Hotspot Detection by Using GPS & GPRS System

K.Ranganath, M.Rajeshwar, Naveen Kumar Laskari, T.Venkat Narayana Rao
Computer Science and Engineering, Hyderabad Institute of Technology and Management,Hyderabad, A P, India

Abstract— This paper is written using an intelligent vehicle movement monitoring system which is based on GPS and GPRS. In this system GPS information is transmitted by means of GPRS wireless network to the monitoring centre. The Monitoring Centre displays the above information on Google Map by means of Internet and sends commands to all the subsystems. This Paper would primarily concentrate on the design and development of specific class of wearable computing systems that could prevent loss of human lives due to common road-accidents and devising a mechanism for avoidance of accidents by providing an efficient recovery-support system. This application can be reused in various other monitoring situations. The real time availability of all exact locations and speeds of the vehicles enables the system to encompass very clear traffic information. This paper introduces GPRS module that receives data sent by GPS module and the software part includes the flow chart of station reporting and network access. It also introduces the software design of the Monitoring Centre for Driver Safety Rating. This system has features such as high speed data transfer, high precision in real time and reliability.

Keywords— GPS, GPRS, Database, Monitoring Centre.

I. INTRODUCTION

This paper primarily concentrates on design and development of specific class of wearable computing systems that could prevent the loss of human lives due to frequent road-accidents and calamities[1][2]. The focus of the application is to devise a mechanism for avoidance of accidents with a foresight of the probable threats during traffic regulations.

As a major component of this ongoing initiative, this proposed work shall focus on evolving an innovative architecture for smart clothing comprising of a wearable computer. This wearable computer will act as a personal safety device while a person is driving a vehicle. The basic idea here is that the wearable must have the capability to alert the wearer. This programmed wearable computer shall have wireless communication capability and would have a unique IPv6 address associated with it. It will also have the capability to continually monitor the critical relevant data (obtained through a variety of input mechanisms including sensors) and depending upon the anticipatory program based threshold levels, would alert the driver in time so as to enable him / her to take up the necessary action, whenever appropriate.

The system may additionally be helpful to the recovery agencies by providing a variety of data like the contact details about wearer's spouse/friend / next of kin / physician etc. such that in the unlikely event of an mishap it could be informed to them. The overall system may also have black box like capability that may help post accident investigations.

A. GPRS and GPS Technology

The GPRS(General Packet Radio Service) is an enhancement over the GSM and adds some nodes in the network to provide the packet switched services. GPRS operates on the existing GSM network infrastructure that it utilizes available time slots during each frame transmission. Thus, it does not overload the existing GSM network traffic and can efficiently provide data services. The GPRS can transfer data at the maximum rate of 115.2 kbps (with the eight available slots of each frame). Due to a very large coverage area of GSM networks around the world, GPRS becomes the largest data service network available and always on thus, it is most suitable for a real-time tracking management system . It does not overload the existing GSM network traffic and can efficiently provide data services[4]. The GPRS is an enhancement over the GSM and adds some nodes in the network to provide the packet switched services.

These network nodes are called GSNs (GPRS Support Nodes) and are responsible for the routing and delivery of the data packets to and from the MS(mobile station) and external packet data networks (PDN). This system provides email and web browser in addition to existing GSM data services such as Short Message Service (SMS) and Circuit Switched Data (CSD) for fax transmission for the information dispersion. The Figure 1 shows the architecture of the GPRS system.

The most important network nodes added to the existing GSM networks are: SGSN (Serving GPRS Support Node) and GGSN (Gateway GPRS Support Node).

The serving GPRS support node (SGSN) is responsible for routing the packet switched data to and from the mobile stations (MS) within its area of responsibility. The major functions of SGSN are packet routing and transfer, mobile attach and detach procedure (Mobility Management (MM)), location management, assigning channels and time slots (Logical Link Management (LLM)), authentication and charging for calls. It stores the location information of the user i.e. like the current location, current VLR and user profile (like IMSI addresses used in packet data networks) of registered users in its location register.

The gateway GPRS support node (GGSN) acts as interface between the GPRS backbone and the external packet data

network (PDN). It converts the GPRS packet coming from the SGSN into proper packet data protocol (PDP) format (i.e. X.25 or IP) before sending to the outside data network. Similarly, it converts the external PDP addresses to the **GSM** address of the destination user. It sends these packets to proper SGSN. For this purpose the GGSN stores the current SGSN address of the user and his profile in its location register. The GGSN also performs the authentication and charging functions. In general, there may be a many to many relationship between the SGSN and GGSN. However a service provider may have only one GGSN and few SGSNs due to cost constraints. A GGSN provide the interface to several SGSNs to the external PDN[3].

Global Positioning System (GPS) is a system composed of a network of 24 satellites of the United States, which are originally used in military services, and later allowed for commercial use[10]. The satellites periodically emit radio signal of short pulses to GPS receivers. A GPS receiver receives the signal from at least three satellites to calculate distance and uses a triangulation technique to compute its two-dimension (latitude and longitude) position or at least four satellites to compute its three-dimension (latitude, longitude, and altitude) position. Once a location is computed, it can calculate an average speed and direction of travelling. Therefore, GPS is a key technology for giving device its position.

B. Google Earth & Google Map

Google Earth is very popular free software that provides maps by satellite images around the world. Google Map is a version of Google Earth that shows the maps on-line using with a web server and a web browser. The program provides plug-ins for community to show objects in the program. Such objects are, for example, 3D objects of skyscrapers using Sketch Up software, pin objects to indicate a point of interest (POI), and line objects to show a track. To show such objects, Google Earth exploits its own programming language called KML (Keyhole Markup Language) which is an extensible mark up language (XML) that is written to describe how the objects turn into. The KML-based objects can also be used with Google Map to show line and pin objects. In our proposed system, we employ Google Earth software and Google Map as our choices of track displays to show locations of vehicles.

II. SYSTEM OVERVIEW

A. System Structure

The whole system consists of two parts, front-end and back-end. The front-end system is portable equipment, and the back-end system consists of database server and Monitoring centre. The functions of each part in the system are as follow.

The front-end equipped in the vehicle is used to receive satellite positioning data and generate help information. Data and information will be transmitted to the database server of the back-end by GPRS module and internet. Simultaneously, the front–end can receive and process the warning information from the database server. The database server is used to receive the positioning and help information from the front-end, and then save the position data to the server. At the same time, it can generate the warning information and transmit it to the front-end if the vehicle is exceeding the speed limit at hotspots[11]. The database server is used to save the GPS data of vehicle position. The data display monitor is used to display the movement of the vehicle on the Google map. The topography of the system is shown in Figure 1 and 1A.

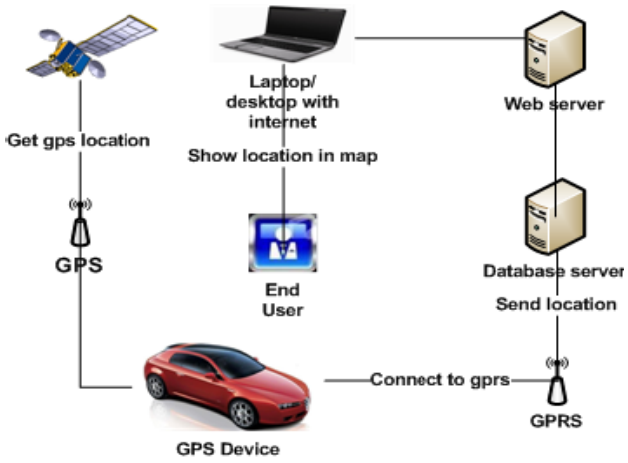

Figure 1. System Architecture

B. System Function

The GPS and GPRS module is cabin mounted equipment, meant for Bus, Car or Goods Fleet operators to ensure safe journey to their destination each and every time for a vehicle under consideration[5][8]. The equipment identifies accident prone areas along a predetermined route and prompts the driver safe speeds limits to be maintained at those spots.

It also sends the actual speed of vehicle's and scenes at these hot spots and it also identifies city/town/village limits, corners, bends, speed breakers, school/hospital areas, etc., and prompts safe speed at that locations and sends to Monitoring Centre. In case a Driver identifies the temporary hot spots like road repairs, accident area, route deviation, etc., he/she can send a message to the Monitoring centre by pressing a key in the GPS & GPRS module[6][2]. The equipment is interfaced with GPS & GPRS module units for dynamic updates of hot spots and the position of the vehicle can be seen in the Google Maps through Internet and this thing are monitored and controlled by the Monitoring Centre. The data is stored in the Database Server and the Monitor Centre and subsequently is used for the rating of Drivers on the road.

III.THE WORKING PRINCIPLE AND ARCHITECTURE

Angel box is cabin mounted equipment meant for Bus, Car, Goods Fleets to ensure safe journey to their destination in each vehicle.

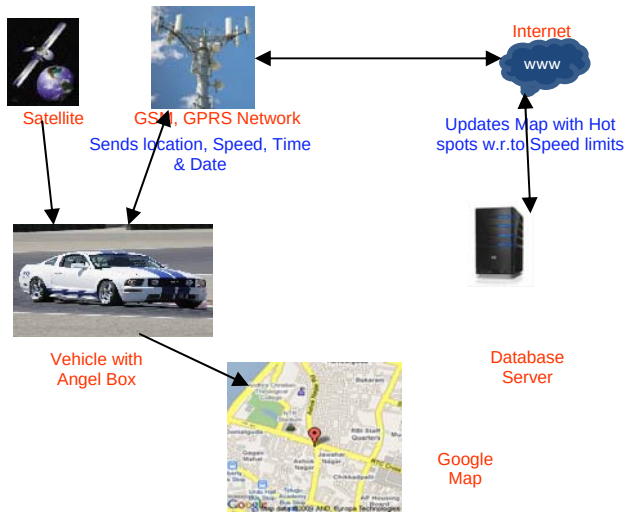

Figure 1A. System Architecture

This paper considers the following three operations:

Pre-Drive Operation: In Pre-drive operation the driver has to sign in, and then stock administrator verifies the driver details whether he authorized or not. If driver is authorized then stock administrator gives the Angle box with source and destination.

On-Drive Operation: In On-Drive Operation the driver first connect the Angle box and he follows the route which is display on Angle box screen. While driving, driver identifies any hotspots like School zones, Hospital zones, road digging, junctions and U-turns etc. he inform to central database by pressing key in the Angle box. While driving we can observe how the driver drives at hotspots.

Post-Drive Operation: After completion of driving the driver has to submit the Angle box to safety administrator. Then safety administrators or Monitoring Center will generate the safety rating of the driver based upon the driving the safety rating code will generate the driver safety rating.

IV. DESIGN & IMPLEMENTATION OF SYSTEM

The front-end portable equipment consists of satellite signal receiver GPS module, main control module and GPRS module. The flowchart is shown in figure 3 to explain the flow of events during implementation. The Beagle board with two serial ports is adopted in the microcontroller of the main control module to complete the communication between GPS module and GPRS module, and G20 is adopted in GPRS module, mainly because it has complete function of TCP/IP protocol. The function block diagram of the system is shown as below in Figure 2.

GPRMC data format in NMEA-0183 is adopted in the GPS output data in this design. The GPRS module used in the front-end can communicate with the database server by using internet.

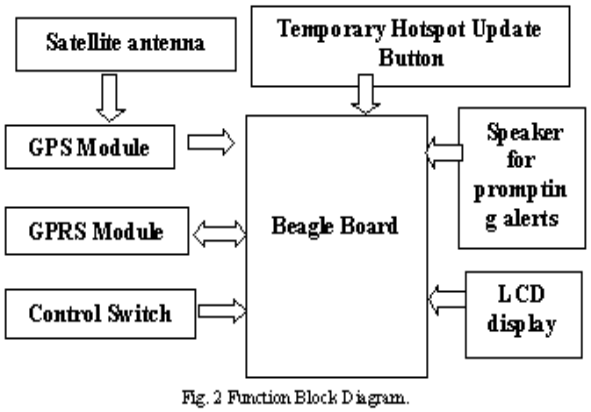

Fig. 2 Function Block Diagram.

In order to receive and transmit the information, the database server must have a static IP address of the internet; it can generate the warning information and transmit it to the frontend portable equipment. MYSQL is used in the database server of the back-end monitoring centre and the GPS data is stored in MYSQL database. The obtained data is implemented in the Google Map's API[7][9]. By using the programming, the GPS data is the plain code format of Google Map to MYSQL, and the GPS data will be stored and managed by using MYSQL. The Google Map display for Vehicle Positioning is developed by using PHP, Java Script, and MYSQL. Where in the GPS data is also used for the Driver Safety Rating on the road by using the programs. The flow chart of the main program is shown below which contributes entire system application.

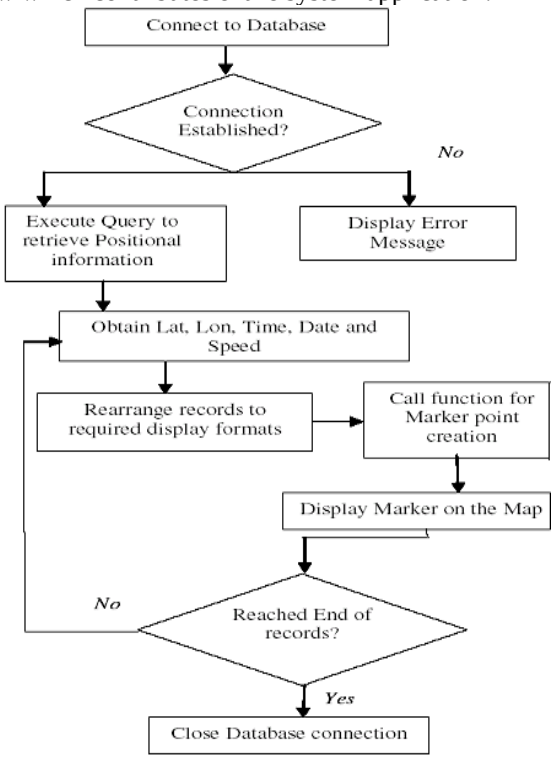

Fig. 3 Flow chart displaying retrieval of GPS data stored in the Database server.

A. Pseudo code for connecting database

```
<?php
$database="yourdbname";
mysql_connect ("localhost", "yourusername", "yourpasswd
");
mysql_select_db($dbase) or die( "Unable to select dbase");
 $result = mysql_query ( "SELECT * FROM yourtable" )
 or die("SELECT Error: ".mysql_error());
?>
```

B. Pseudo code for Permanent hotspots on Google map

```
var iconBlue = new GIcon();
iconBlue.image='http://labs.google.com/ridefinder/images/
mm_20_blue.png';
iconBlue.shadow='http://labs.google.com/ridefinder/images
/mm_20_shadow.png';
 iconBlue.iconSize = new GSize(12, 20);
iconBlue.shadowSize = new GSize(22, 20);
iconBlue.iconAnchor = new GPoint(6, 20);
 iconBlue.infoWindowAnchor = new GPoint(5, 1);
 var iconRed = new GIcon();
iconRed.image='http://labs.google.com/ridefinder/images/m
m_20_red.png';
iconRed.shadow='http://labs.google.com/ridefinder/images/
mm_20_shadow.png';
iconRed.iconSize = new GSize(12, 20);
iconRed.shadowSize = new GSize(22, 20);
iconRed.iconAnchor = new GPoint(6, 20);
iconRed.infoWindowAnchor = new GPoint(5, 1);
```

C.Pseudo code for Permanent hotspots on Google map

```
function load() {
 if (GBrowserIsCompatible()) {
map.addControl(new GSmallMapControl());
map.addControl(new GMapTypeControl());
map.setCenter(new GLatLng(17.541559, 78.386679), 13);
 GDownloadUrl("phpsqlajax_genxml3.php", function(data)
{ var xml = GXml.parse(data);
varmarkers=xml.documentElement.getElementsByTagNam
e ("marker")
for (var i = 0; i < markers.length; i++) {
var name = markers[i].getAttribute("name");
var address = markers[i].getAttribute("address");
var type = markers[i].getAttribute("type");
var
point=newGLatLng(parseFloat(markers[i].getAttribute("lat
")),
 parseFloat(markers[i].getAttribute("lng")));
    var marker = createMarker(point, name, address, type);
} });   }   }
```

D. Pseudo code for Permanent hotspots on Google map

```
function createMarker(point, name, address, type)
var marker = new GMarker(point, customIcons[type]);
var html = "<b>" + name + "</b> <br/>" + address;
GEvent.addListener(marker, 'click', function()
    {marker.openInfoWindowHtml(html);  });
     return marker;   }
```

V. EXPERIMENTAL RESULTS

The paper is implemented and the output's were analysed against the desired output and found useful for the common use in the real time scenario. The figures 4, 5,6 depicts the screen shots results of the application implemented in this paper.

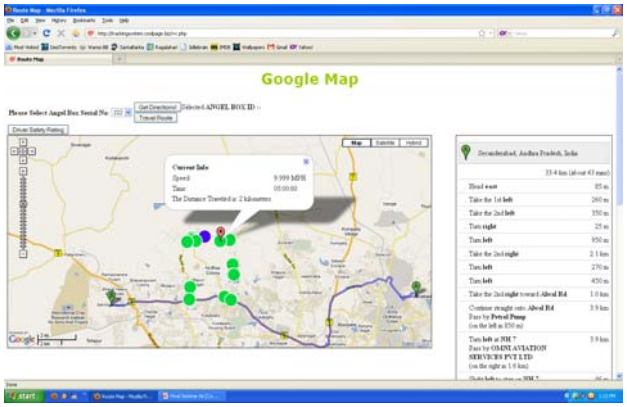

Figure 4 Route Directions with Direction Panel and Hotspots.

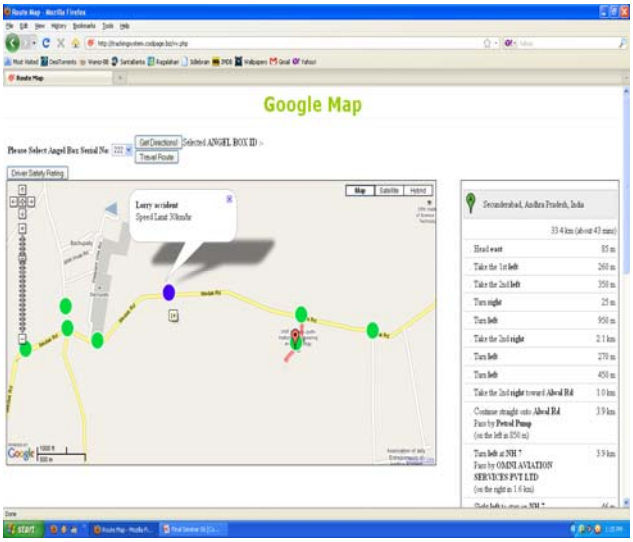

Figure 5. Temporary Hotspot with Marker ID and Description.

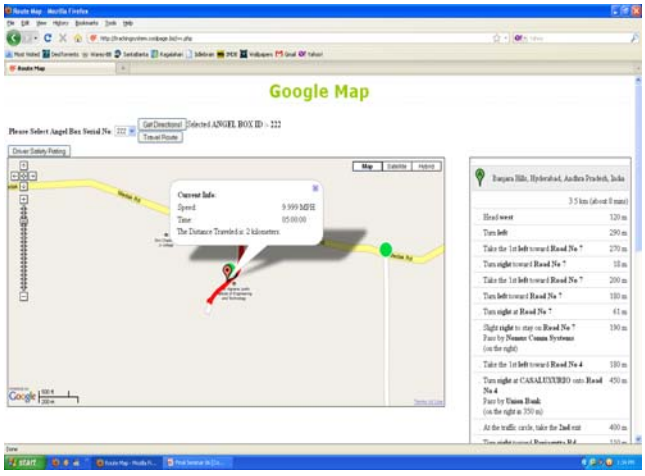

Figure 6: Travel Route of the vehicle & its Information.

VI. CONCLUSION

The paper is successfully tested and the Web Interface was implemented. The Disaster Prevention System Design Using GPS & GPRS is a feasible concept that could prevent the loss of human lives due to common road-accidents. The focus of the application will be on the prevention of loss of human lives due to vehicular accidents by means of devising a mechanism for avoidance of accidents and in the unlikely event of an accident providing an efficient recovery-support system. The developed technology can be reused in various other situations and form. The lack of integration in Indian Vehicle industry can be completely addressed by this solution. Future enhancements for the project include accelerometer based accident detector and fatigue detection of the driver.

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Authors :

Mr.K.Ranganath ,Graduated in Computer Science and Engineering. From Osmania University Hyderabad, india, in 2006 and is M.Tech in Software Engineering from Jawaharlal Nehru Technological University, Hyderabad, A.P., India in 2010. He is working presently as Assistant Professor in Department of C.S.E in Hyderabad Institute of Technology and Management (HITAM), R.R.Dist, INDIA, A.P,. He has 2 years of Experience. His research interests include Mobile Computing and Networking.

Mr. Naveen Kumar Laskari, received the Bachelor Degree and Master Degree from JNT University, Hyderabad, India. He is Assistant Professor in the Department of Computer Science And Engineering, HITAM, and Hyderabad. He has attended and participated in number of seminars and workshops across India. His Research interest includes Image Processing, Data Mining and Information Security.

Mr. Rajeshwar Moghekar graduated his B.Tech from Gulbarga University, Karnataka, India, in 1997, Masters Degree in Computer science from Jawaharlal Nehru Technological University (JNTU), Kakinada, A.P, India, in 2007.He is having 11 years of total experience. He is currently working as an Associate Professor in the department of Computer Science at Hyderabad Institute of Technology And Management, India. He has worked as Technical executive for MicroUniv a Training Division of MicroLand. His main research fields include Network security, ad-hoc networks, Digital watermarking .

Professor T.Venkat Narayana Rao, received B.E in Computer Technology and Engineering from Nagpur University, Nagpur, India, M.B.A (Systems) and M.Tech in Computer Science from Jawaharlal Nehru Technological University, Hyderabad, A.P., India and a Research Scholar in JNTU. He has 20 years of vast experience in Computer Science and Engineering areas pertaining to academics and industry related I.T issues. He is presently Professor and Head, Department of Computer Science and Engineering, Hyderabad Institute of Technology and Management (HITAM), Gowdavally, R.R.Dist., A.P, INDIA. He is nominated as an Editor and Reviewer to 15 International journals relating to Computer Science and Information Technology. He is currently working on research areas which include Digital Image Processing, Digital Watermarking, Data Mining, Network Security and other Emerging areas of Information Technology .