Smart Traffic Control System for Prevention and Control of Blockade, Emergency Vehicle Clearance and Stolen Vehicle Identification

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Abstract: This paper presents a smart traffic control system to avoid traffic congestion and to allow the emergency vehicles to pass with high priority. The main aim of this project is to implement the smart traffic control system to prevent and control of blockade, emergency vehicle detection and identification of stolen vehicle. An RFID tag is implanted on every vehicle such that it is impossible to remove or destroy the tag. These RFID tags are scanned by using the RFID scanner, NSK EDK-125-TTL and ARM7 LPC2148 microcontroller. The number of vehicles that cross the particular predefined path in certain duration will be specified and hence congestion is prevented or controlled by determining the necessary green light duration. If the RFID tag (Identification number) belonging to any stolen vehicle is identified by the RFID scanner at traffic signal junction, then the respective way will be blocked and also a SMS will be sent to the owner as well as the police control room by using GSM SIM900 regarding the location of identified stolen vehicle. The emergency vehicle approaching the signal will be identified using RF modules on ARM7 LPC248 microcontroller which establish the wireless communication between the emergency vehicle and the controller unit at the traffic signal junction. The model is developed in such a way that if two emergency vehicles are approaching the junction from two different directions, then the emergency vehicle which is at shortest distance and first established the communication with master unit at the signal is allowed to cross the junction first by giving the green signal where the second one is given with green signal immediately after the first vehicles crosses the junction.

Keywords: GSM, RFID, RF, Traffic, Congestion, Emergency Vehicle, Stolen

1. INTRODUCTION

India is the second highest populated country in the world with a fast growing economy. The blockade of traffic has become one of the biggest problems of transport in India which is faced by millions of commuters each day. [1] The number of vehicles in India is quickly increasing as a growing middle class can now afford to buy cars. Indian roads are mostly non-lane based and messy in most of the major metro cities across the country. Traffic control systems which are currently being used are not able to meet the desired requirements in reducing the congestion of traffic. The recent trends of road transport include the usage of various wireless technologies to reduce the congestion and to provide the cost effective solutions for smooth transition of traffic. Wireless technologies like RFID, GSM, RF modules, Zigbee can be used in providing the cost effective solutions for congestion control of traffic to achieve the smooth transition of traffic. RFID uses the radio frequency electromagnetic energy to transfer the information between RFID reader and RFID tag. Some general RFID readers will work only for shorter distance of few inches, while some work for a distance of 100 meters or more. A GSM modem contains a slot for SIM card where we can insert a SIM card and operates on a subscription to a mobile operator similar to a mobile phone. These GSM modems are operated and controlled using AT commands. The RF modules use radio waves for transmission and the frequency of radio waves varies from 3Hz to 300GHz. Frequency refers to the rate of oscillation of the radio waves. Radio Frequency propagation occurs at the speed of light. RF waves are naturally produced from sun flares, lightning and from stars in space that radiate RF waves in the process of aging.

II. LITERATURE SURVEY

Congestion of traffic has become a major problem in almost all the cities of developing countries like India. Congestion of traffic is leading to the slow movement of vehicles and blockade of emergency vehicles like ambulance and fire trucks. A simple and traditional system of green and red lights which is operated by giving green and red signals to traffic at a multi road junctions are not able to provide the solution for today’s traffic problems.[2] Green wave system which was used for emergency vehicle clearance is not able to meet the current requirements because it fails when there is any disturbance of green wave and causes the remaining vehicles to have more delay before they reach green signal. The current road transport system is using RFID systems. [3] The advantage of RFID system is a multilane, multi road junction and multi vehicle based system. This system can...
reduce the congestion of traffic but the disadvantage of this system is that it cannot identify the emergency vehicle which is near to the signal unless it is scanned at the signal post. This leads to the delay in passing of emergency vehicle at the signal post which may cause a severe loss. Other system which includes the RFID and GPS are efficient in congestion control and emergency vehicle clearance but they cannot identify the stolen vehicles which can be done at the traffic signal post.

Traffic has become a critical issue for transportation system in most of the cities in across the globe. This is especially true for developing and highly populated countries India and China. [4] Many of the Indian cities are experiencing the movement of vehicles at the speed of less than 5Km/h during the peak hours. The rate of traffic is increasing day by day and the number of vehicles newly coming on to the road are also increasing at a very high rate due to the reduce in the price of cars so that middle class can also buy a car. It has become a challenge to the police department as well as the road transport department to control the traffic and reduce the traffic blockades. Major cities in India like Delhi, Bangalore, Kolkata, Mumbai, Chennai, etc. are experiencing the severe problem in road transportation especially during peak hours.

III. PROPOSED MODEL

It is clearly understood that the current systems for traffic control are not enough for the present situations and there is need for an intelligent system which can control the traffic, identify the stolen vehicle and allow the emergency vehicle to pass smoothly. In order to provide a solution for the current problems, we propose to implement the Smart Traffic Control System to overcome the above problems. The proposed system mainly contains three modules. The first module is traffic signal control system. RFID tag implanted on every vehicle is scanned at the traffic signal post when it comes within the range of RFID reader and it therefore controls the traffic signals with the count of vehicles crossed the signal. This controls the congestion of vehicles. The second module is the stolen vehicle identification module. If any vehicle that is scanned at the traffic signal post is identified as stolen vehicle based on the RFID tag number which was previously entered into the database by the police department, then the way is blocked by giving the red signal and buzzer sound. Also, a message is send to the respective person or department informing about the identification of stolen vehicle at a particular location so that the vehicle can be caught at the current signal or next possible signals. The third module is the emergency vehicle clearance. Every emergency vehicle is equipped with a slave RF transmitter module. If an emergency vehicle is approaching the signal, it establishes the communication with traffic signal post master system using RF technology and the respective will become green allowing the emergency vehicle to pass smoothly without any delay and then allows the remaining ways to become green periodically. If two emergency vehicles are approaching towards same junction from two different directions, then the shorter distant emergency vehicle will be allowed first after which the second emergency vehicle will be allowed so that there will not be any blockade occurring at the signal.

A. GSM Modem:

This system uses a GSM modem which will be connected to the ARM7 microcontroller at the signal post master kit. This GSM modem is used for communication purpose over a mobile network. We use SIM900 GSM modem in this system which can have the features like GPRS, sending and receiving the messages and voice calls. SIM900 works on the frequencies of EGSM 900 MHz, PCS 1900 MHz and DCS 1800 MHz. The GSM modems are controlled and operated using the “AT Commands” for various operations. It is interfaced using MAX232 to the ARM7 microcontroller and requires the AC-DC power adaptor with DC voltage rating as 12V/1A.

B. Microcontroller (ARM7 LPC2148):

ARM7 has now become the most widely used type of microcontroller in the field of mobile devices. It is a 32 bit RISC architecture based microcontroller. LPC 2148 has 64 I/O pins which can be accessed as 8 bits, 16 bits or 32 bits. It has 32kB on chip SRAM and 512kB on chip FLASH memory. The system uses ARM7 LPC2148 because of its advanced features in order to make the system fully automated at the signal post. The microcontroller is responsible for the counting of vehicles and giving the green, yellow or red signals. Also, it is associated with the GSM modem to transmit and receive the messages.
C. RFID Reader:

RFID is an identification system in use in wireless communication which can transmit signals without any physical gadgets and it can be categorized as an automatic identification technology. The working of a RFID system is when a RFID tag is in the range of a RFID reader, the RFID reader identifies the unique data stored in the RFID tags by reading the radio frequency. The means for transmitted the information to the reader is provided by the antenna to the integrated circuit. The RFID tags can be classified into two types, Active and Passive tags. The tags which do not requires power supply are called as Passive tags and the tags which requires power supply are called as Active tags. In this system, we use the Passive type of RFID tags and operate at a frequency of 125 KHz with a range of 10 inches. The operating range of RFID depends upon the type of RFID reader and generally varies from few inches to hundred meters.

D. RF Modules:

RF communication occurs in the range of 3 KHz to 300 GHz. The system uses a RF receiver and a RF decoder (HT 12D) with the ARM7 LPC2148 microcontroller in the master kit at the traffic signal post and a RF transmitter module with a RF encoder (HT 12E) in the vehicle slave kit. These RF modules are responsible for communication between the traffic signal post and the emergency vehicles. The information is encoded using HT12E at the emergency vehicle and then transmitted using RF transmitter to the RF receiver where it is decoded using HT12D at the master kit and the necessary action is taken by the microcontroller at the traffic signal post.

IV. WORKING MODEL

A. Traffic Signal Control System.

This module is responsible for automatically controlling the signals. In this prototype design, we have used RFID reader of frequency 125KHz and passive RFID tags. The RFID tagofeachvehicle is containing a unique identification number. When a vehicle come in the range of reader or receiver, the unique identification number of RFID tag belonging to a particular vehicle will be transmitted to the reader. The microcontroller is responsible for counting the number of vehicles in certain duration. For Testing, we took 5 seconds as default timing out of which green light will be for 3 sec and yellow light for 2 sec. After 5 sec, the particular road will have red signal. The signals will be periodically rotating to all four sides of a junction. If the density of the traffic on a particular road increases, then the road will have green light for more time in order to balance the congestion. If a road has high density compared to remaining roads at the junction and has green signal for more time, then the next green signal will be given to second highest denser road instead of giving it in a circular manner.

B. Stolen Vehicle Identification

If the unique identification number of a stolen vehicle is detected at the traffic signal post using RFID, then the way be completely blocked with a red signal for a duration of 10 sec (for testing purpose) and a buzzer sound will be started to make the police attentive. Also, a message will be send to the respective person or a department indicating that the stolen vehicle is identified at a particular location. This can make sure that the stolen vehicle can be caught at the current signal or at next possible signals.

C. Emergency Vehicle Clearance

This module is mainly responsible for the clearance of emergency vehicle. This module has two sub parts. One is the RF transmitter which is equipped with a power supply inside the vehicle. Other one is the RF receiver placed with the controller at the traffic signal post. When the emergency vehicle is approaching the junction, by pressing the pull button at the transmitter side, the connection will be established between the emergency vehicle and the traffic signal post master controller system with RF communication. The way is given with green signal until the emergency vehicle passes the junction (limited to 10 sec for testing purpose). Once the emergency vehicle crosses the junction, the way is given with red signal allowing other roads to have green signal periodically. If two emergency vehicles are coming from road 1 and road 3 towards the same junction, then the shorter distant vehicle (assume in road 1 for testing) is allowed first to cross the junction after which the second emergency vehicle (in road 3) is given with green signal instead of road 2 in order to allow the emergency vehicle to pass smoothly without any blockade. If a stolen vehicle is detected and the way is given with red signal and if immediately an emergency vehicle is identified in the same direction, the way is immediately given with green signal because the emergency vehicles are more important than stolen vehicles.
Fig 1(b): Emergency Vehicle kit

The experimental results are as follows.

Fig 1: Signal Control Based On Density Of Traffic

Fig 2: Emergency Vehicle Clearance

Fig 3: Stolen Vehicle Identification

V. CONCLUSION AND FUTURE SCOPE

Smart Traffic Control System provides a cost effective solution for controlling the traffic. The system is fully automated and hence requires very less human effort in operating it. The stolen vehicle identification module is very much helpful for the police department in identifying the stolen vehicles and also a message will be send about the identified location of stolen vehicle. Emergency vehicle clearance module allows the emergency vehicles to pass the junction quickly because every minute spend in traffic for emergency vehicles is important as it can cause a severe harm to some precious lives if the delay occurs in travel for an emergency vehicle. This system is useful for many departments like police department, transportation department, health department, safety department and many more.

The future enhancements of this project can be inclusion of GPS to the stolen vehicle identification module so that the location of the stolen vehicle can be continuously tracked. This prototype is designed using RFID scanner which works for a shorter range and this can be improved by using the RFID readers which can work for long distance. All the roads at junction in this prototype are not configured for all the modules and this can be enhanced by implementing all the four roads with all the three modules.

VI. REFERENCES


AUTHOR’S PROFILE

Yaswanth Sai Jaladanki has received his B.Tech degree in Electronics and Communication Engineering from JNTU, Anantapur in 2014. He is now pursuing the M.Tech degree at PBR Visvodaya Institute of Technology and Science, Kavali, Andhra Pradesh, India. His areas of research include sensor networks and wireless communication.

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