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GSM/GPRS Based Vehicle Tracking System and Speed Detection with Toll Collection

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Abstract — Now a day in 21st century traffic on the highways (roads) is so high that's why traffic police fails to trap the driver of the vehicle who violates the speed limitations. Tracking of such vehicles is not possible instantly for traffic officer. So this gives more problems in traffic management system. There is another issue of traffic at toll collection. In recent decade more toll collection are build in India most are on Express way or national high way. They all are work on human interface so that each vehicle has to stop at toll plaza and collect an amount of money at toll plaza this gives a high traffic at toll plaza. Our system having capacity to reduce traffic at toll collection and increase efficiency of police to capture the any driver that increases is speed of vehicle comparing with the restricted speed. This system uses the Atmega 16 microcontroller in combination with Global System for Mobile (GSM) technology.

Keywords- Atmega 16 microcontroller; GSM Module; vehicle;

I. INTRODUCTION

Tremendous growth in intelligent transportation system gives new opportunity in that area which gives use of all technology to beneficial human society. So that using new technology in vehicle to enhance security of driver as well as communication between vehicle and security agency gives such high mechanism to avoid the security violation such as speed violation. Tracking of that vehicle GPS, which stands for Global Positioning System, is a satellite navigation system that can ascertain the latitude and longitude of a GPS receiver device on the vehicle. The GPS consists of more than two dozen global positioning satellites orbiting the earth. Each satellite transmits radio signals, which can help to determine the location, speed and direction of travel of users equipped with GPS receivers. To ensure that the whole world is covered by the constellation of the GPS satellites, they are so arranged that four satellites are positioned in each of six orbital planes. The inbuilt GSM/GPRS Module transfers the data received from satellite to web server and through the unique software application user can track the live or historical data or vehicle. In this technique GPS is required to collect the position of vehicle which having some shortcomings.

a. Sometimes the GPS signals are not accurate due to some obstacles to the signals such as buildings, trees and sometimes by extreme atmospheric conditions such as geomagnetic storms.
b. In-vehicle GPS capable devices generally do not share their location data with other devices and externally
c. Purchasing a GPS based on price can be a major disadvantage

Alternative for this GPS technology is Cell-phones and other mobile devices (e.g. tablets, laptops) can be found in almost all road vehicles. Mobile communication systems (e.g. GSM) inherently require knowledge of cell-phones position in the network. Of course, the positioning accuracy can be considered as moderate, compared to that provided by GPS

A microcontroller often serves as the "brain" of a mechatronic system. So it is use for processing purpose in our system. Like a mini, self-contained computer, it can be programmed to interact with both the hardware of the system and the user. Even the most basic microcontroller can perform simple math operations, control digital outputs, and monitor digital inputs. Newer microcontrollers are much faster, have more memory, and have a host of input and output features that dwarf the ability of earlier models. Most modern controllers have analog-to-digital converters, high-speed timers and counters; interrupt capabilities, outputs that can be pulse-width modulated, serial communication ports, etc. The microcontroller forms the heart of an embedded system. The ATMEGA16 is the microcontroller used here which is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel ATMEGA16 is a powerful microcontroller which provides a highly flexible [5].

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile

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phone. A GSM modem exposes an interface that allows applications such as SMS to send and receive messages over the modem interface. The mobile operator charges for this message sending and receiving as if it was performed directly on a mobile phone. To perform these tasks, a GSM modem must support an "extended AT command set" for sending/receiving SMS messages, as defined in the ETSI GSM 07.05 and 3GPP TS 27.005 specifications. Due to some compatibility issues that can exist with mobile phones, using a dedicated GSM modem is usually preferable to a GSM mobile phone. It should also be noted that not all phones support the modem interface for sending and receiving SMS messages. In particular, most smart phones, including Blackberries, iPhone, and Windows Mobile devices, do not support this GSM modem interface for sending and receiving SMS messages at all. Additionally, Nokia phones that use the S60 (Series 60) interface, which is Symbian based, only support sending SMS messages via the modem interface, and do not support receiving SMS via the modem interface.

Vehicle tracking system using various technologies has required a vast amount of Research and development. Vehicle tracking system using Global System for Mobile Communication (GSM) and Digital mapping, i.e., the General Packet Radio Service (GPRS) and the Internet. Comparing all the technologies based on operational methodology and cost effectiveness we have selected this technology to use in the system where in the system is designed to manage and track a large fleet of vehicles. The key features of the system are an open-source GIS platform, real-time location information update, and a web-based user interface. The system consists of GSM-based vehicle tracking devices, a communications server, a web server, a database server, and a map server. The tracking devices mounted in the vehicles collect location information in real-time via the GSM and transfer's it continuously through GPRS or SMS (Short Message Service) to a central database. The users are able to view the current location of the vehicles on a digital map.

II.RELATED WORK

In this area of vehicle speed detection lots of work has been done before but that required camera base image processing techniques to detect speed of vehicle. Mobile cameras can be used anywhere and can potentially record your speed at 1000 meters or more. Warning of a single location within a mobile camera enforcement area is not necessarily sufficient. If the camera moves within the area then the original warning will be ineffective. RADAR and GPS also use to detect the speed of vehicle. The need to use radar systems is growing in importance. This is not only for military applications but also for civilian applications. The latter includes (but not limited to) monitoring speeds of vehicles on high ways, sport competitions, aero planes, etc. The spread of use of radar systems is affected negatively with the high cost of radar systems and also with the increasing requirements on the accuracy of the outputs. This motivated the research on alternative technologies that offer both higher accuracy and be more cost effective.

Various technology (RFID, WI-FI and so on) can be use to develop such system we are using most advance technology such as GSM/GPRS. There are various methods available for speed measurement of vehicles. But these methods only displays the speed only for the driver of the vehicle either in analog or digital form out of which digital form is advanced one which gives correct value of speed

III. ANALYSIS OF PROBLEM

Tolling as a method of financing the transportation system is becoming more common in the India. Neither the traveling public nor State Departments of Transportation want vehicles to stop or slow down to pay to use a toll facility. To this end, several technologies, collectively called Electronic Toll Collection (ETC), have been developed in the last 15 years, allowing drivers to move in and out of toll systems without delay. Open Road Tolling (ORT), with all-electronic toll collection, is now the preferred practice, being more efficient, environmentally friendly, and safer than manual toll collection.

In this system, tolling technologies and practices are discussed. Likely developments and enhancements are reviewed. Ultimately, this research system will develop recommendations for vehicle identification/registration systems with the potential to go beyond the tolling function to include other desirable transportation system management functions [6].

There are various methods for detecting the speed of moving vehicle one is video image sequences. In this study, the captured traffic movies are collected with a stationary camera which is mounted on a freeway. The camera was calibrated based on geometrical equations that were supported directly by using references. Camera calibration for exact measurements may be possible while accurate speed estimation can still be quite difficult to achieve. The implemented system will overcome this problem.

IV. AVI TECHNOLOGY

Automatic vehicle identification technology is use to identify the vehicle. It collects the data of vehicle by using various sensor for identify the vehicle. That data contain id of vehicle and information about

A. RF Smart Tags:

An RF smart tag is an RF device, located in the vehicle that is used in conjunction with an in-lane RF an RF smart tag is an RF device, located in the vehicle that is used in conjunction with an in-lane RF antenna/reader to communicate identifying information about the vehicle, customer, and account balance information to the toll system. Some portions of the tag information are fixed (such as vehicle and customer data) while others are updateable (such as balance information). The smart tag contains a microprocessor, which maintains account balance information updated each time the smart tag is used. RF smart tags have not been used extensively either in the United States or around the world.

RF smart tags operate in full duplex mode, meaning that they are able to send and receive data at the same time. They actively generate the signal used to communicate with the antenna/reader via a transmitter. Three frequency ranges are used by RF smart tags:

a. 900 to 928 MHz
b. 2.45 GHz
c. 5.8 GHz

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Only the 900 to 928-MHz frequency range is used in the United States with the other frequencies in use in other parts of the world. The maximum read/write range of RF smart tags is greater than that of RF tags (owing to their use of active transmission); however, in actual use they are usually within 20 or 30 feet of the antenna during communications.

V. POSITIONING TECHNIQUES FOR TRACKING

A. Position System Classification:

To classify the positioning system, we need to consider where the position measurements are made and the position information is used. Three broad classifications are made: self positioning and remote positioning, indirect positioning.

a. Self-Positioning:

In a self-positioning system the positioning receiver should make the suitable signal measurements from geographically distributed transmitters and then it should use these data to determine its position. The most known self-positioning system is GPS. A self-positioning receiver, thus knows where it is, and applications collocated with it can use this information to make position-based decisions required for navigation.

b. Remote Positioning:

In a remote positioning system, the receivers should measure a signal originating from, or reflected off, the object to be positioned. Then to be able to estimate the location of the object, the collected data are sent to a central site where they will be analyzed. This position information can then be used at the central site or be sent to another system running an application such as a computer-aided dispatch (CAD) system. A good example of remote-positioning systems is remote sensing radars.

c. Indirect Positioning:

Using a data link, it is possible to send position measurements from the self-positioning receiver to a remote Site or ice-versa. A self-positioning system that sends position data to a remote location is referred to as indirect remote positioning, and a remote positioning system transmitting an object's position to the object is referred to as indirect self positioning.

VI. SIMULATION ENVIRONMENT FOR TRACKING GSM

We introduce the proposed system model. We assume the system model as following:

a. the number of BS is N,
b. signals from BSs are measured at MS,
c. received signal strength from each BS is independent to each other, hexagonal base stations configuration (Figure VI),
d. All cells in the system are deployed with omni directional antennas.

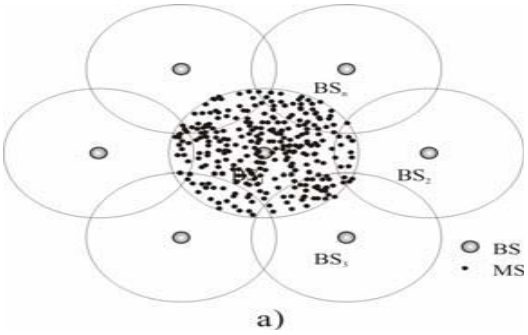

Figure VI: Network model in hexagonal fashion with more than one MS

The MS locations are model in two cases. In the first case we assume that the MS moves randomly in area of centre cell (Figure VI a). In the second case the MS lies in unique point (See Figure VI b).

Note that the accuracy of the method depends on:

a. the MS and base stations' geometry,
b. the channel parameters i.e. statistical characteristic of received signal amplitude changes,
c. Cell radius.

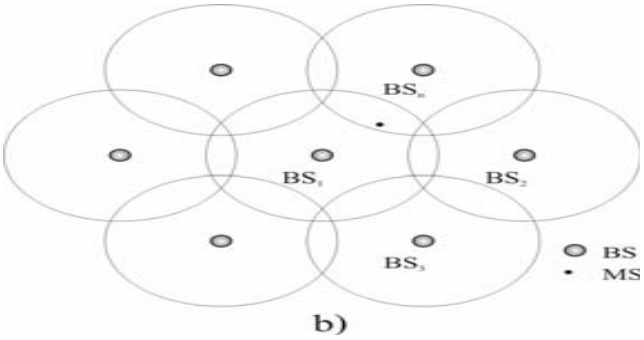

Figure VI: Network model in hexagonal fashion with only one MS

VII. IMPLEMENTED WORK

Our system consists of only one equipment board that contains more than nine major components. These are ATMEGA16 microcontroller, Stepper motor, LCD Display, IR Receiver, IR Transmitter, Power Supply, Max 232, GSM/GPRS Modem and ULN 2003.

This system will collect the speed and transmit to base station through GSM/GPRS modem. Initially the SMS will be sending from the GSM modem (SIM300 MODEM) to the base station & is transferred to the server. As per the commands given by the modem to the server, the control signal from the SMS is extracted and is used as information about vehicle and if speed is greater than limited speed which is set by each government agency then all fines reduce from his account and SMS is send to driver that such amount is reduce form you are account. If these types of vehicle are not responding to warning then we have to use GSM base tracking system to track that vehicle and arrest them to tack appropriate action on him. Our system will help make our roads safer. It will provide a tool for law enforcement to monitor speeding vehicle activity and assist in tracking down violators.

There is also issue of toll collection plaza to solve this issue we are using an IR transmitter and IR receiver. Here IR transmitter is use to transmit signal from toll plaza to that of on board equipment and IR receiver is use to receive that signal. The main concept behind receiving that signal is on board equipment can understand that toll plaza is nearer to

that vehicle. So that there is no need to stop the vehicle because of this no traffic jam is occurred during toll collection and no human interface is required during toll collection.

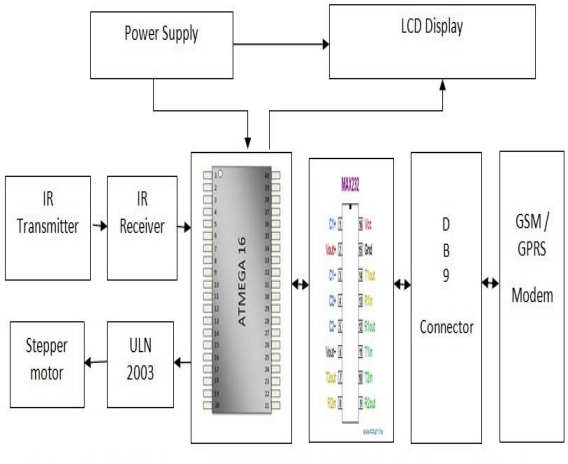

Figure VII: Block diagram of GSM/GPRS based Speed Detection with Toll Collection

VIII. SPEED DETERMINATION

To calculate the speed of vehicle we need to deploy RF transmitter at school area, hospital area and restricted area. There are two RF transmitter first one is situated at starting of restricted area and second one is situated ending of restricted area then if vehicle pass from first point of vehicle which is shown in figure 5 then RF transmitter transmit the signal that received by RF receiver which is present in monitoring & control center or BS. Those signals contain ID of vehicle so that base station can recognize vehicle. After that if vehicle comes in front of second receiver then again that process repeatedly happen.

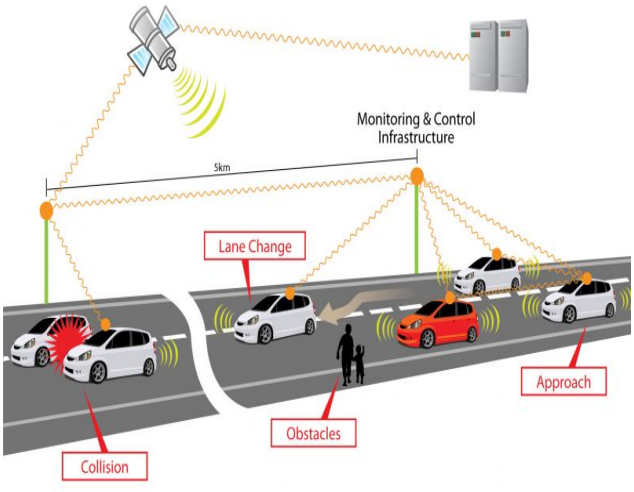

Figure VIII.A: Vehicle Speed Detection

Now consider that distance between two BS is fix that is restricted area. Time difference between two signals is use time for calculation of the speed. All value such as time and distance is use to calculate the speed of vehicle. Now if speed is high than restricted speed then money should be reduce from his account and message is send to driver as well as shown in his LCD display(See Figure VIII.B)

Figure VIII.B: Over speed message display on LCD

IX. CONCLUSION & FUTURE WORK

In this research project we utilize modern technology for development of project. So that it is beneficial human society. A detailed study is required for formulation of implementation methodologies and standards of ITS technologies particularly for developing countries. Currently, we are expanding the system in different directions including combining the two techniques of speed estimation for better accuracy and applying other techniques to enhance the quality of the data, and evaluating the system

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