Design of Traffic Light Controller Using Timer Circuit

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Abstract

In order to maintain the steady flow of vehicles when their numbers are increasing by leaps and bound each day, an efficient controlling of traffic is extremely required. This work provides a simple schematic model with which a very basic level of safe unmanned traffic signaling with pedestrian crossing request has been accomplished by using simple electronics circuits without the help of computer programs. The work also illustrates the design, the outputs and test cases used to implement the model. At the end the scope of improvement of the model has been discussed.

I. Introduction

The aim of this project is to model and implement traffic signaling system in a discrete cross-road using NE-555 timer circuit. The design would also need to facilitate pedestrians to request for crossing the road as and when required by pressing a switch. This model of traffic signaling system is now being implemented across several metro and second tier cities of India.

Most of the crossings handle the automated traffic signaling using fixed duration intervals between the Red, Yellow, Green and Pedestrian Pass Signal. The uniqueness of this model lies in the implementation of on-demand Pedestrian-Pass signaling, thereby transforming the design into dynamic controller.

II. Design Methodology

The heart of the signaling system in this case is a timer which would go on endlessly. This is implemented using a NE-555 timer set in astable configuration. The Pedestrian Pass is initiated and maintained for a fixed time. This is implemented using another NE-555 timer set in monostable configuration.

The duration of the timer pulses are controlled by judiciously selecting the resistance and capacitance (RC) combination. The duration of the traffic signals (Red, Yellow, and Green) is managed using a decade counter which fires after every N number of pulses.

Since the entire experiment depends on the working of the NE-555 timer, it was necessary at first to check the functioning of the timer using a CRO.

III. Design Implementation

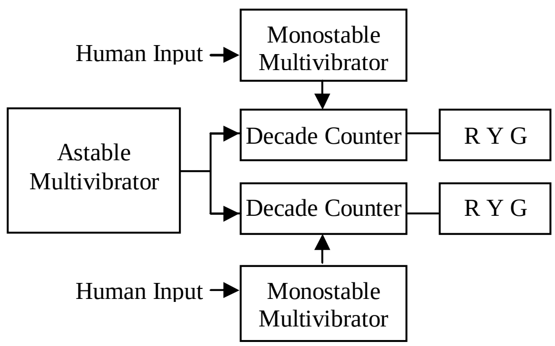


Figure 1: Block Diagram

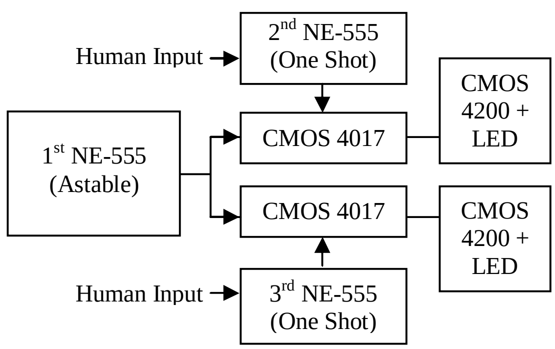
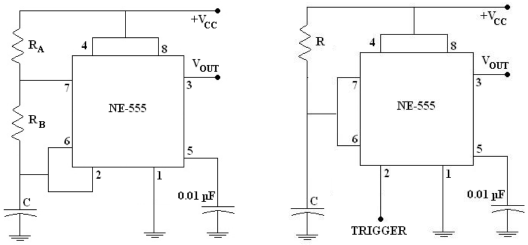


Figure 2: Implementation using ICs

Astable Configuration: The 1st 555 timer was set in astable mode. The RC was chosen to be R_A = 100 KΩ, R_B = 33 KΩ and C = 10 µF. The pulse interval obtained was around 1 sec.



T=0.693(RA + 2RB).C T=1.1(R.C)

(a) (b)

Figure 3: (a) Astable (b) Monostable Configuration

Monostable Configuration: The 2nd and 3rd 555 timers were set in monostable mode. The RC was chosen to be R = 200 KΩ, C = 19.7 μF. The pulse interval obtained was around 5 sec.

Counter: A decade counter (4017) was used with 4-1-4-1 time interval configuration which mapped to R-Y-G-Y colors respectively. The first 4 signifies 4 pulses of astable multivibrator for red followed by one pulse for yellow. The second four corresponds to green and the last one again for yellow. So the timing sequence corresponds to Red-Yellow-Green-Yellow-Red and so on.

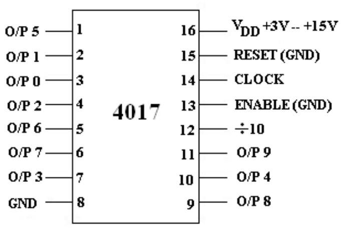


Figure 4: IC 4017 Chip

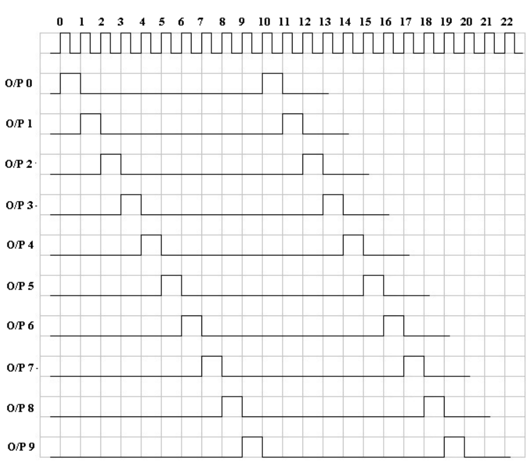


Figure 5: Decade Counter Output

The 1st timer chip was used as the clock inputs of two 4017 ICs to provide same pulse durations. The monostable circuit was connected to the reset inputs of the two 4017 ICs so as to make two independent pedestrian pass requests.

LED: The LEDs were connected in series with a low resistance (125 / 220 ohms) to protect the LED from being damaged and then connected to NOR gate (4002). The LEDs were connected in a way that the positive terminals were connected to the ground and the negative terminals were connected to the IC 4002 NOR gates via the current limiting resistances.

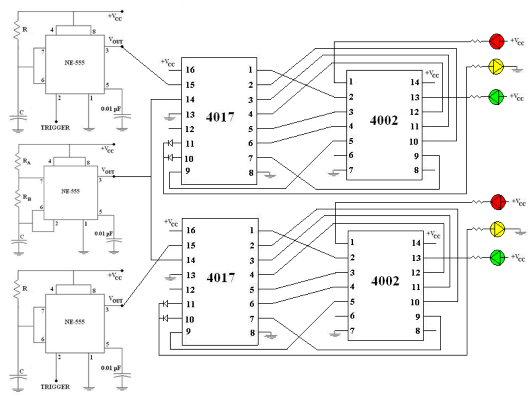


Figure 6: Complete Circuit Diagram

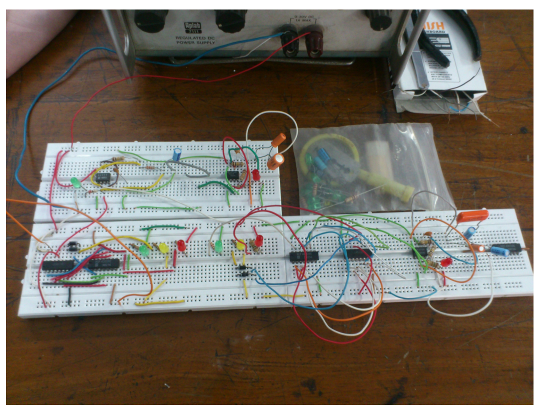


Figure 7: Prototype Controller

Highlights

- Diodes are used for connecting the yellow LEDs since we want to show that an OR logic can be established using diodes as well. Moreover, for the yellow lights, which would glow for a shorter duration, a four input OR IC won't be necessary. So using a diode saves space and power, as for every IC we are using, a Vcc and ground has to be provided to activate the IC.

- In this model, pedestrians are getting the facility to request for Pedestrian Pass signal to cross the road when needed.

IV. Result

The rhythm is initiated by delaying either of the one shot manually by 5 seconds approximately so that when one would reach green, the other signal would be red.

The normal rhythm of lights continues to glow until a pedestrian arrives at any one direction of the cross-road and breaks the circuit. With this model, the pedestrian is given 5 seconds to cross the road after which the normal rhythm will start again. The pedestrian should use the circuit breaker only when the signal is green, preferably at the 4^{th} count of green, in this case because of some constrain in the design.

V. Testing

The response time of the astable connections were measured with the help of CRO and LEDs. The testing of the pins and sequence of the decade counter that they were activated at proper order whenever a train of pulses were fed to the clock of 4017 chip from the astable timer was verified by connecting 10 LEDs to its pins via resistances of low values.

By keeping the reset of 4017 grounded, it was seen that red glowed for approximately 4 seconds, yellow for 1 second followed by green for 4 seconds, yellow for 1 second and so on. This complete cycle was repeated over and over. When the monostable output was fed to the reset of 4017 IC, and a pulse was provided to monostable input, the rhythm was disturbed and the position was reset back to the red light. The monostable circuit held that state for approximately 5 seconds. This value can be changed by varying the values of resistances and capacitances.

Breaking the signal at the second count of green would result in exact matching of the rhythm for our configuration after waiting for approximately 5 counts. In any other cases, an offset in the initial rhythm was observed.

VI. Conclusion and Scope for Future Improvements

A traffic light control system based on 555 timer circuit has been designed. The novelty of this design includes the facility of Pedestrian Pass as and when required.

The little defect in the proposed model can be overcome in such a way so that any time a pedestrian presses the switch for crossing, the initial rhythm remains unperturbed. Also, logic can be provided for the case in which two pedestrians use the circuit breaker simultaneously at both the crossings.

If the RC values of astable and monostable configurations are so chosen that the system's rhythm is maintained. However, we can change the duration of the control signal by proper choice of RC values.

VII. References

1. Traffic light project of the electronics club (www.kpsec.freeuk.com/projects/trafficlight.htm)
2. A.Malvino, Electronic Principles, Tata Mc-Graw Hill.
3. CMOS Integrated Circuit Data Book, National Semiconductor Corporation.