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Implement Green Wave system and Detection of Stolen Vehicles

Vantala Hima Bindu
M.Tech Student (Embedded Systems),
Department of ECE,
Miracle Educational Society Group of Institutions.

Sivaprasad Budireddi, M.Tech
Associate Professor,
Department of ECE,
Miracle Educational Society Group of Institutions.

Abstract:

In today's world, traffic jams during rush hours is one of the major concerns. During rush hours, emergency vehicles like Ambulances, Police cars and Fire Brigade trucks get stuck in jams. Due to this, these emergency vehicles are not able to reach their destinations in time, resulting into a loss of human lives. We have developed a system which is 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' 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. Around the world, green waves are used to great effect. Often criminal or terrorist vehicles have to be identified. In addition to the green wave path, the system will track a stolen vehicle when it passes through a traffic light. In contrast to any traditional vehicle tracking system, in which the Global Positioning System (GPS) module requires battery power, our tracking system, installed inside the vehicle, does not require any power. The information regarding the vehicle has to be updated in the system database. So, it is an autonomous 2-tier system which will help in the identification of emergency vehicles or any other desired vehicle. It is a novel system which can be used to implement the concept of the green wave.

Keywords:

Green wave, low cost, Emergency Vehicle Clearance, tracking, detection of stolen vehicles.

I. INTRODUCTION:

Many systems are used to implement the green wave systems. We have developed a cost effective system using Radio frequency identification (RFID) Technology, Global system for mobile communication (GSM) modules and latest high speed microcontrollers to achieve the desired results. The primary objective is to identify the emergency vehicle and track its location so that we can provide a green wave to the emergency vehicle. Conventional technologies use image processing systems to identify the emergency vehicle. But these systems have a drawback during bad weather conditions. Due to wind, rain, fog, etc., the image received by the camera is distorted by noise and it becomes difficult for the system to identify the desired vehicle. Thus, we have built our system using RFID transponders and readers. The advantage of RFID is that it is a cost effective system which will provide uninterrupted communication in our network even in bad weather conditions.

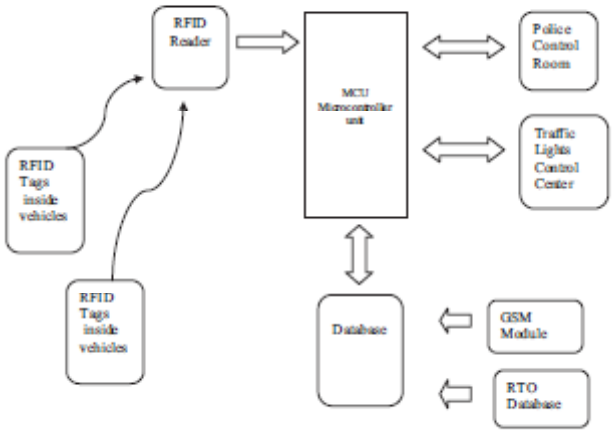

Fig.1 System Structure

II. SYSTEM STRUCTRE AND BLOCK DIAGRAM:

The basic block diagram of the system is illustrated in Fig.1. The system comprises of a RFID reader and a RFID tag or transponder. We will use a high frequency reader which will provide long range to the system.

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During the manufacturing of vehicles, passive tag or transponders are embedded inside the dash board of the vehicle such that it is not easily visible to human eyes. During the registration of the vehicle, each vehicle gets a unique license plate number. In our system a database is maintained, in which table comprises of information like Unique ID of tag against which the vehicle license plate number and its category is stored. We have defined three categories for this system namely Emergency vehicle, Stolen Vehicle and a Normal Vehicle. A Column of priority is also added in table, in which three levels are defined: - low, high and highest. A priority "T" for stolen vehicles. However, as per the demand of the user, more levels and categories can be added easily. Readers are installed on every junction of the city, on top of the roads. The reader reads the unique ID present on the tag or transponder and sends the information to the main system to check its category and priority in the database and take the desired action accordingly. For immediate update of category of vehicle and also its priority level the database is connected to the GSM module. The RTO database is also connected to the main database, so that regular updating of the system database can be done. As soon as the vehicle is registered with Regional Transport office (R.T.O), the vehicle is registered with our system as well. The microcontroller unit is connected to the police control room, to send the alert signals of any stolen vehicle detected. In Table 1, a block of database is shown. In this database, a table is formed in which attributes like unique ID of tag, category of vehicle, priority, location and number of junctions are recorded. In India all the vehicles are registered with R.T.O.

Table 1: BLOCK OF DATABASE:

Unique ID	Category	Priority	Location code	No.of junctions
xx1234xx	Emergency	HT	456	4
xx456xx	Stolen	T	323	————
xx673xx	Normal	L	782	————
————	————	————	————	————

III. SYSTEM FEATURES

A. Categories:

The system has three predefined categories of vehicle namely, normal vehicle, stolen vehicle and emergency vehicle. These categories can be changed as per the requirements. The updating of the priority can be done dynamically with the help of the GSM module as shown in the system structure block diagram.

B. Priority of Vehicle:

There are three levels of the priority of the vehicle defined in the system namely low, high and highest. For stolen vehicles the priority is set as 'T'.

C. Update of database dynamically through SMS:

The database of the system is connected with the GSM module, so, the information regarding the category and priority of vehicles can be easily updated in seconds through a Short Messaging Service (SMS).

D. Traffic Monitoring:

All the information of the vehicles passing through the junctions is also stored in the system database, which could be used at a later stage for traffic monitoring and other purposes.

E. Sensing the Direction of the stolen vehicles:

Readers will be installed before every traffic light junction such that the direction of movement of stolen vehicle is easily detected. Readers will be installed over the road at a certain height. Readers need to be protected from direct sunlight and rain, so, they need to be covered.

IV. SYSTEM HARDWARE:

The complete system consists of following parts.

A. RFID Readers:

High frequency RFID readers are installed above the roads prior to every traffic light system in all directions in such a manner that the entire area comes under the range of RFID reader.

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B. RFID Transponders:

Passive RFID transponders are installed inside every vehicle at the time of manufacturing. RFID transponders consist of unique ID. Once the vehicle is registered and gets the license plate number, its data is stored in the database along with the category of the vehicle, either 'Normal' or 'Emergency', which could be changed to any other category as per the requirements.

C. Base Station:

The Base station is equipped with a microcontroller unit connected to the database consisting of all the information. The database is connected to the GSM module which helps in immediate update of the database. However the database can be updated manually as well. The RFID readers are connected to the base station with the help of XBEE transceivers. The readers will keep on sending the unique identification (UID) of the vehicle from every traffic light to the microcontroller unit (MCU). The MCU will then check for the category and the priority of vehicle in the database and will accordingly send outputs to the traffic lights and Police Control Room.

D. User interface for Emergency Vehicle:

An interactive interface for user vehicle is also available, in which the driver of the emergency vehicle will update the priority of vehicle. As in most cases, if there is no patient in the ambulance, its default priority level will be set to low. This interface also helps the driver to select the junctions through which the emergency vehicle will pass. The priority of the vehicle, location and the total no. of junctions to be passed through are sent to the system with the help of a GSM module. This data is received by the GSM module of the system and the database is updated.

V. FLOW CHART OF SYSTEM SOFTWARE:

The above flow charts give the basic algorithm of the software developed for the entire system. In Fig. 2, the category 'high' of the vehicle is denoted by "H" and 'highest' is denoted by "HT". In Fig 3, the category of the vehicle stolen is denoted by "T". The category highest has a priority over the high. On an event of two vehicles approaching towards a traffic light junction simultaneously from opposite directions, the priority will be given to the vehicle whose priority is defined as highest. If both the vehicles have registered for the highest priority, the system will serve the vehicles on first come first serve basis. In Fig. 2, the destination information is received by the driver which in turn selects the junctions through which the vehicle has to pass to reach the destination.

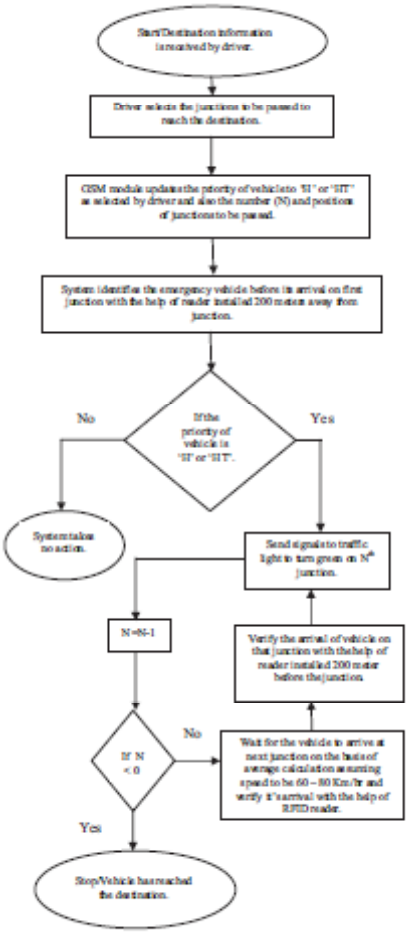

Fig. 2 Flow of Software for Green wave

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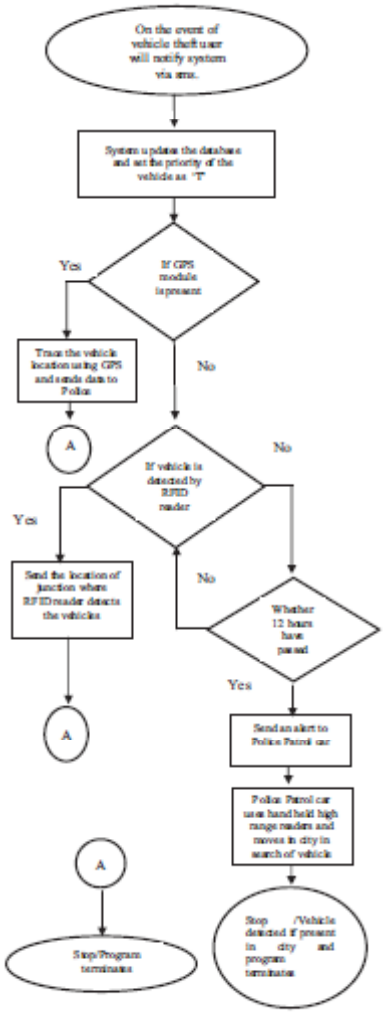

Fig. 3 Flow of Software for Detection of Stolen vehicles

The GSM module will update the priority of vehicle to 'H' or 'HT', as selected by driver, and will also update the number and position of junctions to be passed through. The system then identifies the emergency vehicle before its arrival on the first junction with the help of the reader, installed 200 meters away from the junction. Now, the priority of vehicle is checked. If the priority is 'H' or 'HT' then the system sends signals to turn the traffic light to green on the Nth junction and N is decremented by one. Now, if N is less than zero, it means that the vehicle has reached the destination. If N is not less than zero, the system waits for the vehicle to arrive the next junction on the basis of average calculation, assuming the speed to be 60-80 Km/hr, and verifies its arrival with the help of RFID reader. The arrival of vehicle on that junction is verified with the help of reader installed 200 meter before the junction.

Then, again, signals are sent to the traffic light to turn green on Nth junction and again the process continues till N becomes less than zero. For detection of stolen vehicles (Fig. 3), the user will notify the system about the vehicle theft via SMS. The system will update the database and set the priority of the vehicle as 'T'. Then, the presence of a GPS module will be checked. If a GPS module is present, the vehicle location will be traced and sent to the police. If the GPS module is not present, then it is checked whether the vehicle is detected by RFID reader. If yes, then it sends the location of junction where RFID reader detects the vehicle. If RFID reader is also not present, it will be checked whether 12 hours have passed or not. If not, then again it is checked if the vehicle is detected by RFID reader or not and this continues. If yes, then it will send an alert to police patrol car. The police patrol car uses hand held high range readers and moves in city in search of vehicle and the vehicle is detected if it is present in the city.

VI. PROTOTYPE IMPLEMENTATION:

In our prototype we have used Atmel's Atmega16 microcontroller along with low frequency RFID reader (125 kHz) and passive transponders based on EM4102. Three different categories are emergency, stolen and normal. In our coding section, three different UIDs (Unique identification code) of tags are stored in the program. A 16x2 (Liquid crystal display) LCD is interfaced with the microcontroller to display the category of the vehicle with the traffic light model. The traffic light model is shown by red and green (Light emitting diode) LEDs in the model. The code written is compiled in AVR Studio 5 and burned on microcontroller using Universal serial bus (USBASP) programmer. The prototype structure is same as shown in Fig. 1. The RFID transponders are fitted in four manually driven toy cars. The RFID readers read the information from the tag; this information is fed into the microcontroller unit for the further processing. The information read is unique identification code (UID). Once the vehicle is in the range of the RFID reader, the reader reads the UID on tag and compares it with UIDs stored in the database. If it corresponds to any of the category defined, then the LCD displays the category of the vehicle. If the vehicle category is 'emergency', the traffic light module is activated. Assuming the average speed of the emergency vehicle, the red light is turned to green and the process goes on for all the junctions through which the emergency vehicle shall be passing.

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The timing of the red lights is such that the red light turns to green only when the vehicle is 300m away from the junction, so that a green wave is given to the emergency vehicle only. Now, if a stolen vehicle passes from any of the junctions and its information is already updated on the system, the system will give an alert signal using red LED indicating that a stolen vehicle has passed from the junction. If a normal vehicle is passed, no action is taken by system. In that case, the reader just detects it and that data can be used for data monitoring purposes. The drawback of the prototype is that if one or the other vehicle approaches, the LCD goes blank and it does not detect any of the vehicles hence it does not support anti-collision feature for passive tags. The system uses low frequency tags and readers. Hence, we get a low range of operation that is just 4 to 5 cm. To resolve all these issues which are mentioned above we used readers with anti collision features. To increase the overall range of the system, we used high frequency readers. By using the above mentioned techniques, the major drawback of the prototype was resolved. A highly efficient prototype is finally developed.

VII. RESULTS AND CONLUSION:

The program was successfully burned on the micro-controller using USB programmer and when an emergency vehicle approaches this reader, it is successfully detected by the system as an emergency vehicle and traffic light module is activated. On the other hand, if any stolen vehicle is detected, it is displayed on the LCD. The system is efficient. This prototype presents a novel solution to implement the concept of green wave in urban cities.

Table 2

Traditional system	Our System
High cost, as they use GPS module.	Low cost.
No dynamic updating available in traditional system.	Immediate updating of information of stolen vehicles through SMS.
Image processing based systems will not work during bad weather conditions	Will work in all weather conditions.
Can't provide 24 X 7 X 365 surveillance.	Hence providing 24 X 7 X 365 surveillance.
Data Services may be required by the consumer, hence increasing the cost.	No data services are required by the consumer, hence highly cheap.

The overall system is quite cost effective and has various advantages over the conventional technologies. Below table 2 compares the conventional technologies and our developed system. In traditional systems, to track the vehicle so as to provide green wave, GPS is used. The cost of a GPS module is very high as compared to a RFID transponder. The transponders are not only very cheap to manufacture but are also very small in size. The small size of transponder gives an advantage over the GPS, GPS can be easily removed by anyone, whereas it is very hard to locate a RFID transponder and remove it. We also have an option of updating the system dynamically with the help of a SMS through the GSM module. In some of the cases, to identify the vehicle, image processing based system is used, which has a major drawback during the bad weather conditions. Bad weather may be due to heavy rain, fog, dust storm. On the other hand, our system is not affected by any of these bad weather conditions. Our system can work in any weather, so it has the capability to provide a 24x7x365 surveillance without any disruption. The traditional system can't provide a 24x7x365 surveillance. This system is very helpful in building a smart city. The city equipped with the developed system will never have any issues related to traffic management. Moreover it will make the city more secure in context of detection of stolen vehicles. Green wave also helps in saving environment as it will reduce emission of CO, NOx, PM10. It will also reduce the consumption of fuel by the vehicles which are provided with the green wave. Moreover, vehicles travelling in platoons will get a clear way without any traffic

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