

Intellectual Speed Control with GPS and Radar for Emergency Vehicle Pre-Emption

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Abstract :According to several statistics the majority of the Car accidents are caused by highspeedand disrespect of the inter-vehicles security distance. In spite of this, more than 60% of drivers do not comply with speed limits on urban roads or trunk roads. The worst situation is when a trunk road passes through a village. There, almost 80% of drivers break the speed limit. In order to give to drivers the means for controlling the speed of their cars, several constructors have developed various systems such as the speed limiter or regulator already present in some cars. In this field, research continues to give more effective systems, like speed regulator systems with GPS (Global Positioning System) which allows to adapt the car velocity to that authorized in its localization zone. In this paper we describe an Intelligent Cruise Control with GPS and Radar (ICCGR) that combine GPS and radar systems to adapt the vehicle speed to respect the speed limitation and to avoid running up against others vehicles. The system integrates a GPS subsystem which makes it possible to locate the car and to determine authorized speed in its zone of localization. The radar subsystem detects any obstacle In front of the vehicle and gives the optimal speed to avoid the most dangerous one. A traffic signal pre-emption system,and a related method for its use, using differential global positioning system measurements for accurate monitoring of the position , speed and direction of an emergency or service vehicle.

Keywords : GPS, Radar systems, ICCGR.

I. INTRODUCTION

The major threats to the world are pollution ,global warming, road accident etc. This project provides solution prevent road accident, and allow priority to the emergency vehicles. Accidents may occur due to various reasons one the main reason is due to over speed. We restrict the speed of the vehicles automatically when it enter the specified zone using IR. The transmitter is specified in a particular area and receiver is fixed at the top of the vehicle. If the speed is less or equal to the given speed, the system does not get activated. After the vehicle leaves the specified location it automatically return to the default position. Therefore, the accident can be reduced to some extent. By using IR transmitter and receivers can prevent accidents at a specified zone only. In RF there are two part transmitter and receiver in the transistor when press the micro switches key given some input of microcontroller , the microcontroller check the key input whose key press and what is the data or information sending after this process the microcontroller1 encoded the input by the RE module the receiver the data by RE module and collected by receiver microcontroller and the microcontroller decoding the information signal and display on the seven segment and microcontroller sending the data in dc Motor, and motors start the receiver part send feedback which data is receives ,sending by the RF module again the transmitter RF module receive feedback information and decoding by microcontroller and display on LCD (liquid crystal display). It's whole process based on the frequency modulation. In order to avoid accidents at all places by using GPS system.

The Zone status transmitting unit is fixed in sign boards at different locations. This gives the zone information. There are various zone information like School zone, 'U' turn zone., high way zone, and so on. The need of the vehicle is controlled automatically according to the zone where the vehicle is located. Signal is transmitted from sign board at a frequency range of 433.92 MHz . The Vehicle speed control and monitoring unit is fixed in any vehicle. This unit receives the signal transmitted from the zone status transmitting unit. This unit consists of various blocks Receiver unit, Transmitter unit, Micro controller unit, Display unit (LCD),Ann-unciate buzzer,motor unit, Speed control valve. ICCGR (Intelligent Cruise Control with GPS and Radar) its main role consists in limiting the car speed automatically to the local prescribed speed given by the driver, the GPS or by the radar post processing. The ICCGR can be seen as an electronic help which facilitates the control of a car. It informs the driver about the various changes of speed limits and, in some cases, obliges him to respect them. The GPS relates generally to control of traffic signals under emergency conditions and, more particularly,to systems for automatic control of traffic signals in such a way as to preempt normal signal operation and permit the unimpeded and safe passage of emergency vehicles, such as ambulances, police cars, fire trucks and so forth. There is a related need for preemption control systems to give priority to non-emergency vehicles, such as buses, which have to maintain a schedule in busy traffic. It has been widely accepted that, particularly in high density traffic areas, there is a vital need for such systems. Not only must an emergency vehicle be free to move through an intersection in a selected direction of travel, but the traffic flow in other directions, which could interfere with the movement of the emergency vehicle, must be stopped by an appropriate signal indication until the emergency vehicle has passed. A number of present day systems have been utilized to accomplish this general purpose, but all have fallen short of the desired result in some respect.

A common approach has been to provide apparatus on the emergency vehicle to transmit an emergency signal to a receiver associated with the traffic signal. The traffic signal controller, which has been suitably modified, is actuated to operate the signals in a predetermined emergency sequence. Some systems of this type require the installation of a receiver or sensor under the road surface, to detect where the vehicle is located with respect to the traffic signals. Obviously, systems of this type present difficulties of installation and maintenance. Various traffic pre-emption systems use radio signals, infrared signals, ultrasonic signals, audio signals or optical signals transmitted from the emergency vehicle and detected in some manner at the controlled intersection. A common difficulty with all systems of the prior art is that of accurately determining the time of arrival of the vehicle at the intersection. Clearly, pre-emption of normal traffic control should not occur too early. Apart from the obvious inefficiency this entails, there is an element of risk in that impatient drivers may try to enter a controlled intersection before the emergency vehicle arrives. Various techniques have been proposed for determining vehicle location for use in traffic preemption. For example, electronic "signposts" can be installed beside or beneath the roadway to detect the passage of vehicles. Such systems are used, for example, to determine the locations to help maintain more accurate bus schedules. For the traffic preemption problem, however, installing multiple sensors or "signposts" near each intersection would be very expensive and still would not necessarily provide the desired accuracy.

More specifically, optical pre-emption systems are limited by the line of sight between the vehicle and the intersection control unit. Audio pre-emption systems detect the sound of an approaching siren on an emergency vehicle and take appropriate action. Unfortunately, the sound can be blocked by other vehicles or buildings, and microphones must be installed at points approaching the intersection. Radio pre-emption systems currently available utilize signal strength to determine distance from the intersection. However, natural variations in terrain and man-made obstructions render this approach quite inaccurate.

Beacon based systems are more accurate, but do not permit subsequent adjustment to pre-emption distance needed for changing traffic patterns or construction zones. Also the installation cost of a beacon system is high because long lengths of underground cable have to be installed beneath the intersection and its approaches. Sensor loops underground are used to sense the vehicle positions, but are prone to breakage in cold weather. A failed sensor can render the system inoperative while repairs are made over an extended period, possibly months.

Another common aspect of traffic signal pre-emption systems is that they are typically manually actuated from the emergency vehicle. When the driver actuates a button or switch in the vehicle, an emergency signal is

transmitted to the controller at the intersection, to pre-empt normal operation and modify the controller temporarily for passage of the vehicle. Some systems allow the driver to indicate a direction of turn at the intersection, so that the traffic signals can be appropriately controlled during pre-emption. However, existing pre-emption systems are typically not optimized to disrupt normal traffic control for as short a time as possible, or to clear as much of the interfering traffic as possible from the intersection.

Moreover, existing pre-emption systems have no provision for pre-empting signals at adjacent intersections to one side or the other of the vehicle direction of travel when a pre-emption request is made. In existing systems, some intersections may not be pre-empted soon enough, if the vehicle deviates from a straight path along a single street, and may be pre-empted unnecessarily if the vehicle turns before reaching a nearby pre-empted intersection. The present invention has the goal of providing safe and unobstructed passage for emergency vehicles, while at the same time minimizing disruption of normal traffic through the intersection, and eliminating many of the disadvantages of the prior art systems.

II. INTELLIGENT CRUISE CONTROL WITH GPS AND RADAR

A . The GPS subsystem

The GPS subsystem computes, in real time, the car speed, its direction and its current position using geographical data (latitude and longitude). According to this information and to the data base of the roadmap, the prototype locates the current and the next position of the car and then the speed limits to be respected.

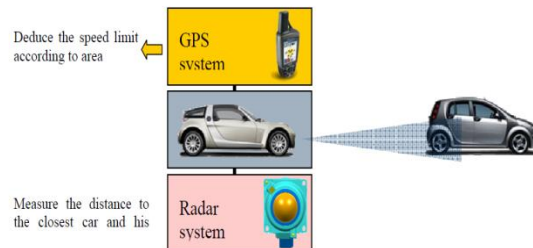


Fig .1. The system synoptic

B. The radar subsystem

The radar subsystem is able to detect and track 20 targets. In order to detect these target the radar sent a electromagnetic wave toward the obstacles, this signal is reflect and comeback to the receiver, the radar computing unit estimate the fly time and the frequency variation due to the Doppler effect that can affect the received signal and deduce the rage and the speed of each target.

Some time the received signal is very noisy and the radar can detect an inexistent target. To avoid this problem the used radar integrates a tracking algorithm. Thus the radar can track 20 vehicles and give there range, velocity and associated to each oh them a credibility factor, the credibility value grow if the considered target is detect regularly and decrease if is not detected any more. The system uses the radar to detect the entire target in front off the vehicles in order to avoid running up against. But in the case when the radar detect a multiple obstacle the system must choose the must significant and dangerous target.

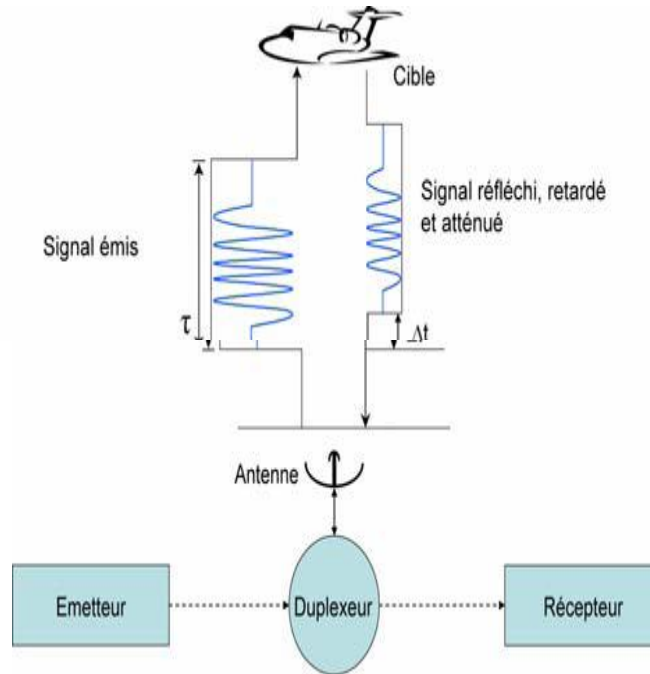


Fig.2. the radar principle

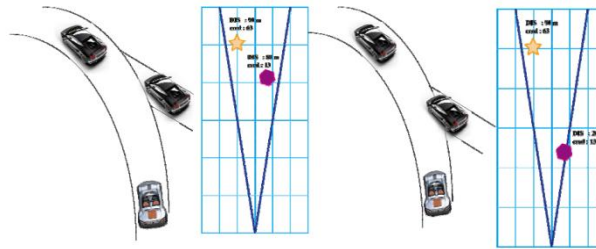


Fig. 3. a & b : multi Target situation

In this case, the system must distinguish the most dangerous target among it. For that two criteria can be considered:

- The First one is to consider that the nearest obstacle is the most dangerous, this criterion goes very well in the situation Figure 3-b, but it will generate an false alarm in the case describes in figure 3-a since the nearest target is out of zone danger.
- The second criterion is to balance the distance with the credibility factor of the target. To find a good compromise one associates with each target a weight α which can be quantified

$$\alpha = \text{credi} * \text{dists}/\text{dist}$$

$$\alpha = \text{cred} * \log (\text{dists}/\text{dist})$$

Where:

- credi is the credibility factor given by the radar tracking system for each target.
- Dist is the distance toward this target.
- Dists is the security distance threshold.

We carried out several simulations and we deduced that the first weight generates a hard threshold, the second one is more adapted to ours application.

III.EMERGENCY

A traffic signal preemption system using differential global positioning system (GPS) corrections, for a signalized intersection having a traffic signal controller capable of operation in a normal mode and in a preemption mode upon receiving a signal for preemption, the system comprising: a traffic signal subsystem, including; a GPS reference receiver having an antenna installed at a known position, for receiving GPS signals and computing measurement corrections for the GPS signals; a communication radio for receiving data from an approaching emergency vehicle, and an intersection computer, containing a model of the intersection and programmed such that corrected vehicle position, speed and direction measurements are used to determine when to send a signal to the traffic controller to switch to preemption mode in such a way as to minimize disruption of normal traffic; a vehicle subsystem, including; a GPS receiver for receiving GPS signals, said signals including signals from which the vehicle's position, speed and direction can be determined; a communication radio for transmitting data to the traffic signal subsystem radio, and a vehicle computer, for coordinating operation of the vehicle GPS receiver and the vehicle communication radio; and a differential GPS subsystem portion in communication with the GPS reference receiver to receive therefrom the measurement corrections and in communication with the GPS receiver to receive the GPS signals and to compute and to provide to the intersection computer, corrected vehicle position, speed and direction. A traffic signal preemption system as defined in claim 1, wherein; the traffic signal subsystem has a radio transmitter by which the GPS measurement corrections computed by the intersection computer are transmitted to the vehicle; and the vehicle computer computes the corrected measurements of the vehicle position, speed and direction for transmission to the traffic signal subsystem. A traffic signal preemption system as defined in claim 1, wherein: the vehicle communication radio transmits uncorrected vehicle position, speed and direction measurements to the traffic signal subsystem; and the intersection computer computes corrected vehicle position, speed and direction measurements.

A traffic signal preemption system as defined in claim 1, wherein; the vehicle communication radio transmits raw GPS measurements to the traffic signal subsystem; and the intersection computer computes corrected vehicle position, speed and direction measurements. A traffic signal preemption system as defined in claim 1, wherein; a single GPS reference receiver serves multiple controlled traffic intersections and broadcasts GPS corrections to multiple vehicles in the same vicinity; the vehicle computer in each vehicle computes the corrected measurements of vehicle position, speed and direction for transmission to the traffic signal subsystem. A traffic signal preemption system as defined in claim 1, wherein: the vehicle subsystem includes a turn signal indicator, wherein the vehicle communication radio also transmits turn signal and vehicle identification information to the traffic signal subsystem.

A traffic signal preemption system as defined in claim 1, and further comprising: means for identifying selected points for use in a learn mode on each approach route to the intersection; and means contained in the traffic signal subsystem, for operating in the learn mode, during which each approach route to the intersection is recorded for use in a normal mode of operation. A traffic signal preemption system as defined in claim 1 wherein corrected vehicle position, speed and direction measurements are used to determine when to send a signal to the traffic controller to switch to preemption at an optimum time in such a way as to minimize disruption of normal traffic.

A traffic signal preemption system as defined in claim 8 wherein; the traffic signal subsystem has a radio transmitter by which the GPS measurement corrections computed by the intersection computer are transmitted to the vehicle; and the vehicle computer computes the corrected measurements of the vehicle position, speed and direction for transmission to the traffic signal subsystem. A method of operating a traffic signal preemption system for a signalized intersection having a traffic controller, comprising the steps of; receiving global positioning system (GPS) signals at a reference GPS receiver whose location is accurately known; computing differential GPS corrections to be applied to received GPS signals; receiving GPS signals at a vehicle GPS receiver said signals including signals from which the vehicle's position, speed and direction can be determined; transmitting some form of the received vehicle GPS signals to a traffic signal intersection subsystem; using the

differential GPS corrections, computing corrected vehicle position, speed and direction; and computing from the corrected vehicle position, speed and direction measurements, taken with known intersection approach data, an optimum time to send a signal to the traffic controller to switch to a preemption mode of traffic control.

A method as defined in claim 10, wherein; the method further includes transmitting GPS corrections to each vehicle equipped for receiving them; the step of computing corrected vehicle position, speed and direction is performed in the vehicle; and the step of transmitting some form of received vehicle GPS signals transmits corrected vehicle position, speed and direction. A method as defined in claim 10, wherein: the step of computing corrected measurements is performed in the traffic signal intersection subsystem; and the step of transmitting some form of received vehicle GPS signals transmits uncorrected vehicle position, speed and direction measurements. A method as defined in claim 10, wherein: the step of computing corrected measurements is performed in the traffic signal intersection subsystem; and the step of transmitting some form of received vehicle GPS signals transmits raw GPS measurements obtained in the vehicle. A method as defined in claim 10, and further comprising: transmitting from the vehicle to the traffic signal intersection subsystem additional data including vehicle identification information and vehicle turn signal information. A method as defined in claim 10, and further comprising: determining in the reference GPS receiver an accurate position of the receiver, by averaging position measurements taken periodically over a long time interval. A method as defined in claim 10, and further comprising operating the system in a "learn" mode of operation, including the steps of: switching the system to learn mode; driving the vehicle over each approach route to the intersection; mapping the approach routes to the intersection for use in normal operation; identifying and recording selected successive vehicle positions along each approach route to the intersection; and recording desired preemption positions for later use in normal operation. A method as defined in claim 10, and further comprising the steps of; preempting traffic control at more than one adjacent intersection, based on the vehicle's intended direction of travel through the intersection, as derived from turn signal information transmitted from the vehicle whereby only intersections through which the vehicle will pass are subject to preemption.

The method of claim 17 wherein the more than one intersection includes a first intersection toward which the vehicle is moving and any intersection in the system to the right or left of the first intersection as determined respectively by the right or left turn signal of the vehicle being activated.

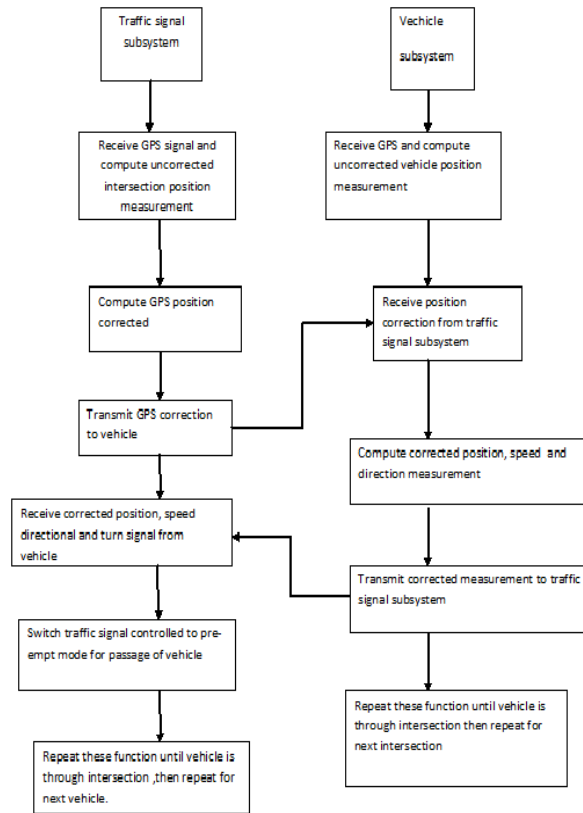


Fig .4 Block diagram of a traffic signal pre-emption system



Fig.5.Traffic system

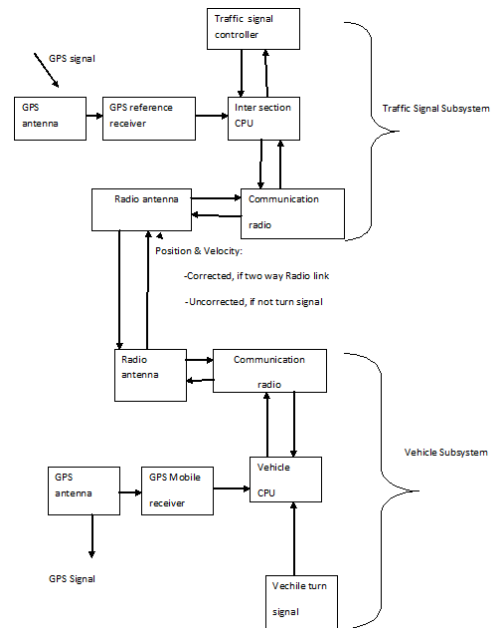


Fig.6. Vehicle transverse approach route and transmit position and velocity Benefits (Advantages):Traffic signal system

1. Reduction in normal recurring.

2. Significantly enhanced operational tools congestion to effectively manage traffic incidents.
3. Reduced pollution. Faster response to reports of faults.
4. I improved public transport service.
5. Reduction in emergency response times and safer travel.
6. Reduction in Garda time required to perform traffic control functions.
7. Less congestion during road works.
8. Improve traffic guidance and traffic flow
9. Reduce fuel consumption
10. Increase safety

IV. CONCLUSIONS

We conclude that, by using IR and RF transmitter and receiver can prevent accidents in specified zones only and cannot be implemented in vast areas and also signal loss may occur. This signal loss may cause the vehicles to escape. By using GPS system, can prevent accidents not only in specified zone but also in all places. The traffic light control system based GPS had successful been designed and developed. From this we can make a people life safe.

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