Study of Vehicle Tracking System's Hardware Components

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Abstract : A huge number of valuable lives are lost due to road traffic mishaps every day. The general causes are driver's fault and delayed response from emergency services. There is a requirement to have an efficient road accident detection and information communication system in place to save wounded persons. A system that sends information messages to nearby emergency services regarding the accident place for timely reply is extremely in need. Literature survey indicates that, various automatic accident detection systems are suggested, developed by researchers from worldwide. It includes accident detection using smart phones, GSM and GPS technologies, vehicular ad-hoc networks and mobile applications and many more. The working of an automatic road accident recognition system and information communication system in every means of transport is very vital. This paper presents a brief study of vehicle tracking systems which is used to save affected person's life. The tracking system mostly used with vehicles for the purpose of tracking their location as and when required, additionally the few system includes arrangements to raise alarm under certain preset critical conditions like fire or accident.

IndexTerms - *GSM, GPS, Vehicle tracking system, IR sensor, Alcohol sensors.*

I. INTRODUCTION

Road accidents are multi-causal and are the consequences of interplay of different issues which can approximately be categorized into human errors, road condition/environment and vehicular condition. From the outlook of road safety strategy, an objective way to ascertain the factors liable for a road accident would be to look into data pertaining to the situations under which it has happened. Road accidents during 2017 attributable to different kinds of traffic regulations infringements reveals that over speeding represents the main violation related with accidents (see **Table 1.1** below). Over speeding and driving on wrong side together reported for 76.7 per cent of total accidents and 73.1 per cent of total deaths. Disobedience of other rules, viz., drunken driving, red light jumping and use of mobile phones together accounted for just 6.2 per cent accidents and 6.5 deaths. Highway accidents which do not involve traffic rules breach or violation not known (such as hit-and-run cases) comprise 17.1 per cent and accounted for 20.3 per cent of the total casualty. Breach of any traffic rule constitutes human mistake or driver's error. But from the outlook of road security policy, violations such as over speeding and driving on wrong side does not constitute individual error only, but also probable mistake in road design. [1]

Traffic rules violation	Number of accidents	Persons Killed	Persons injured
Over-speeding	3,27,448 (70.4)	98,613 (66.7)	34,3083 (72.8)
Driving on wrong side	29,148 (6.3)	9,527 (6.4)	30,124 (6.4)
Drunken driving/consumption of alcohol & drug	14,071 (3.0)	4,776 (3.2)	11,776 (2.5)
Use of mobile phone	8,526 (1.8)	3,172 (2.1)	7,830 (1.7)
Jumping red light	6,324 (1.4)	1,826 (1.2)	5,977 (1.3)
No violation & not known	79,394 (17.1)	29,999 (20.3)	72,185 (15.3)
Total	**4,64,910**	**1,47,913**	**4,70,975**

Table 1.1 Road accidents by type of traffic rules violations - 2017

This statistics indicates the need of measures to be taken for designing of systems which will send alert if accident occurs so that timely help can be provided.

In this paper we have literature survey in section II, Section III explains various techniques used by researchers for the designing of vehicle tracking system, Section IV Application areas and conclusions are mentioned in section V.

II Literature Survey:

M. Al-Khedher Ramadan et al. [2]   has designed a machine in which the consumer can follow the location of aimed means of transport on Google Earth. With GPS locator, the intended current location is decided and shared, along with a range of parameters obtained by vehicle's data port, by means of Short Message Service (SMS) through GSM networks to a GSM modem that is linked to PC or laptop. The GPS coordinates are corrected with a discrete Kalman filter

A tracking system can notify the position and road travelled by vehicle, and that information can be observed from any other remote place. It also includes the web application that gives user precise location of object. These are the features of system proposed by PankajVerma et al. [3]   .

By modifying the current components, V.Ramya et al. [4]   provided vehicle cabin safety, security based on embedded system which administrates the concentration of the poisonous gases such as CO, LPG and alcohol within the vehicle and provides vigilant information as alarm during the dangerous situations. The SMS sends to the authorized person through the GSM. In this method, the IR Sensor utilized to notice the static barrier in front of the vehicle and the vehicle stopped if any barrier identified.

Zhang Wen et al. [5]   , investigates location key, map corresponding and squeezed data associated with the positioning, forecasts the movement of the vehicle location.

Chen et al. [6]   explained that, the network were built up by hardware and software of the GPS- GSM [7, 8]   . The proposed GPS/GSM based System has the two components, primary is a mobile unit and one more is controlling station. The system processes, interfaces, connections, data communication and reception of data linking the mobile unit and control stations are functioning successfully. They observed that the results are compatible with GPS technologies. For user, it is a box that holds a GPS chaser and a GSM modem. When consumer ask for location from the web or application subsequent to registration and logging into the web server an SMS request will be sent to the GSM modem in consumer device. It necessitates internet connectivity on both sides of client and server which is not convenient for some cases where there is no internet connectivity at any of the server or client sides. Additionally, the connection between the server and client should be managed by both server and client. Sonia C.V et al. [9]   designed an android application to track mobile phones. It has SMS based location tracking system using GPS data. It did not include online tracking method with which one can discover the place without using SMS service. KuanYew Tan, et al. [10]   executed a campus vehicle tracking system with the aid of WiFi proximity method and GPS data.

III. Hardware used for vehicle tracking system designing:

3.1 GPS Technology: The Global Positioning System (GPS) is a satellite-based navigation system consists of a network of 24 satellites located into orbit. The system offers necessary information to military, public and business clients around the world and which is liberally available to everybody with a GPS receiver. GPS functions in all climate conditions at everywhere on the earth. A GPS recipient must be locked on to the signal of at least three satellites to calculate approximately 2D location (latitude and longitude) and track movement. With four or more satellites in sight, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the vehicle location has been determined, the GPS unit can decide other information like, speed, distance to destination, time and other.

3.2 GPS and GPRS Shield: The Global Positioning System (GPS) is the Global Navigation System (GNSS) that receives signal from at least three satellites to compute its two dimensional (latitude and longitude) position. Therefore, GPS is a key technology for getting position. GPS was developed by the United States Department of Defense. The GPS in vehicle tracking systems is employed to provide users the coordinates of the location anywhere on earth. The GSM/GPRS module is responsible of establishing connections between a tracking system and a remote user for transmitting the information of vehicle's location, using TCP/IP connection through the GSM/GPRS network.


[GPS and GPRS shield]

3.3 Power Supply The power supply fragment is very significant for all electronic circuits. The 230V, 50Hz AC mains is stepped down by transformer X1 to distribute a secondary output of 12V, 500 mA. The transformer yield is corrected by a full-wave rectifier comprising diodes D1 through D4, filtered by capacitor C1 and regulated by ICs 7812 (IC2) and 7805 (IC3). Capacitor C2 bypasses the ripples present in the regulated supply. LED1 acts as the power indicator and R1 limits the current through LED1.

3.4 Sensor: Different sensors are used to collect different data of the vehicle.

3.4.1 IR SENSOR

The IR- sensor contains of Transmitter at one side of the track and another side (opposite) Receiver will be adjusted in site, all four IR-sensors that track the signals are placed if any emergency vehicles cross over the signal. The IR sensor detach the incite and sends the information to the controller, when it identifies the emergency vehicle crossing over the IR- line, transmits the communication to concerned Traffic controller leading to glowing of the LED.

The IR sensor can be utilized to monitor the activity i.e. whether the seatbelt slit is properly locked or not.
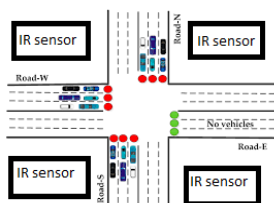
IR sensor tracking system.

3.4.2 Piezoelectric Sensor

Piezoelectric sensor is embedded in helmet to sense the pressure & vibrations whenever the rider meets with an accident. This sensor observes the shock and converts them into electrical signals. These electrical signals are transmitted to the encoder.

3.4.3 Alcohol Sensor

It assists to notice whether the driver has consumed alcohol not [12]   .

3.4.4 mq-135 alcohol gas sensor: Wide detecting scope, Fast response and High sensitivity, Stable and long life Simple drive circuit.

Alcohol Gas Sensor

3.4.5 Temperature sensor is used to monitor the temperature of the region or part of interest that could be, ambient temperature, engine temperature or the outside atmospheric temperature. Most of the temperature sensor modules have their own sensing system supported with necessary processing circuitry to make the signal compatible with standard equipment. The output of such sensor module is available both in analogue digital format so that it can easily be interfaces to a microcontroller based system.

3.4.6 Eye blink sensor is used to monitor that whether the driver feeling sleepy. Such sensors are employed when the operator attention is critical as is in the case of vehicle driving or operators of machines requiring critical concentration and attention.

3.4.7. **Level sensor** is used to monitor the level of fuel in the fuel tank. If it is below threshold then sensor indicates that the fuel level is critical by initiating the output. For certain applications where the fuel level is to be continuously monitored there is an additional output providing analogue signal that is proportionate to the amount of fuel present in the fuel tank.

3.5 RF Encoder & Transmitter

RF encoder codes the received electrical signals into suitable form so that the transmitter can send it to the receiver section in the vehicle.

3.6 RF Receiver & Decoder

RF Receiver receives the coded signals from the transmitter section and decodes it through RF decoder.

3.7 Microcontroller:

3.7.1 Arduino Microcontroller: The Atmega328 microcontroller in Arduino UNO is used as the brain to control the vehicle tracking system with GPS and GSM module. There are higher versions of Arduino like DUE and Mega providing more powerful processors. A program is written using C programming language, compiled, and then saved into the flash memory of microcontroller.

Arduino Uno Board

3.7.2 AT89S52 controller: There are system developed using a basic microcontroller like AT98S51 or S52. These microcontrollers have the advantage that they are in system programmable so that the microcontroller can be reprogrammed without removing it from its native circuit. Microcontrollers from AT89S series are versatile having large amount of program and data memory with faster data processing capabilities.

3.7.3 The Microcontroller unit (MCU)

There are two ways to control an electronic circuit either using: Microprocessor or MCU. The Microprocessors are usually referred to as general-purpose microprocessors because they do not contain RAM, ROM and I/O ports. So, system designers have to add an external RAM, ROM and I/O ports to make a system functional. Addition of these components will make the system bulkier and much more expensive. The advantage of using microprocessor is that the designer can decide the amount of RAM, ROM and I/O ports needed to accomplish a task.

(a) Microprocessor embedded on a board [14]   (b) AMD Microprocessor [15] .
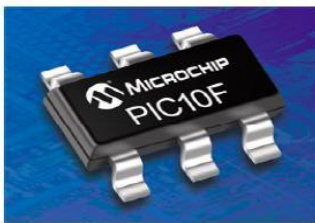
However, MCUs have a CPU in addition to the fixed amount of RAM, ROM and I/O ports, which are embedded on a chip with support functions such as a crystal oscillator, timers and serial or analog input output (I/O) [16] . The MCUs are designed for embedded applications and can be used in remote controls, power tools, toys and other appliances. Invention of MCUs has reduced the size and cost of designs. MCUs are suitable where cost and space are critical. There are four types of MCUs (8 bit): 8051 family, PIC, Zilog and Freescale. The MCU families are not compatible with each other, which means, if we write a code for 8051 MCU it will not work on PIC MCU. This is mainly due to different instructions and registers set in each MCU.

(a) 8051 Family Microcontroller [17]   (b) A Microcontroller pin description [18]

(a) A PIC Microcontroller [19]   (b) A Zilog Microcontroller [20]

3.7.3 Renesas Microcontroller: The Renesas microcontroller is used as the brain to control the vehicle tracking system. Renesas ports are used for the GPS and the GSM/GPRS modules. A software program to control them is written in the C programming language, compiled and then saved into the microcontroller's flash memory.

3.8 Liquid crystal display (LCD): LCD is a flat panel display, electronic visual display, based on Liquid Crystal Technology. It is used to display the initialization messages from microcontroller, latitude and longitude positions from GPS [13] .

IV Application Areas:

1. Used in automotive and transport vehicles from lighter vehicles like cars, to heavier automotive like ships and aeroplanes.
2. Security and remote monitoring of vehicles especially during military operations.
3. System is also can be interfaced with Vehicle airbag system such that when the sensors detect the accident, the airbags get opened.
4. School transport vehicle accident detection.
5. For Private Transportation Services: Private Transportation Service providing companies necessitate to supervise their taxicabs in real time to provide the superior service to the customers. Such system offers the online monitoring and the safety characteristics like driver authentication, Physical panic button, Camera pictures transmission to base station and voice alarm system which can be guarded remotely.
6. For School Bus Service Providers: This system will facilitate the school managements for online supervision of the school busses and they can make sure the vehicles over speed etc. Parents can be acquainted with the vehicle location through SMS or using the web link which will have the present position of the school-bus to pick up their children.
7. For Shipment Service providers: Shipment Service provider companies need to supervise their vehicle through online, which permit the better usage of the warehouse. By analyzing the navy data they will know the time engaged to deliver the shipment in different timing of the day. They can plan the less traffic routes and timings to minimize the transportation cost. [11]

V Conclusion: Security systems and navigators have always been a necessity of human's life. The developments of advanced electronics have brought revolutionary changes in various fields. Here we have described various hardware components which can be used for the development of above mentioned safety tracking systems.

In this paper we present the need of safety measures to avoid accidents by using various sensors such as Gas, Alcohol and many more. The vehicle tracking and monitoring system would send the messages to the owner or friends continuously about the location and any major event in respect of situations like accident till the first aid or rescue reaches.

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