A Device for High Priority Inter Vehicular Communication with Travel & Traffic Information

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Abstract

There are many problems that could go wrong on roads, due to weather, due to carelessness of the driver, mechanical issues etc. Managing all these issues at a controllable level is sometimes difficult. Better-informed road traffic can cut down these problems at a significant level. Developing a reliable system for gathering travel and traffic information is the solution for many of these problems. Through this publication we would like to put forward an idea of a vehicular device that can act as a part of a bigger system to synchronize and solve the problems faced up to a certain extent.

Keywords: Intelligent Transportation System(ITS), On-Board Unit(OBU), Road Side Unit(RSU), Inter-Vehicular Communication (IVC), VANET, Raspberry-pi, Wi-Fi

I. INTRODUCTION

Today traffic management, safety and security initiatives are an increasing priority. Current road facility is suffering with many issues like lack of:

- Live Traffic Updates
- Vehicle to vehicle communication
- Environment alert
- Traffic rule violation control
- Fake vehicle identification
- A predictive traffic signal automation

Traffic management in cities requires proper plans. The roads are lesser and vehicles are more. The high volume of vehicles, the inadequate infrastructure and irrational distribution of development are main reasons. The stream of traffic is to be maintained because it directly affects the country personals. Traffic congestion reduces travel speeds, creates uncertainty and requires more driver effort. It is a major source of frustration for busy and productive people.

Conventionally, road traffic related technologies are listed under Intelligent Transportation System (ITS). ITS aims to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks.

Various forms of wireless communications technologies have been proposed for ITS.

Short-range communications of 350 m can be accomplished using IEEE 802.11 protocols, specifically WAVE or the Dedicated Short Range Communications standard being promoted by the Intelligent Transportation Society of America and the United States Department of Transportation.

Longer range communications have been proposed using infrastructure networks such as WiMAX (IEEE 802.16), Global System for Mobile Communications (GSM), or 3G.

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Most vehicles have an On-Board Unit (OBU) which controls and monitor various systems inside the vehicle itself. By integrating this OBU as a source of vehicle information for the ITS infrastructure can yield a better system for traffic monitoring and management.

II. BACKGROUND

Many American and European organizations have proposed various systems for traffic control, mostly traffic signal management, but their functions were limited and lack of a system for Inter-vehicular communication prompted many drawbacks.After the inception of ITS and standardization of IVC, many researches have been carried out in this field. Most prominent among them was California Partners for Advanced Transportation Technology (PATH), a research and development program of the University of California, Berkeley, in Intelligent Transportation Systems founded in 1986 is pursuing research and development of vehicular ad hoc networks and Chauffeur of EU [1].

A. Vehicular communication-based on IEEE 802.11:

The wireless LAN technology 802.11 offers high data rate wireless access for local area environments. WLANs provide much higher data rates than the mobile WiMAX and 3G networks and are relatively cheap and easy to install and maintain, where the fast advancements and sophistication of chipset and semiconductor industry, IEEE 802.11 devices price curve continues to drop-down. The Federal Communications Commission (FCC) has allocated 75 MHz of spectrum at 5.9 GHz that will used by IEEE 802.11p wireless access in vehicular environments (WAVE) and dedicated short-range communications (DSRC) chipsets[2].

B. Inter Vehicular Communication:

Inter-vehicle communication (IVC), on one hand, is an important component of the intelligent transportation system (ITS) architecture. Vehicular Ad-hoc Networks (VANETs) are emerging as the preferred network design for ITS/IVC providing communications among nearby vehicles in the support of internet access, as well as a variety of safety applications. Due to the main limitations of V2V and V2I, seamless vehicular connectivity management represents a new challenge for VANETs. To achieve the advantages of both two protocols, novel hybrid vehicular communication paradigm, named Vehicle-to-X (V2X) is followed which uses V2V-V2I protocol switching.

III. PROPOSED SYSTEM ARCHITECTURE

The ITS prototype works in the following ways: Each vehicle can communicate with nearby by Wi-Fi access-points as well as nearby vehicles. Thus the real time traffic density of a particular area can be calculated using number of vehicles paired to local networks. These local networks are part of bigger infrastructure network on which a central server works. The information from local networks are updated in a central server, later it can be send to each vehicle to have a proper update about current traffic.

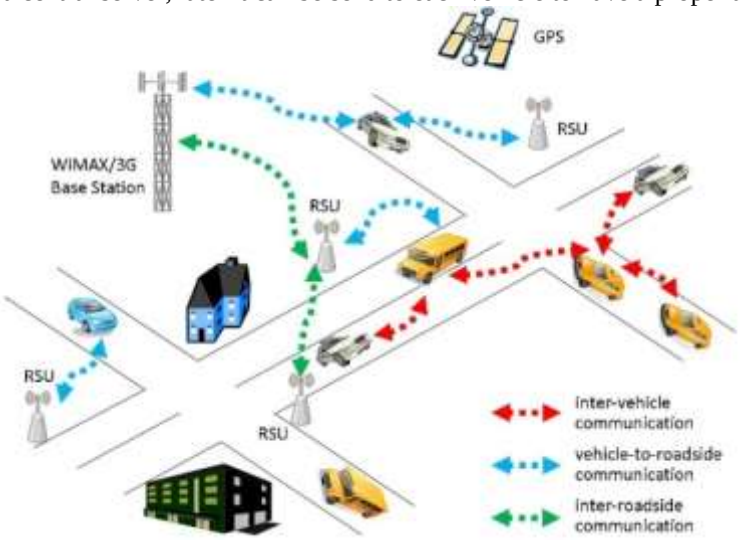

Fig. 2: ITS Network Model

The centralized control and monitoring system design based on ITS model is composed of four major parts: The network server, database server, Road-Side Unit (RSU) network, On Board Unit (OBU) or vehicular unit. The network server is working on the traffic data acquired from the system so as to show in a website form. [5] Various web applications based on this system are setup over this network. For example, the applications like vehicle tracking, traffic analysis are done on this network. The

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database network is used for classifying and saving the different information in the database. The database network can build a firm and safe bridge between server and vehicular unit.

The RSU network acts as a bridge between the database server and the vehicular unit. It help the vehicular units to upload its data to the database server and also retrieve traffic data or control signals (future prospects) from the server. The network essentially consists of large number of Wi-Fi access-points distributed along the roadside working under an infrastructure network like Wi-MAX or 3G etc. Unlike vehicles, RSUs have widely different capabilities; for instance, RSUs are not equipped with sensors, are stationary and their position is known a priori.

The network server-database server part of the prototype consists of a local server setup on WAMP(Windows Apache MySQL pHp) server 2.5. WAMP-server works on the Windows 8.1 platform and the server environment is based on Apache 2.4.9 server. [4] It has a great deal of security features which can be attributed to a fully-fledged sever environment. The database server used is MySQL 5.6.17. It works client-server architecture based on queries and views. The core part of MySQL server is relational databases. Various related tables storing information about the vehicle and traffic data are created and available for value updation from the systems' information source in a secure fashion. PHP (v 5.5.12) codes for different processes like listening to client (OBU) for information, processing information to generate traffic data like traffic density are running at the central server. Various webpages running on PHP and Jscript for real-time traffic density mapping, live traffic info, vehicle tracking etc. forms the part of network server applications and in turn the ITS applications also.

The prototype RSU network is formed by LAN of TP-Link wireless Routers each interconnected by Ethernet cables. Each router is an access-point for OBUs to connect to the server and also to other OBUs. These routers work with IEEE 802.11n protocol which is not followed in VANETs although the standard protocol differ in slight ways and thus for the demonstration, the former is effective.

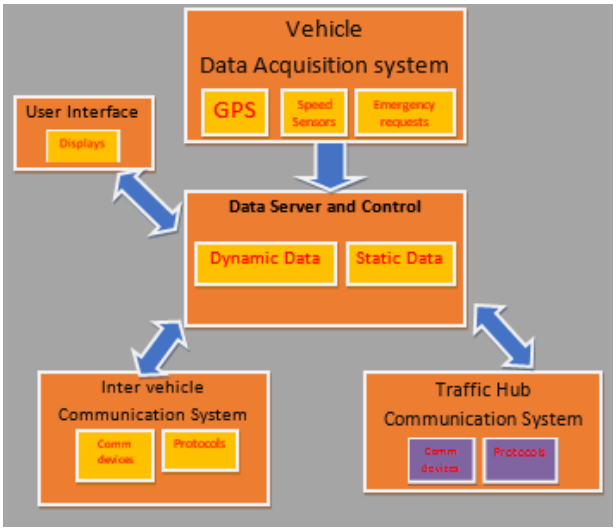

Fig. 4: OBU Block Diagram

The OBU is a computer residing in the vehicle which gathers information about vehicle such as its position, speed, vehicle registration details (stored in its special module during vehicle registration) and uploads it to the ITS database server. [3] It has a great deal of other possible functionalities such as Inter-vehicular communication in decentralized mode (without aid of RSU) and better monitoring of vehicle parts and its control.

The OBUs are installed in vehicle dashboard. It consists of a Raspberry pi and TP-Link Wireless nano Wi-Fi adapter. Various sensor systems like GPS Speed/Odometers (Hall Effect sensors) and vehicle modules are connected to the Raspberry pi's GPIO pins.

The Raspberry pi is programmed to connect to networks provided by RSU. Thus it periodically checks for any reliable connections for a valid connectivity towards a server serving requests of multiple vehicles' on board units. It will capture real time dynamic data and send it over the network based on the application. The static data is mainly used to validate the connection and distinguish each vehicle. After successful establishment connection with server, OBU will inform the server about current location of vehicle along with its speed and other necessary information's. OBU will now collect traffic related information's from the server through the same RSU.OBU also allow connection requests from near-by vehicles to form a local VANET to enable the possibility of Inter Vehicle Communication scheme[9]. It will also broadcast messages to near-by vehicles upon request from user. Thus the vehicle that needs to communicate will act as the access point (AP) to form the local VANET.

To make the system more interactive and effective a touch sensitive display unit is to be attached. This will hold various options for the user, like overtake requests, accidental alerts and a real time interactive map over which densities of all RSU's are plotted based on the information collected from server.

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IV. CONCLUSION

The project may be very well used in where the traffic signals is kept and in many other places where we need to full fill the need of the automation. In the future we implement the project's idea in the industries. This proposed idea is also a remedy for avoiding the increasing number of accidents; reduce the rate of traffic density.

This publication will be highly useful if the system described is implemented in large scale for the betterment of the public transport. So from the above description of the problems faced and also a real time solution to it, we hope to bring all such problems to an end and under control with proper management and control system and for the betterment of public.

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