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Traffic Density Control

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Abstract- *Recent years have witnessed exponentially growing vehicles in the available traffic infrastructure, which are geographically constrained. Managing traveling entities in the traffic network with same physical parameters is major challenge for the research community. The aim of our paper is to reduce the problem of traffic congestion which is a very severe problem now-a-days. As we all know that the present traffic light system consists of a predefined hardware which has a fixed time for green light and red light. To optimize this problem, we have made a framework for an intelligent traffic control system. Generally, we have seen that the conventional traffic light system does not depend upon the density of the traffic. So, we proposed a scheme using microcontroller, in which the timings of green light and red light are assigned based on the density of the traffic present at that time. This can be done by using LASER diode and Photo diode.*

Index Terms*—LASER diode, Photo diode, traffic lights, density, microcontroller etc.*

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I. INTRODUCTION

Traffic lights, developed since 1912, are signaling devices
that are conceived to control the traffic flows at road intersections, pedestrian crossings, rail trains, and other locations. Traffic lights consist of three universal colored lights: the green light allows traffic to proceed in the indicated
direction, the yellow light warns vehicles to prepare for short stop, and the red signal prohibits any traffic from proceeding [1].

Modern life style and daily needs of the increasing population are increasing the vehicle count at an alarming rate in every country worldwide [2]. Infrastructure growth is slow as compared to the growth in number of vehicles, due to space and cost constraints [3]. In India, this fact can be verified by the statistics of annual production and sales for different categories of vehicles. On the contrary, the existing traffic infrastructure has its physical limitations for expansion to accommodate this exponential growth of moving entities. So, transportation of vehicles within required time limit has been a serious issue over the years and there have been continuous efforts by the research community to handle this problem using a dedicated domain termed as ITS (Intelligent Transport System).

Nowadays, many countries suffer from traffic congestion problems that affect the transportation system in cities and cause a serious dilemma. Despite of replacing traffic officers and flagmen by automatic traffic systems, the optimization of the heavy traffic jam is still a major issue to be
faced, especially with multiple junction nodes [4].

Fig.1 Traffic density in Metropolitan City

The traffic lights ensure that vehicles from every direction get a chance to proceed through the intersection in an orderly fashion. Normally, we will have the traffic signal lights programmed for specific time intervals. But in day-to-day life, we observe that traffic on one side on a two-way road is predominantly more when compared to the other. In such a situation, providing equal intervals of time for both types of traffics, attributes to congestion during hours of heavy traffic, making traffic delays.

But, here we propose a system that generates the traffic light signals based on the vehicle density, contrary to the old method of allotting the same time intervals to all roads irrespective of their traffic density.

The main advantage of this system is that it reduces the waiting time for vehicles.

II. LITERATURE SURVEY

Traffic congestion is one of the major problems the world is facing today. Traffic monitoring and controlling is a difficult task. Congestion on roads eventually results in slow moving traffic, which increases the time of travel, thus stands-out as one of the major issues in metropolitan cities [5]. The aim of the traffic research is to optimize the flow of

vehicular traffic and goods. The flow of the traffic constantly changes depending on the time of the day, day of the week and time of the year. At times, road work and accidents further influence the complexity. Hence, traffic light optimization is a complicated process. Even for single junctions there might be no obvious solution and the problem becomes even more complex for the multiple junctions, as the state of one light in one junction directly influences the flow of traffic towards many other lights. Conventional traffic light system is based on fixed time concept allotted to each side of the junction which cannot be varied as per varying traffic density. Junction timings allotted are fixed. Sometimes higher traffic density at one side of the junction demands longer green time as compared to standard allotted time.

With the ever-increasing vehicles on the road and the number of road users, the limited resources provided by current infrastructure lead to ever increasing travelling times. Human life is affected due to delay in the arrival of ambulance [6]. Hence, an intelligent control of traffic is an important issue to be considered. The Traffic Monitoring Authority needs to find new methods of overcoming this problem- like construction of new roads, flyovers etc.; and development of sophisticated traffic monitoring and control systems. One way to improve the traffic flow and safety of the current transportation system is to apply automation and intelligent control methods to roadside infrastructure and vehicles. Following are the applications and advantages if we replace the conventional traffic system with an intelligent control system.

III. BLOCK DIAGRAM

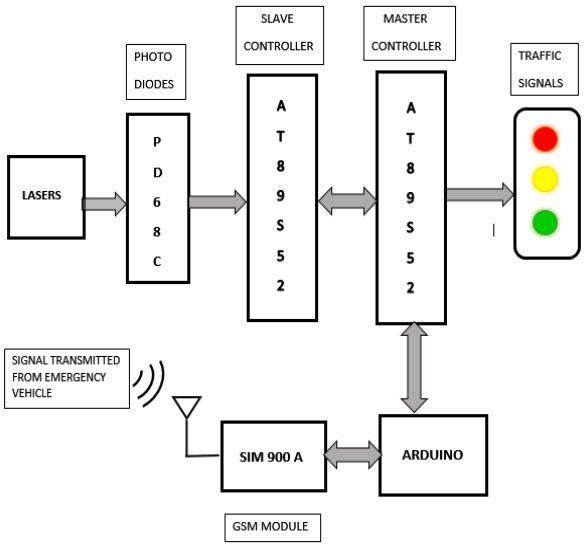

Fig. 2

In this system, we will use LASER diode and Photo diode to measure the traffic density. They are arranged on each side of the road and are interfaced to the slave microcontroller. Based on these sensors, controller detects the traffic and controls the traffic system.

Photo diodes are connected to the slave microcontroller. If there is traffic on road, then the photo diode circuit output becomes logic zero, otherwise logic one. Based on logic 0 and logic 1 output, the slave microcontroller transmits the data to master microcontroller which then compares the status of all signals from other roads and based on first come first serve basis, master microcontroller accordingly changes the glow time of green signal of the corresponding junction to a higher value. Thus, as the number of stationary vehicles increase, the green light glows for more time for that road.

For Emergency vehicles, we are using an android application for sending location of an emergency vehicle. Here we are using GPS module(sim900A) which will be interfaced with master microcontroller to receive location of emergency of vehicle. In the emergency mode, for a vehicle like ambulance, fire brigade or police car, the signals are altered for the fast and easy movement of these vehicles. If an emergency vehicle is passing by, the signals on the roads will be changed, so that the traffic is cleared for the emergency vehicle. This is an important feature which is very useful in case of an emergency [7].

IV. WORKING

Fig.3 Project Model

A. LASER diode

The LASER diode used in this project requires 2.8V to 5.2V and draws 25mA current. This diode can withstand in temperature ranges from -10°C to 40°C. Light emitted by this LASER is in the visible frequency spectrum. We are using 650nm wavelength LASER.

These LASER diodes are using for detecting traffic on each road. These LASER diodes are placed on the road in such a manner that they will be separated by a

fixed distance so that we can determine level of traffic on that road. We are using 3 LASER diodes for each road to determine low, medium and high traffic density.

B. Photo Diode

Photo diodes are used to sense light falling on it. The photo diode that we are using (PD68C) is sensitive to the visible light spectrum with peak sensitivity at about 980nm. Optical filters can be placed in front of the photo diode to make it more sensitive to a specific wavelength (in this case, 650nm).

The photo diode is used in the photoconductive mode, connected to an operational amplifier which is used as an inverting amplifier. The output of this inverting amplifier is connected to a comparator which outputs high or low depending on its input. If the input goes above a set voltage threshold, the output goes high; otherwise, the output remains low

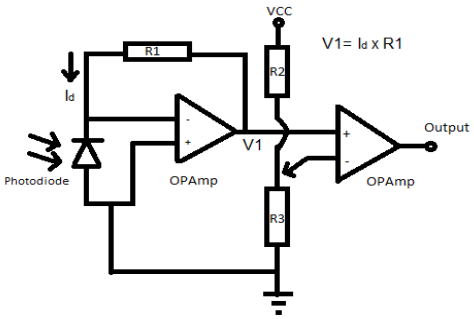

Fig. 4 Circuit diagram for Photo Diode

Whenever vehicles come in between LASER diode and its corresponding photo diode, the photo diode circuit's output goes to logic 0. This output is given to the slave microcontroller, so that slave can monitor the output of photo diode circuit to check the presence of traffic. As these photo diodes are placed in line of sight of LASER diodes, the output will be continuously monitored after a few seconds for 3 times to check whether there is actual traffic present or not.

C. Slave Microcontroller

We are using master-slave configuration as shown in fig.5 one acts as master and other acts as a slave.

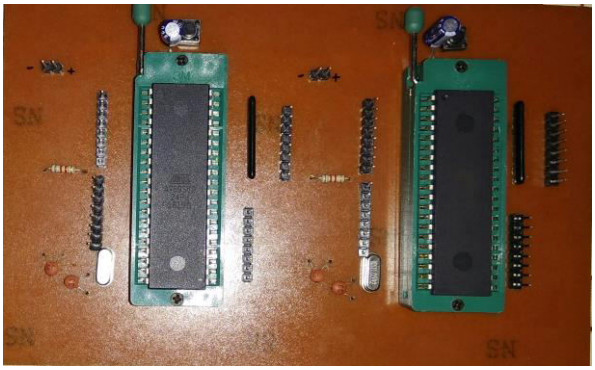

Fig. 5 Master and Slave Configuration

Output of the photo diode circuit is given to slave microcontroller(AT89S52). Slave will continuously monitor the output of photo diode and if output of photo diode circuit becomes low, slave will again check for a low-level output for few seconds to confirm presence of traffic on that road. If output is still low, it sends an interrupt to the Master microcontroller and gives signals to master indicating level of traffic (High or Low Traffic). Depending on level of traffic, master will adjust traffic signal timings. All these things are done by slave microcontroller only when the signal on that road is red.

Same thing is done for the other roads. If high traffic density is detected on more than one road, then master microcontroller will adjust traffic signal timings accordingly so that junction traffic will be optimized as soon as possible.

D. Android Application

Fig. 6 Android application

We have developed an android application that will get the current location using GPS as shown in fig. 6 and send this location to the GSM module at a

junction. We are using this application to give provision to emergency vehicles. This application will only be made available to the drivers of emergency vehicles who can send their location by just a single tap on the application.

E. GSM Module and Arduino

We are using SIM900A GSM module only for receiving location of emergency vehicles. This module is interfaced with Arduino board, so that it can read incoming messages using 'AT commands'.

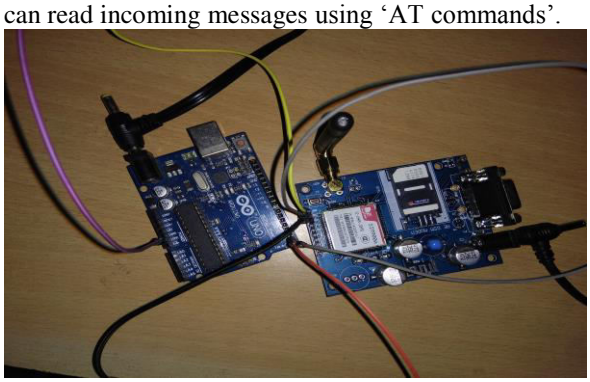

Fig. 7 Arduino UNO board and GSM module(SIM900A)

Arduino board (Arduino UNO) continuously checks for messages from emergency vehicle and reads it once it receives them. Based on the GPS location of emergency vehicle, microcontroller finds on which road emergency vehicle is stuck and interrupts Master microcontroller. Arduino board is interfaced with master microcontroller. It will also send signals indicating road on which emergency vehicle is stuck to master microcontroller. This all thing only happens when emergency vehicle is at pre-defined distance from traffic signal and driver is sending the location of emergency vehicle using android application.

F. Master Microcontroller

The Master microcontroller (AT89S52), is handling all traffic signals and its flow. Whenever it receives an interrupt, it adjusts traffic signals' glowing time based on traffic level on that road. As interrupt from Arduino board is set at highest priority to serve it as soon as possible.

V. CONCLUSION

Here the two objectives, that are, first, calculating the density of the vehicle on the road for the flow of the traffic smoothly without congestion and second, developing Priority Based signaling which will help to give the priority to the emergency vehicles are met successfully.

By using this system, we try to reduce the possibilities of traffic jams, caused by independent glow time of traffic signal, also insuring that emergency vehicle won't get delayed due to traffic jams.

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