorter on is negative terminal.

WORKING:

Here 555 timer produces continuous pulses via pin 3. The width of these pulses can be varied by varying the resistance (R1, R2) or capacitor(C1). These pulses are given as input to the decade counter. For every incoming pulse the output state of the decade counter is get incremented.

» For first puls-Q0 high-blue LEDs are glow.
» For second pulse-Q1 high(not connected)-all LEDs are OFF.
» For Third pulse-Q2 high-blue LEDs are glow.
» For forth pluse-Q3 high-all LEDs are OFF.
» For fifth pulse-Q4 high-blue LEDs are glow.
» For sixth pulse-Q5 high-red LEDs glow, blue LEDs OFF. Hence, blue LEDs flashes for three times.
» For seventh pulse-Q6 high-all LEDs are OFF.
» For eighth pulse-Q7 high-red LEDs are glow.
» For nineth pulse-Q8 high-all LEDs are OFF.
» For tenth pulse-Q9 high-red LEDs are glow.
» For eleventh pulse-Q0 high-blue LEDs glow and red LEDs OFF. Hence, red LEDs flash for three times. This process repeats continuously.

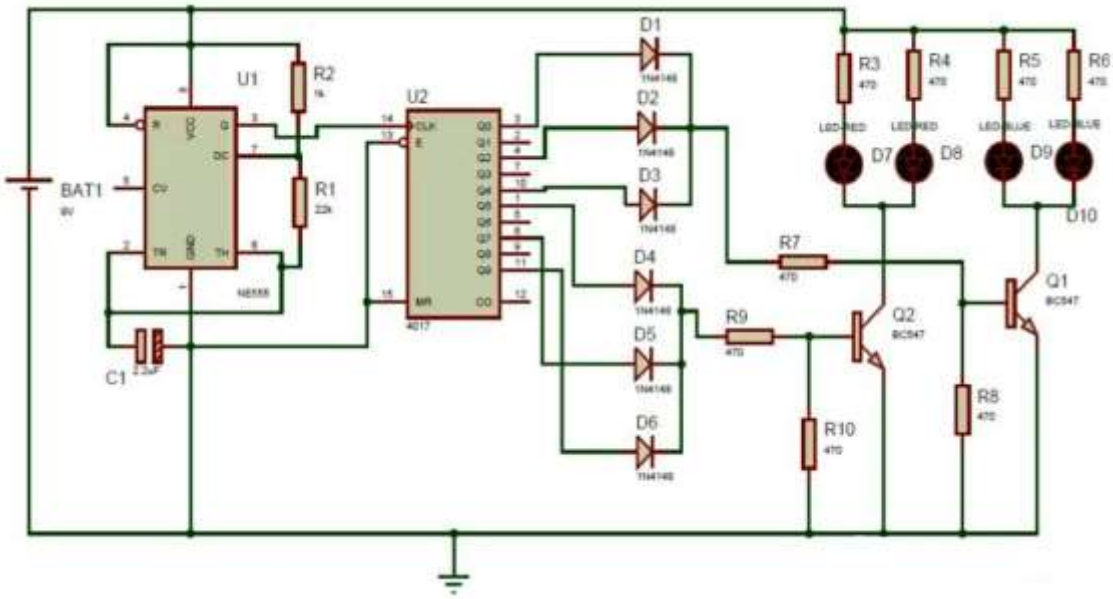


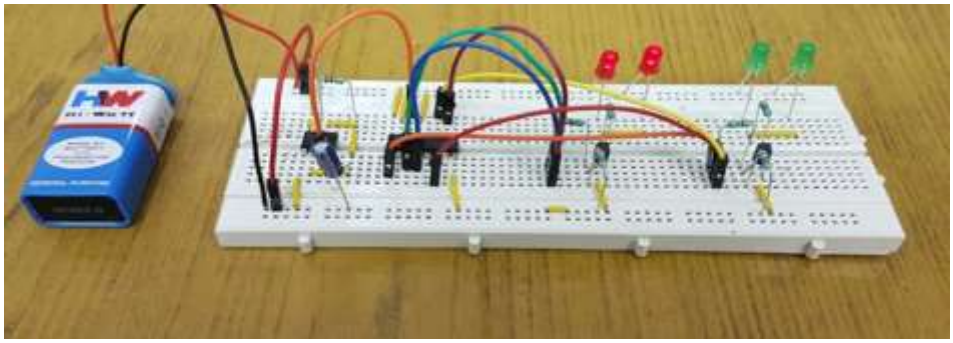
Fig.4 Schematic diagram of Flashing Light Using IC 555 and IC CD4017

HOW TO OPERATE

» Apply power to the circuit.

» Now observe the LEDs, red LEDs flashes three times and blue LEDs are flash three times and these process repeats.

» If you want to set the different time delays for LEDs then vary the resistance or capacitor.



APPLICATIONS

» This circuit used as an indicator Lighting for police cars, Ambulance and other Emergency Vehicle

» We can use it as LED flasher circuit by making some modifications.

» We can make chaser circuit for purpose of Decoration

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