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DESIGN OF SMART AUTOMATIC STREET LIGHT SYSTEM

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ABSTRACT

This paper reports an design of smart automatic street light system, which needs no manual operation for switching ON and OFF of light. When there is a need of light it automatically switches ON designed using Timer IC 555 and LDR.

KEYWORDS: Electronic Box, Comparator, Flip-Flop, LDR

Smart automatic street light is designed using Timer IC 555 and LDR. When darkness rises to a certain level then sensor circuit gets activated and switches ON and when there is other source of light i.e. daytime, the street light gets OFF. The sensitiveness of the street light can also be adjusted. In our work, we have used eight LED as a symbol of street lamp, but for high power switching one can connect Relay (electromagnetic switch) at the output of pin 3 of IC 555 that will make easy to turn ON/OFF any electrical appliances that are connected through relay. IC 555 timer is a one of the most widely used IC in electronics and is used in various electronic circuits. The timer got its name from the three 5 kilo-ohm resistor in series employed in the internal circuit of the IC. The 555 timer comes as 8 pin DIP (Dual In-line Package) device. There is also a 556 dual version of 555 timer which consists of two complete 555 timers in 14 DIP and a 558 quadruple timer which is consisting of four 555 timer in one IC and is available as a 16 pin DIP in the market.

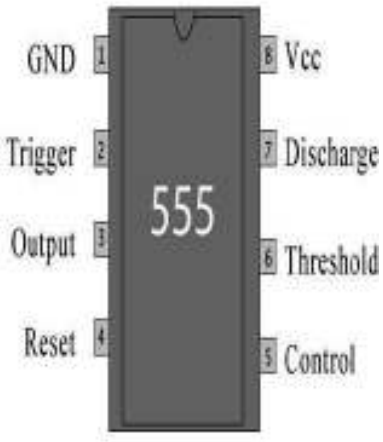

Figure 1: IC 555 Pin Diagram

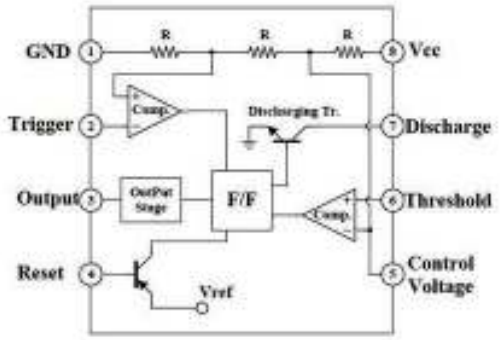

Figure 2: Internal Configuration of IC 555

As shown in figure 1 and 2, IC555 includes two comparators, one RS flip-flop and other few discrete components like transistors, resistors etc. the biasing voltage (Vcc) is divided in three parts through voltage divider using same value of resistors R. From these, 1/3 Vcc is given to non-inverting terminal of trigger comparator and 2/3 Vcc is given to inverting terminal of threshold comparator. The outputs of both comparators are given to R and S inputs of flip-flop. The Q' output is actual output of IC and Q output drives discharging transistor that provides discharging path to external capacitor whenever it is high. When negative trigger <1/3 Vcc is applied at trigger input pin, the trigger comparator gives high output that resets the flip flop and Q' output that is the output of chip goes high.When positive trigger >2/3 Vcc is applied at threshold input pin, the threshold comparator gives high output that sets the flip flop. The Q output will become high and the output of chip goes low. At that time discharging transistor that provides discharging path to external capacitor. The high reset input keeps flip-flop enable. If it is low, flip-flop disables and output will be low. No any effect of threshold and trigger comparator outputs[Available at 2].

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MATERIALS AND METHODS

Comparator

The Comparator are the basic electronic component which compares the two input voltages i.e. between the inverting (-) and the non-inverting (+) input and if the non-inverting input is more than the inverting input then the output of the comparator is high. Also the input resistance of an ideal comparator is infinite.

Voltage Divider

As we know that the input resistance of the comparators is infinite hence the input voltage is divided equally between the three resistors. The value being Vin/3 across each resistor.

Flip/Flop

Flip/Flop is a memory element of Digital-electronics. The output (Q) of the flip/flop is 'high' if the input at 'S' terminal is 'high' and 'R' is at 'Low' and the output (Q) is 'low' when the input at 'S' is 'low' and at 'R' is high.

FUNCTION OF DIFFERENT PINS

a. **Ground:** This pin is used to provide a zero voltage rail to the Integrated circuit to divide the supply potential between the three resistors shown in the fig.2.**b. Trigger:** the voltage at the non-inverting end of the comparator is $V_{in}/3$, so if the trigger input is used to set the output of the F/F to 'high' state by applying a voltage equal to or less than $V_{in}/3$ or any negative pulse, as the voltage at the non-inverting end of the comparator is $V_{in}/3$.**c. Output**: It is the output pin f the IC, connected to the Q' (Q-bar) of the F/F with an inverter in between as show in the figure 2.**d. Reset**: This pin is used to reset the output of the F/F regardless of the initial condition of the F/F and also it is an active low Pin so it connected to 'high' state to avoid any noise interference, unless a reset operation is required. So most of the time it is connected to the Supply voltage as shown in the figure 2.**e. Control Voltage**: As we can see that the pin 5 is connected to the inverting input having a voltage level of (2/3) V_{in}. It is used to override the inverting voltage to change the width of the output signal irrespective of the RC timing network.**f. Threshold**: The pin is connected to the non-inverting input of the first comparator. The output of the comparator will be high when the threshold voltage will be more than (2/3) V_{in} thus resetting the output (Q) of the F/F from 'high' to 'low'.**g. Discharge**: This pin is used to discharge the timing capacitors (capacitors involved in the external circuit to make the IC behave as a square wave generator) to ground when the output of Pin 3 is switched to 'low'. **h. Supply**: This pin is used to provide the IC with the supply voltage for the functioning and carrying of the different operations to be fulfilled with the 555 timer.

The IC 555 can be used as following 3 types

a. Astablemultivibrator – it has no stable state. It has two quasi stable states that automatically changes from one to another and back. So actually it changes from high to low state and low to high state without any trigger input after pre determine time.
b. Monostablemultivibrator – it has one stable state and one quasi stable state. It jumps into quasi stable state from stable state when trigger input is applied. It comes into stable state from quasi stable state after pre determine time automatically.
c. Bistablemultivibrator – it has both stable states. Two different trigger inputs are applied to change the state from high to low and low to high [Available at 4 and 5].The IC 555 timer is used in many circuits, for example One-shot pulse generator in Monostable mode as an Oscillator in Astable mode or in Bistable mode to produce a flip/flop type action. It is also used in many types of other circuit for achievement of various purposes for instance Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM) etc.

LDR

As shown in Fig 3, a LDR is a light_cotrolled variable resistor made of a high resistance semiconductor. An LDR is also called as photoresistor or photocell. In the dark, a photoresistor can have a resistance as high as several mega ohms (MΩ), while in the light, a photoresistor can have a resistance as low as a few hundred ohms. If incident light on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. An LDR can be applied in light and dark activated switching circuits.LDR used in some dynamic compressors together with a small incandescent or neon lamp, or light-emitting diode to control gain reduction. A common usage of

this application can be found in many guitar amplifiers that incorporate an onboard tremolo effect, as the oscillating light patterns control the level of signal running through the amp circuit [Available at 6].

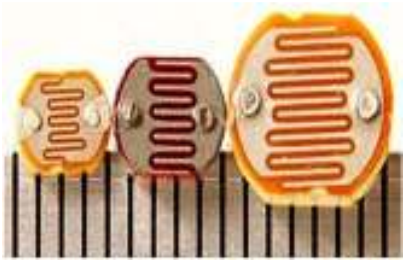

Figure 3: LDR

RESULTS AND DISCUSSION

This circuit as shown in fig. 4 uses a popular timer IC 555. IC 555 is connected as comparator with pin-6 connected with positive rail, the output goes high(1) when the trigger pin 2 is at lower then 1/3rd level of the supply voltage. Conversely the output goes low (0) when it is above 1/3rd level. So small change in the voltage of pin-2 is enough to change the level of output (pin-3) from 1 to 0 and 0 to 1. The output has only two states high and low and cannot remain in any intermediate stage. It is powered by a 6V battery for portable use. The circuit is economic in power consumption. Pin 4, 6 and 8 is connected to the positive supply and pin 1 is grounded. To detect the present of an object we have used LDR and a source of light.

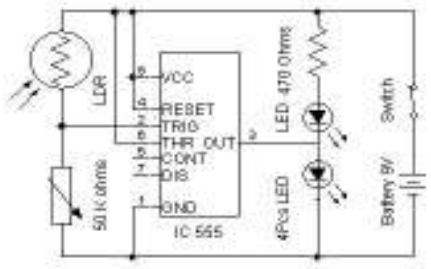

Figure 4: Circuit Diagram of Automatic Street Light

LDR is a special type of resistance whose value depends on the brightness of the light which is falling on it. It has resistance of about 1 mega ohm when in total darkness, but a resistance of only about 5k ohms when brightness illuminated. It responds to a large part of light spectrum. We have made a potential divider circuit with LDR and 100K variable resistance connected in series. We know that voltage is directly proportional to conductance so more voltage we will get from this divider when LDR is getting light and low voltage in darkness. This divided voltage is given to pin 2 of IC 555. Variable resistance is so adjusted that it crosses potential of 1/3rd in brightness and fall below 1/3rd in darkness. Sensitiveness can be adjusted by this variable resistance. As soon as LDR gets dark the voltage of pin 2 drops 1/3rd of the supply voltage and pin 3 gets high and LED or buzzer which is connected to the output gets activated [Available at 1 and 4].

WORKING

When light falls on the LDR then its resistance decreases which results in increase of the voltage at pin 2 of the IC 555. IC 555 has got comparator inbuilt, which compares between the input voltage from pin2 and 1/3rd of the power supply voltage. When input falls below 1/3rd then output is set high otherwise it is set low. Since in day time the sun light falls on the LDR then its resistance decreases which result in output is set to low. So in day time the street will be in off state .Since in brightness, input voltage rises so we obtain no positive voltage at output of pin 3 to drive relay or LED, besides in poor light condition we get output to energize. But in night time, i.e., when darkness rises to a certain level then the resistance of LDR is increases which result in decrease of the voltage at pin 2 of IC 555.In this case input falls below 1/3rd of power supply voltage, sensor circuit gets activated and switches LED to ON [7-8].

RESULTS

Figure 6- 12 shows the corresponding practical observations for the automatic street light as follows. The wave form observed when the CRO connected Instead of battery as shown in fig. 5.The wave form observed at the LDR is as shown in fig. 6. The wave form observed at the LED1is as shown in fig.7. The observed wave from at the pin 3 of IC 555 is as shown in fig. 8. If the sun light falls on the LDR, then LED1 will glow, this is as shown in fig. 9 & 10. During night time there is no sunlight falling on the LDR, which switches ON the street light and is as shown in fig. 11 & 12.

Figure 5: Wave Form Observed In the Absence of Battery

Figure 6: Wave Form Observed at the LDR

Figure 7: Wave form Observed at the LED1

Figure 8: Wave form at pin3

Figure 9: During Day Time Street Light Automatically Switch Off

Figure 10: During Day Time

Figure 11: During Night Automatically Street Light Glows

Figure 12: Setup of Automatic Street Light

CONCLUSION

The progress in science & technology is a non-stop process. New things and new technology are being invented. As the technology grows day by day, we can imagine about the feature in which thing we may occupy every place. The presentation of "AUTOMATIC STREET LIGHT" needs no manual operation for switching ON and OFF. When there is a need of light it automatically switches ON. It is much useful in our daily life. When darkness arises, if forgot to switch ON the street light it may leads to cause accident. So our design will make to prevent such kind of problems, and also it helps passengers to travel safely. Hence we conclude that the principle of the development of science is that "nothing is impossible". So we shall look to a growth of science in bright world.

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