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Automatic Speed Limit Violation Detection and Warning System Using GPS and GSM Modem

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ABSTRACT: Speeding is one of the major causes of road accidents. As the drivers deliberately drive above the regulated speed limit, having an in vehicle automatic speed limit warning system could help to prevent a significant no. of speeding and accidents from happening. This paper presents the development of speed limit violation detection and warning system hardware prototype. Specifically, GSM modem will receive SMS cell broadcast message containing the speed limit information on entering the cell area. Upon over speeding beyond the specified speed limit the system will warn user two times and for over speeding third time the system will generate fine along with the GPS coordinates of the vehicle and will update the information of over speeding to the user's profile on cloud web server using GPRS. The system will also send SMS to the user registered mobile which contain information regarding fine along with website address. A webpage on cloud has been developed which the user can access to pay its fine and can also view location of over speeding. The main hardware components of the system are GPS module, GSM modem and Raspberry pi. The developed system demonstrates the feasibility of real time speed limit violation detection which can also be used for many applications including vehicle tracking and its security.

KEYWORDS: GSM, Cell Broadcast, speed limit, GPS, Cloud Computing

I.INTRODUCTION

One of the major causes of accidents is speeding. When drivers deliberately drive above the regulated speed limit, whether to show off, meet a deadline, or just for fun, they put their own lives and the lives of others at risk.To overcome above situation speed limit is mandatory. Every year, India loses more than 0.1 million lives due to road traffic crashes. According to WHO, the road traffic fatality rate of 16.8 deaths per one lakh population is estimated in India. Having an in vehicle automatic speed limit warning system could help to prevent a significant no. of speeding and accidents from happening.

My idea is to develop speed limit warning system built in the car that can warn the user upon over speeding beyond the specified speed limit. The information regarding speed limit will be broadcasted via GSM cell to the system upon entering its cell area. The system will show speed limit to the driver which he/she has to maintain until next speed limit from different GSM cell is broadcasted. The system will also check whether driver is driving below speed limit or not and will warn or generate fine for not obeying the rules.

II.REVIEW OF RESEARCH PAPERS

PAPER-1 On Field Performance Analysis of IEEE 802.11p and WAVE Protocol Stack for V2V & V2I Communication. (IEEE 2014, Authors: Team Embedded, Centre for Development of Advanced Computing(C-DAC))

This paper gives overview and performance analysis of DSRC technology. Dedicated Short Range Communication (DSRC) is an emerging medium range wireless technology aimed primarily at vehicular safety. DSRC standards are based on 802.11a with adjustments made for low overhead operations made on 5.9GHz. Wireless Access for Vehicular

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Environment(WAVE) is the amendment that allow wireless devices to communicate with each other in a high speed mobility vehicular environment. WAVE short messages are used for broadcast application that require instant exchange of safety information between vehicles or Road Side Unit(RSU). The Automotive Industry has started working to develop DSRC technology for use in Vehicle to Vehicle (V2V) and Vehicle to roadside Infrastructure (V2I) communication. For this purpose, US Federal Communications Commission (FCC) has allocated 75 MHz of licensed spectrum at 5.9GHz for the operations of Intelligent Transportation System (ITS).

PAPER-2 Safety Alert & Advisory Information System using Vehicular Communication (SAVER). (IEEE 2014, Authors: Team Embedded, Centre for Development of Advanced Computing(C-DAC))

In this paper author has proposed SAVER system architecture using DSRC technology. Author has also developed applications for Vehicle to Vehicle(V2V) & Vehicle to Infrastructure(V2I). The applications include speed limit and driver advisory for vehicular safety. The proposed SAVER system is a three tier architecture which consists of an On Board Unit (OBU), Road Side Unit (RSU) & a Server. These devices communicate over a wireless network to perform calculations and issue advisories/warnings to drivers through advanced safety applications. Both OBU & RSU consists of Wireless Access for Vehicular Environment(W A VE) stack that defines complete standards, services and functions that a station should perform in a vehicular network. OBU after entering an RSU coverage area receives packet broadcasted from RSU , parses the packet and present the advisories to driver when vehicle entered any of the regions. In case of speed limit application the current speed of the vehicle is compared with the speed limit set for the region and issue warning to driver when speed exceeded.

PAPER-3 Development of Vehicle Tracking System using GPS & GSM Modem.(IEEE 2013, Authors: Pham Hoang Oat, Micheal Drieberg and Nguyen Chi Cuong, Electrical and Electronics Engineering Department, University Technology PETRONAS)

This paper presents the development of the vehicle tracking system's hardware prototype. Specifically, the system will utilize GPS to obtain a vehicle's coordinate and transmit it using GSM modem to the user's phone through the mobile network. The three main components of the systems are the GPS receiver module, GSM module and Arduino Uno microcontroller. The GPS receiver module's main function is to obtain the vehicle's coordinates. These coordinates are periodically sent to the Arduino Uno microcontroller. The Arduino Uno processes this information and will then send the location information to the GSM to be transmitted through the mobile network to the user when requested or on a periodic basis.

PAPER-4 RFID Based Automatic Speed Limit Warning System.(IEEE 2012, Authors: Huanjia Yang, Shuang-Hua Yang ,Department of computer Science, Loughborough University)

In this paper author investigated automatic speed limit transmission based on RFID technologies. The current speed warning systems include GPS systems and speed sign recognition based on real-time image processing. GPS based speed warning systems are usually integrated with GPS navigation systems. A GPS sensor receives satellites signal and calculate the coordinators of the vehicle. The system then locates the vehicle on pre-loaded road map and indicates the corresponding speed limit according to a speed limits database.
Speed sign recognition is a technique based on real-time image processing. Cameras are installed on the front of the vehicle and continuously capture images ahead of the vehicle. Algorithms are developed to identify and read the speed limit signs on the road by processing the images so captured. In present research paper the speed limit are stored in RFID tags which will be embedded on signposts or certain points of road surface. When a vehicle passes such a signpost or surface point on a specific road, a reader installed in the vehicle will retrieve the corresponding speed limit information from the tags. Such information could then be indicated on an in-car display, or be used for a driver warning system to alert the driver they are speeding.

III.DSRC TECHNOLOGY

DSRC (Dedicated Short Range Communications) technology is specially developed for vehicle-to-vehicle(V2V) and vehicle-to-infrastructure(V2I) communication in Intelligent Transportation System (ITS). DSRC technology can supply the high speed wireless communication service to vehicle-to-infrastructure (V2I) communication, vehicle-to-vehicle (V2V) communication and other transportation service. DSRC has a high data transfer rate and small communication delay. It is widely used in ETC (Electronic Toll Collection) and public safety. It can build a high speed and reliability

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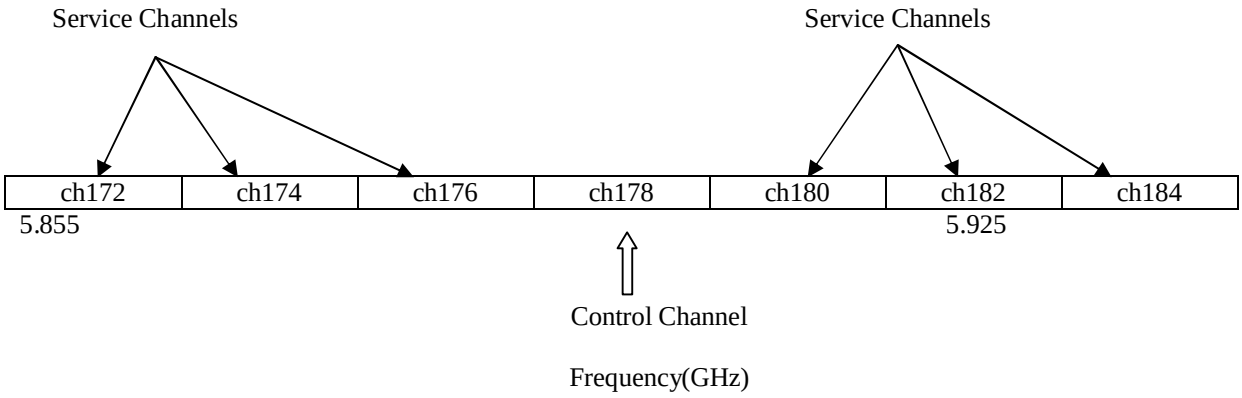
communication network. The transport information and control system of International Organization for Standardization (ISO/TC 2004) is in charge of making the international standard of DSRC. There are three DSRC standard camps in the world: Europe ENV Series, USA 900 MHz and Japan ARIBSTDT75 Standard.

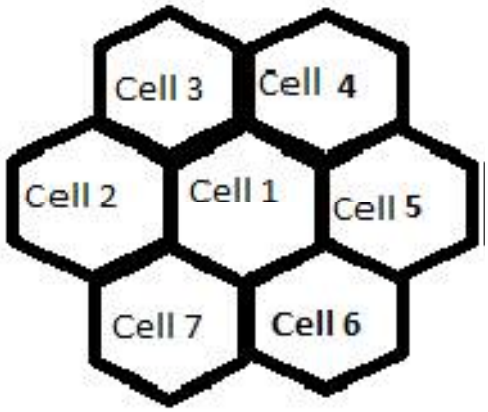


There are two types of channels available in DSRC namely Control Channel(CCH) and Service Channel(SCH) as shown in fig. All the channels have 10MHz of bandwidth. The first channel is used for collision avoidance and vehicle-to-vehicle communication; the middle channel is used for control systems and control instructions to broadcast messages; the last channel is used for long distance and huge power communication; the other four channels which have been left are all service channel.

IV.GSM & CELL BROADCAST TECHNOLOGY

Global system for Mobile (GSM) is a second generation cellular system standard that was developed to solve the fragmentation problems of the first cellular systems. GSM was first introduced in Europe in 1991 and today it is the most common cellular standard. GSM is the world's first cellular system to specify digital modulation and network lever architectures and services. It is an open, digital cellular technology used for transmitting mobile voice and data services.GSM supports voice calls and data transfer speeds of up to 9.6 kbps, together with the transmission of SMS (Short Message Service).

The main principle inside cellular network is replacement of a single high power transmitter by many small power transmitters and In this case each low power transmitter covers a small area or small range called a 'cell'.



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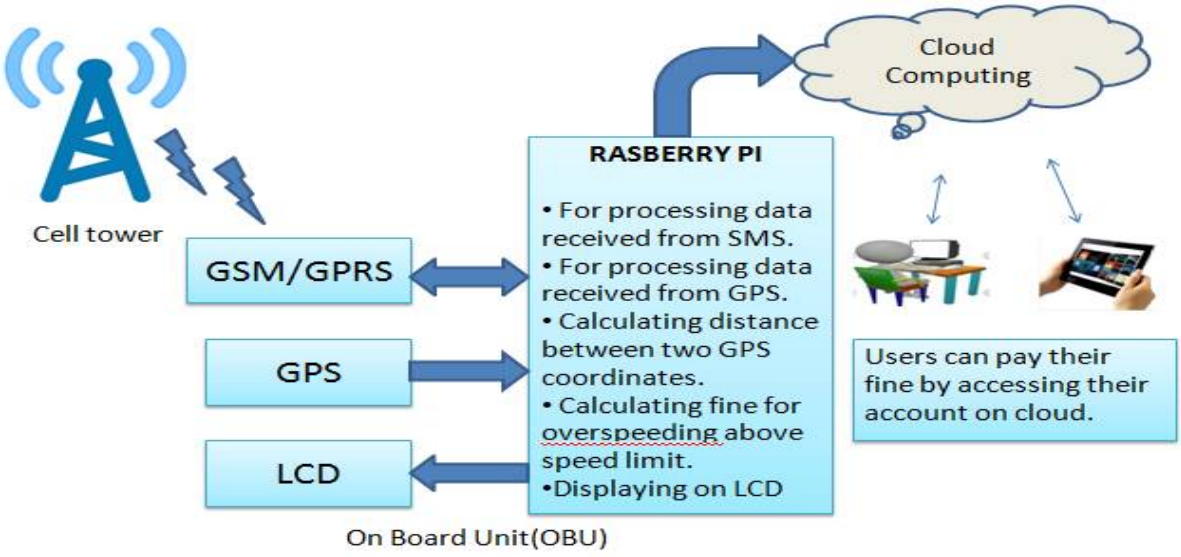
A cellular network is a radio network distributed over land areas called cells, each served by at least one fixed-location transceiver known as a cell site or base station. These cells joined together provide radio coverage over a large geographic area. This radio network enables a large number of portable transceivers (e.g., mobile phones, pagers, etc.) to communicate with each other and with fixed transceivers and telephones anywhere in the network, via base stations, even if some of the transceivers are moving through more than one cell during transmission. The cell and network coverage depend mainly on natural factors such as geographical aspect/propagation conditions, and on human factors such as the landscape (urban, suburban, rural), subscriber behavior etc.

Cell Broadcast (CB) is a mobile technology that allows messages to be broadcast to all mobile handsets within a designated area. CB messaging can be supported by most mobile network operators as it is defined by the ETSI's GSM committee and is part of the GSM standard. CB is designed for simultaneous delivery of messages to multiple users in a specified area. Whereas the Short Message Service - Point to Point (SMS-PP) is a one-to-one and one-to-a-few service, Cell Broadcast is a one-to-many geographically focused messaging service.

Characteristics	Short Message Service(SMS)	Cell Broadcast Service(CBS)
Transmission type	Message sent point to point	Message sent point to area
Message dependency on mobile no.	Yes	No
Message dependency on location	No	Yes
Two way communication	Yes	No direct response
Repetition	No Repetition	Messages can be repetadely broadcast between 2s to 32min
Message size	140 160 characters	93 characters
Message type	Static messages sent to register no.	Custom messages sent to areas

V. CONCEPTUAL BLOCK DIAGRAM



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For using cell broadcast sections of the road is divided according to coverage area of cell. OBU in vehicle on entering a cell gets a new SMS-CB(cell broadcast). SMS contains information regarding "speed" in that cell where speed limit is mandatory. Driver should maintain the speed limit till next speed limit information from a different cell is broadcasted. Upon over speeding beyond the specified speed limit the system will warn user two times and for over speeding third time the system will generate fine along with the GPS coordinates of the vehicle and will update the information of over speeding to the user's profile on cloud web server using GPRS. A webpage has been developed which the user can access to pay its fine and can also view location of over speeding.

VI.CONCLUSION

The development of speed limit violation detection system's hardware prototype is presented in this paper. Efficient use of cell broadcast technology can be used to develop safety alert and advisory information system. The developed system demonstrates the feasibility of real time speed limit violation detection which can also be used for many applications including vehicle tracking and its security.

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