Automation Model for Operation of Traffic Signals in Peak Hours

[1]Krishna Vikas Amidipuram, [2]Sathvik Balu Talagama,
[3]Shankar Charan Nimmagadda, [4]Mrs. B. Priyanka

Dept. Electronics and Communication Engineering, Sreenidhi Institute of Science and Technology
Hyderabad, India

Abstract: The traffic signaling system in use now is not efficient as it functions as per the fixed timings and not adjusted to act according to the traffic density i.e., traffic over the high-density roads may have to wait for long time. Therefore, this system is designed to clear the heavily crowded roads first. The concept is to maintain priority by sensing the traffic density in addition to the normal timings. In normal condition, the proposed signaling system functions according to the fixed timings, if any side of the road is overcrowded than normal density, the system energizes the green indicator to little more extra time by which over crowded road can be cleared. The proposed system can sense all 4 sides of the cross roads and allows clearing the traffic with grace time when traffic is more than the normal condition. To prove this concept practically, 4 sided cross roads model is implemented on a wooden plank for demonstration. The proposed model uses Tone decoder circuit to send IR waves for detection of the vehicle movement.

Keywords: IC 89C51, LM567, Traffic Density

I. INTRODUCTION

Across the world, traffic jams are getting worse and worse. The problem is more complex in developing countries where cities are growing much faster than those in the developed countries. The average annual population growth in developing countries is estimated at around 5% compared to 0.7% in developed countries. Traffic is also increasing day by day in tandem with population growth.

It has become an adverse experience these days to go out during peak hours, in the metropolitan cities. It takes hours to go to a nearby place where there are number of traffic signal junctions. The timer system, in which a predetermined period is set for the vehicles to move is currently being used by the traffic control system. By this we may not exactly clear the traffic because the traffic may not be constant in all the directions. In this paper a new system is proposed where traffic is controlled based upon the density (i.e., number of vehicles) at the signal junctions. The implemented model has a unique detection system with the help of tone decoder to get the accurate location and density of the vehicles around, which makes the system more efficient.

II. LITERATURE SURVEY

A. PAPER REVIEW

Optimization of a City's traffic light controller can be done with IR sensors and microcontroller. Based on the number of vehicles that pass through the fixed time slot on the road, the microcontroller determines the traffic light delays for the next recording interval based on the density range of traffic. Based on the number of vehicles that pass through the fixed time slot on the road, the microcontroller determines the traffic light delays for the next recording interval based on the density range of traffic [1].

Kaiyi Zhang, Xiaoqing Yu and Wanggen Wan proposed a series of methods from which it can be understood that object sensing circuits consisting of IR transmitter, IR receiver and tone decoder, can be the best replacement for conventional IR sensors. By incorporating them, it is possible to detect the obstacles more accurately which is essential for managing traffic [2].

In this Paper titled " Emergency Vehicle Priority and Self-Organising Traffic Control at Intersections Using Internet-of-Things Platform" it is understood that Internet-of-Things-based infrastructure for managing emergency vehicle priority and self-organized traffic control at junctions is presented. Urban traffic congestion is a serious problem as there are more and more cars on the road. Traffic snarls, particularly those drivers will experience more delays at junctions, which will also result in more fuel usage and air pollution [3].

B. *Problem statement:*

The present existing model in the application used microcontroller and IR sensors and few prototypes uses Arduino for the implementation but IR sensors have an disadvantage when used in daylight so that is a constraint in the model so we need to reduce the effect of day light on IR sensors.

C. *Proposed model*

In the present paper that we are doing a model that works on automation model of the traffic signals without any human intervention here we introduced LM567 (tone decode) along with the IR sensors which modulated the IR wave produced by the transmitter so that the daylight does not seriously affect the receiver sensor thus it overcomes the problem of effect of the external light on the model designed.

III. CIRCUIT DIAGRAM AND PROPOSED METHODOLOGY

The present model has a traffic sensing circuit, four similar circuits are constructed to sense all four sides of road traffic,. IR sensors are used to detect the flow of traffic and each sensing circuit is constructed with IR signal Transmitter and IR signal receiver. These two devices are interfaced with LM567 IC which is configured in trigger mode and generates logic low signal when it detects any object passing through these sensors. The set of sensors arranged over a PCB along with its associated circuit constructed with

LM567 IC must be arranged a side of simulated road over the wooden plank. Here to prove the concept practically, four sides of the roads are simulated over wooden plank known as traffic circle over which all four signal posts and four sensor boards are arranged at suitable places.

The obstacle sensing or vehicle sensing circuit is designed with LM567 IC, this is a tone decoder IC that generates a tone frequency. For counting the numbers of vehicles in the all directions four sets of sensors are used with different LM567 IC's. All these four sets of sensors are arranged at the junction of the road in all the directions. Each sensing block is designed with two IR LED's namely IR signal transmitting LED and IR signal receiving LED. Both the sensors are arranged side by side facing towards the road to detect the passing vehicle. The tone generator part of the IC is configured as astable mode of operation, which produces a tone frequency of 10 KHz approximately and it is amplified using a transistor.

The transmitting IR LED disseminates the amplified signal. Like a laser beam, the IR LED transmits its signal in a line. Like a laser beam, the transmitting LED sends an IR signal into the air in one direction, and the receiving LED takes in the signal. The IR signal sensor can be called as IR signal detector and whenever this device detects IR signal, the final output of LM567 IC will become zero otherwise it remains in high state. The IR energy radiated from IR signal transmitting LED will be transmitted in straight line like a laser beam, when this energy hits a target or passing vehicle some of its energy will be reflected back and this reflected energy will fall on the IR signal receiver by which the IC generates logic low signal momentarily. The output of this circuit is fed to the Microcontroller chip and it is programmed to count the interrupted signals those are treated as equal to the number of vehicles passing through the sensors. Likewise all the sides of the roads moving traffic can be detected for further process. The tone decoder IC used here is configured to provide a logic low signal through saturated transistor switch to ground when input signal is present. The same IC also can be used as oscillator in 'Astable' configuration. Therefore this IC can be used for duel functions.

Block Diagram

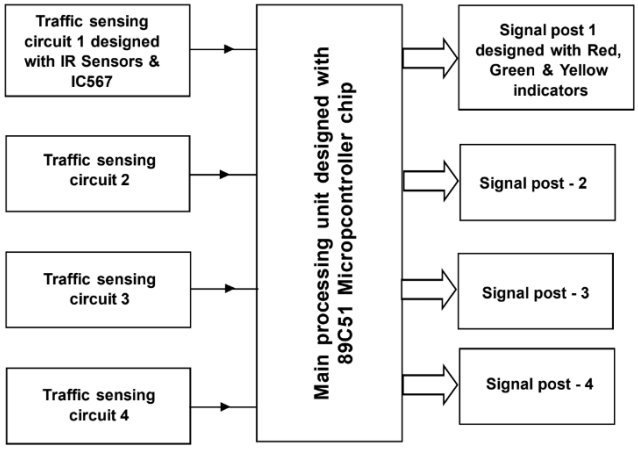

Fig. 1. Block diagram of the model.

The oscillator section is designed to generate 10 KHz tone frequencies and this signal is amplified and fed to IR LED for radiating IR signal into the space. The IR signal detector LED is connected at the input side of tone signal decoding section, as long as this LED detects IR signal, IC output remains in zero state. Likewise the controller will be getting the signals from the four sensing blocks, according to the received information from the sensors. The controller chip is programmed to provide normal signal system according to the timings in all directions and whenever the system detects that a particular side of road traffic is more than other three sides, then this particular green indicator in this side of signal post remains in energized condition for little more time to clear the excess traffic. Likewise the controller chip is programmed to monitor all 4 sides' traffic continuously.

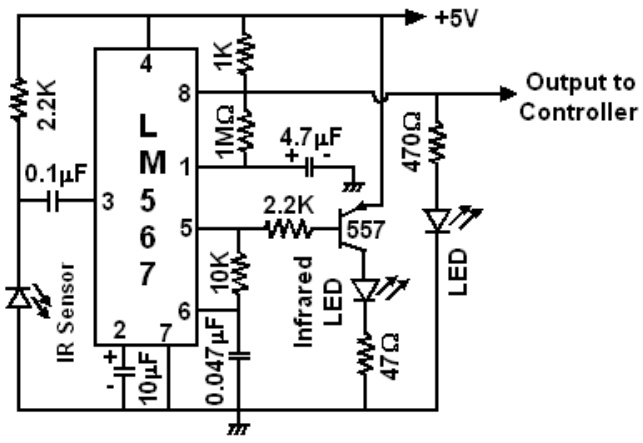

Fig. 2. Internal structure of Tone decoder.

IV. RESULTS

There are two cases (i) Normal case, when all the lanes have almost same amount of traffic. (ii) When one of the lanes has higher density as compared to the rest.

A. *Normal case, when all the lanes have almost same amount of traffic*

The programming logic of the model is, we have four roads named 1, 2, 3 and 4. So in general case our system will start clearing traffic from all the roads. To clear the traffic on road 1, we have signal green light ON and all others green light to be OFF. This means all the other roads have red light ON, whereas we have switched the red light OFF on road 1. Since we wanted to clear the traffic here first. After 30 seconds, we have the green LED to ON for the road 2, to clear the traffic on road 2. So similarly, all green LEDs OFF except road 2 and all the red LEDs ON except road two's LED. Next, we have clear the

Fig. 3. Case 1. Normal case when all lanes have same amount of traffic.

traffic on road 3 after that road 4. We did this in the cycle of 1, 2, 3 and 4 respectively. This cycle is work continuously for time delay of 30 seconds until there is heavy traffic on any one of the roads.

B. *When one of the lanes has higher density as comapared to the rest.*

We have also taken second case of this model for better understanding; we have considered heavy traffic on any of the roads. So let's assume Road 1 having heavy traffic, then the system will try to clear out the traffic first on road 1. To do that we have set the green LED for road 1 to HIGH. If green LED is high, then red LED for road 1 is LOW. Since we wanted to clear the traffic without any collisions, we have set other roads green LEDs to LOW and red LEDs to HIGH. Now this is continued until the traffic on road 1 has been reduced from high traffic to normal. To control traffic we need to control all LEDs at the same time. Microcontroller is programmed for this purpose.

The output displayed is more accurate compared to the previous automation models as we replaced the normal IR sensors circuit with Tone decoder where we overcome the effect of the sunlight on the sensors. In case of our model, we generate specific frequency waves as they are easily recognised and thus the rate of success is high in our scenario.

Fig. 4. Case 2. When one of the lanes has higher density as compared to rest.

V. CONCLUSION & FUTURE SCOPE

This project work "Automation model for operation of traffic signals in peak hours" is designed and developed successfully, for the demonstration purpose a prototype module is constructed and it is arranged over a wooden plank in which cross roads circle is simulated with all required devices like, signal posts, traffic density sensors, etc., and results are found to be satisfactory. Presently, the system is designed to allow more traffic through overcrowded road by sensing the traffic density. Means if any side of the road is crowded with more vehicles than other three sides, then that side's green indicator will be energized for more time to clear the traffic. In normal condition, fixed timing is used to clear all four sides of the traffic in a sequence as observed at traffic circles

Additional features can easily be incorporated into this module if required. The sequence of timings according to the road traffic can be adjusted by modifying the microcontroller program. Presently the system designed here does not contain display panel, if required it can be added to all four sides, but it creates lot of complexity and hence it is avoided and it will be considered in future work.

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