ENHANCED TRAFFIC LIGHT CONTROL SYSTEM WITH REDUCED CONGESTIONUSING RFID AND GSM

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ABSTRACT

Traffic light system management is a critical issue of the road. Traffic signal lights play a main role in the traffic management. The existing traffic light system follows the predetermined sequence. So, these traffic lights are not able to count the number of vehicles and the priority of the vehicles on intersection point of the roads. As a result some vehicles have to wait even if there is no traffic on the other side. The vehicles like Ambulance, Fire Brigade and VIP vehicles are also stuck in traffic and it results in loss of their valuable time. In this paper traffic light system is designed efficiently in order to overcome the problems faced by the emergency vehicles with good quality of service andreduced traffic congestion.

1. INTRODUCTION

With the dramatic growth of the urbanization, industries and population, there has been a tremendous increase in the traffic which leads to several problems like traffic jams, accidents and traffic rule violation. This in turn has an adverse effect on the economy of the country as well as the loss of lives. The expected increase of four wheelers from 2005 to 2035 is 13 times, while 2 wheelers are expected to increase about 6.6 times. Traffic light system plays a major role in traffic management. Traffic light systems are the signaling devices that are placed on the intersection points of the road which is used to control the flow of traffic on the road. Most of the traffic lights around the world follow a preprogrammed timing circuit. Sometime the vehicles on the red light side have to wait for green signal even though there is little or no traffic. It results in the loss of valuable time.

In the designed system, the sensors used are IR and photodiodes,which are in line of sight configuration across the roads to detect the density at the traffic signal. The density of the vehicles is measured in four zones based on which timings are allotted accordingly. RFID is used in Ambulance and VIP vehicles for giving priority among the common vehicles.

2. LITERATURE SURVEY

Traffic congestion is a major problem in cities of developing Nations like India. Increase in population and the middle-class segment contribute significantly to the rising number of vehicles in the cities [6]. Congestion on roads results in slow moving traffic, which increases the time of travel, thus stands-out

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as one of the major issues in metropolitan cities. In [7], green wave system was discussed, which was used to provide clearance to any emergency vehicle by turning all the red lights to green on the path of the emergency vehicle, hence providing a complete green wave to the desired vehicle. A 'green wave' [1] is the synchronization of the green phase of traffic signals. With a 'green wave' setup, a vehicle passing through a green signal will continue to receive green signals as it travels down the road. In addition to the green wave path, the system will track a stolen vehicle when it passes through a traffic light. Advantage of the system is that GPS inside the vehicle does not require additional power. The biggest disadvantage of green waves is that, when the wave is disturbed, the disturbance can cause traffic problems that can be exacerbated by the synchronization.In such cases, the queue of vehicles in a green wave grows in size until it becomes too large and some of the vehicles cannot reach the green lights in time and must stop. This is called over-saturation [10], [11]. In [8], the use of RFID traffic control to avoid problems that usually arise with standard traffic control systems, especially those related to image processing and beam interruption techniques are discussed. This RFID technique deals with multivehicle, multilane, multi road junction areas. It provides an efficient time management scheme, in which, a dynamic time schedule is worked out in real time for the passage of each traffic column.

The real-time operation of the system emulates the judgment of a traffic policeman on duty. The number of vehicles in each column and the routing are proprieties, upon which the calculations and the judgments are done. The disadvantage of this work is that it does not discuss what methods are used for communication between the emergency vehicle and the traffic signal controller. In [9], it proposed a RFID and GPS based automatic lane clearance system for ambulance. The focus of this work is to reduce the delay in arrival of the ambulance to the hospital by automatically clearing the lane, in which, ambulance is travelling, before it reaches the traffic signal. This can be achieved by turning the traffic signal, in the path of the ambulance, to green when the ambulance is at a certain distance from the traffic junction.

The use of RFID distinguishes between the emergency and non-emergency cases, thus preventing unnecessary traffic congestion. The communication between the ambulance and traffic signal post is done through the transceivers and GPS. The system is fully automated and requires no human intervention at the traffic junctions. The disadvantage of this system is it needs all the information about the starting point, end point of the travel. It may not work, if the ambulance needs to take another route for some reasons or if the starting point is not known in advance. Traffic is a critical issue of transportation system in most of all the cities of Countries. It involves a manual analysis of data bythe traffic management team to determine the traffic light duration in each of the junction. It will communicate the same to the local police officers for the necessary actions.

To resolve the traffic congestion problem, we not only have to consider the volume of the traffic, but also several other factors like traffic speed, road

occupancy, traffic density etc. Several technologies have been proposed for congestion detection, such as inductive loop, magnetometer, infrared, acoustic, ultrasonic, visual camera, radar etc. [2]Inductive loops that can be placed in a roadbed to detect vehicles that pass over the loop, while more sophisticated sensors estimate the speed, length, and weight of vehicles and the distance between them. While this system works for traffic at all speeds, it does have the drawback of a high error rate in detection and transmission of traffic information. Other drawbacks include cumbersome installation of inductive loop devices, tedious maintenance and the improbability of managing traffic locally.

Another popular technology is usage of cameras and image processing as shown in references [3, 4,]. Here one or more cameras are installed in an airplane at a high altitude, so that all the objects on the road are visible. The optical data from both the visible and infrared spectrum as captured from the camera are studied. In reference [4], optical time series analysis is used to group the vehicle speed or traffic behavior while in reference [5] fuzzy logic is used. The estimated velocity profiles coincide qualitatively and quantitatively quite well but these cannot be used to detect the exact cause of congestion. Also these technologies are only useful for managing traffic on highways. Moreover performance of these methods is largely dependent on the quality of the geo referencing of overlapping images and the quality of the road database. The system is expensive too and fuzzy algorithm is not fool proof. Passive infrared sensors, as mentioned in reference [7], do not transmit any energy of their own; rather they detect energy emitted from vehicles, road surfaces, and other objects in their field of view. Magnetic sensors can be used to sense a vehicle due to changes in earth's magnetic field caused by moving vehicle as shown in references [8, 9]. Thus all the afore-mentioned technologies solve only a part of the problem of traffic management. The basic problem is that these systems are not efficient to deal with real-time traffic control. This paper proposes a new approach to precisely detect the real time traffic congestion and tackle it with the help of the emerging active RFID technology.

3. Proposed Traffic Light Control Scheme

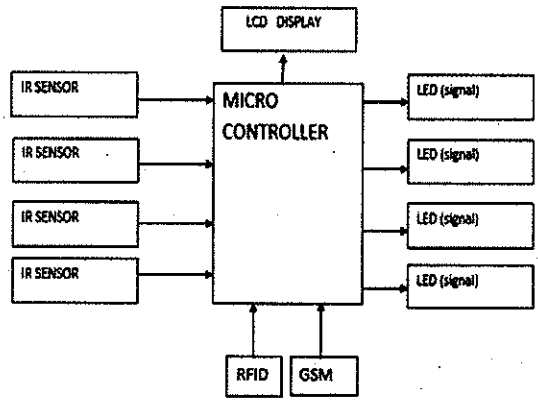

Figure 1 : Block diagram of traffic control system using RFID and GSM

Figure 1 shows the block diagram of traffic control system using RFID and GSM. Here microcontroller (PIC 16F877A)is used at the junction of the roads whichstores information about the large number of vehicles. Before switching to green, it should satisfy all the conditions and interrupt options which jump from one loop to another loop hence it consumes less power and no external hardware is required.

It mainly consists of three sections. i) To identify the density of the road congestion in each road lane. ii) To make the road lane free or green signal when an Ambulance or any VIP vehicle enters the road lane. To solve this problem we are using the RFID techniques.iii)Using the GSM modem which communicate over the mobile network.

3.1 Measure of density in each road lane

The IR sensor counts the number of vehicles in each road lane and the density of the vehicle in each road is displayed in the LCD monitor as shown in fig 2. The traffic light signal duration to each road at present is about 90 seconds in general for red light and 30 seconds for green light. In the designed system the time duration for the green light has been reduced to 10 seconds as shown in fig 4. The calculated value of vehicle density in each road lane is added up to ten seconds of green signal. This helps to control traffic congestion. This is the continuous cyclic process.

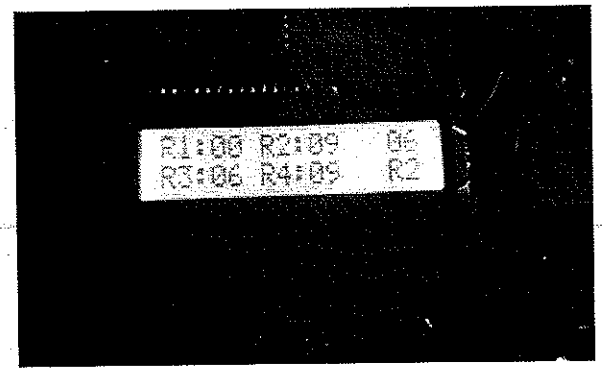

Figure 2 : Measure of density in each road lane

3.2 RFID Reader

Every Ambulance and the VIP vehicles will be given a RFID card with the data encrypted. The RFID receiver is placed about 200 meters before the signal lane. When the Ambulance or VIP vehicle enters the road lane and crosses the RFID receiver, the receiver reads the data from the RFID card. It sends the signals to the microcontroller to interrupt the signal and make the ambulance road lane to make green so that the Ambulance can pass the signal crossing the road easily.

3.3 GSM Module

It performs same function as RFID .After the vehicle crosses the signal on the road, the traffic control signal functions on regular basis. This process can be done by sending message to the mobile number in the GSM as shown in fig 3. When it receives the data of the lane, signal gets interrupted and that particular lane will be opened for the vehicle to cross it. The working of traffic signal lights is shown in fig 4.

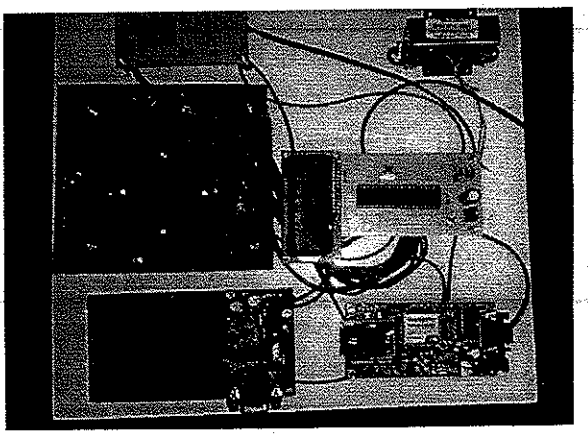

Figure 3 : Model of traffic light control system using RFID and GSM

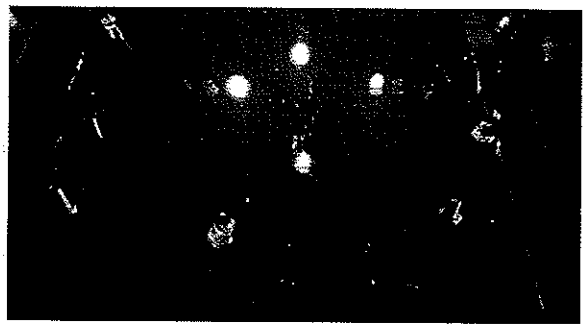

Figure 4 : Working of traffic signal lights

4 Conclusion

The designed system is efficient in terms of performance, cost, and maintenance with good quality of service and reduced traffic congestion. As the entire system is automated, it requires very less human intervention. In this paper the system is designed by considering one road of the traffic junction. It can be improved by extending to all the roads in a multi-road junction. Further enhancements can be done to the prototype by testing it with longer range RFID readers.

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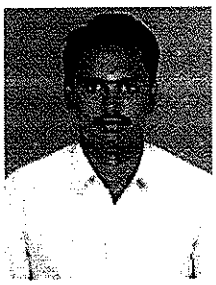
Authors Biography



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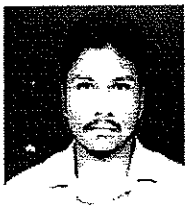

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