Implementation of Driver Assistance System Based on Review of Different Accident and Speed Violation Detection Techniques

[1] Hiral Atulkumar Patel, [2] Prof. Madhuri D. Thakkar
[1, 2] *Department of Electronics & Communication Engineering, Parul Institute of Technology*

Abstract

In the present day scenario, traffic rules are frequently violated by the drivers and over speeding occur due to improper driving behaviour. So, a driver assistance system is required to prevent over speeding, violation of road rules and also to display alert messages. The proposed system has an alerting, recording and reporting system for over speed violation management and it also includes accident detection and reporting to the police station system. It will use GPS module to get the speed, time and location information. The main advantage of this system is that there is no need for individual modules for these two detections. Only one module is used for both over speed violation detection, accident detection and reporting. So the cost of the whole system will be reduced.

1. Introduction

As the rate of accidents is increased in our day-to-day life, speed of vehicles should be controlled as much as possible. During 2011, a whole of 4, 97,686 road accidents were reported in India, which is a result of lack of speed control and violating the road rules [5].

To Ensure decline in accidents and to improve road safety, speed control techniques such as speed control in school and college zones by using RF transceiver, Automatic braking systems, Camera based detection, RFID technology, Zigbee based detection are implemented. The existing techniques are still not able to reduce the number of accidents effectively and they are expensive also. Their range is also very small, so, we have to place repeated receivers on the road at very short intervals, which increases the system cost.

Hence, there is a need to implement Intelligent Speed Adaptation (ISA) in which violation management provides efficient monitoring, registering and reporting system of vehicle speed if exceeds the limit. Moreover, if the accident occurs, this system sends the information to the police station, so that, they can inform to hospital/ambulance or any registered number.

2. Literature Review

After doing literature review in the area of accident detection and prevention of traffic rules' violation, we came to know that there are various techniques available for detection of speed violation and accident, like RF transceiver, GPS module, Automatic braking systems, Camera based detection, RFID technology, Zigbee based detection. We have explained following techniques in brief:

A. Use of GPS module in accident detection system
B. Use of RF transceiver in wireless vehicular accident detection
C. RFID technology based detection
D. Over speed violation detection through Zigbee

A. Use of GPS module in accident detection system

The use of GPS and GSM interfacing with microcontroller shortens the alarm time to a large extent and locate the site of accident accurately. When a vehicle meets with an accident immediately vibration sensor will detect the signal or if a car rolls over, and Micro electro mechanical system (MEMS) sensor will detects the signal and sends it to controller. Microcontroller sends the alert message through the GSM MODEM including the location to police control room or a rescue team [1]. By means of satellite navigation system, first aid rescuers can accurately locate the place with maximum error controlled by 10 meters, so that they can save the injured people as soon as possible [2].

B. Use of RF transceiver in wireless vehicular accident detection

RF transceiver is also used to send the accident information. The RF transmitter module interfaced with the microcontroller will transmit the accident information to the nearby Emergency Service Provider. This information is received by the RF receiver module at the 'service provider' control room in the locality.

The service provider can use this information to arrange for ambulance and also inform police and hospital [3]. The limitation of this method is that the installment of repeated receivers on the road at a very short interval because the RF transceiver module used has a range up to 100 meters under ideal conditions.

C. RFID technology based detection

In RFID based embedded system for prevention of road accidents, the system uses N number of RFID tags to transmit general area information and RFID reader in vehicle. Whenever vehicle meets with an accident, the system reads the area information from RFID tags placed on the road and transfers this information to the specific numbers stored in database using GSM module [4]. The limitation of this method is that the installment of N number of RFID tags on the road to transmit general area information.

D. Over speed violation detection through Zigbee

Over Speed Violation detection can be implemented using Zigbee module, in which Zigbee transmitter is used to send the speed limit of the particular lane entered by the vehicle. The receiver unit placed in the vehicle receives the messages and sends to the microcontroller. When speed of the vehicle exceeds the limit, the microcontroller records the violated speed and time. A GSM module sends message to the nearest traffic personnel immediately after a violation occurs [5]. The limitation of this method is that we have to place N number of Zigbee transmitter modules in city to get the speed limit of the particular lane entered by the vehicle because Zigbee module has a very small range.

3. Problem Definition

After long research in this area, we came to know that the existing techniques are still not able to reduce the number of accidents effectively and they are expensive also. Moreover, the traditional system is having two or more modules for speed violation and accident detection. Whereas as proposed system facilitates **Speed Violation and Accident Detection** using a single module so that the cost of the whole system will be reduced. The system has GPS module which continuously checks the location and speed of the vehicle. When speed of the vehicle nears the speed limit it displays the warning and if exceeds the limit, the microcontroller records the violated speed and time. Then GSM module sends message to the nearest traffic personnel. Moreover, if the accident occurs, this system sends the message to the respective numbers stored in the microcontroller.

4. System Structure

The hardware structure mainly integrates the ARM Cortex Microcontroller, GPS module, GSM module, Vibration sensor to detect accident, LCD display, Alarm.

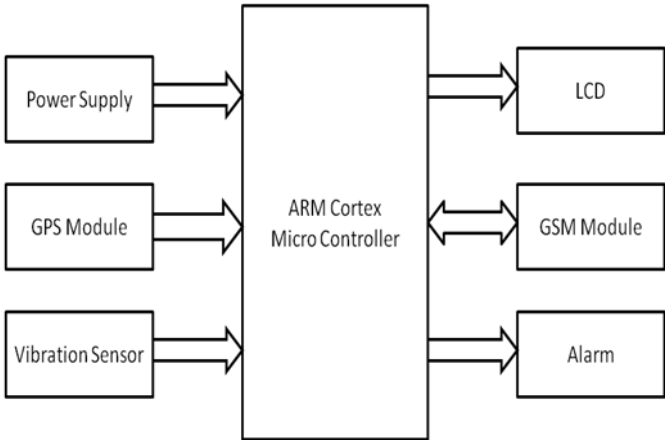

Figure 1: Block Diagram of Vehicle System

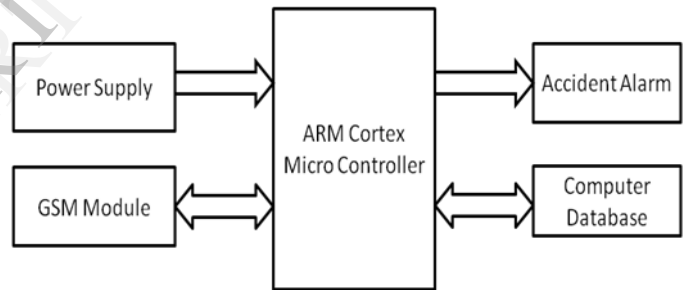

Figure 2: Block Diagram of Traffic Police System

Figure 1 and 2 shows the block diagram of the proposed system for over speed violation as well as accident detection. The vehicle has the GPS module which continuously checks the location and speed of the vehicle. The system has the speed limit of the particular lane entered by the vehicle and also gives alerts like “school zone”, “steep slopes”, “city area”, etc. in LCD.

When speed of the vehicle nears the speed limit it displays the warning and if exceeds the limit, the microcontroller records the violated speed, time and location. The LCD displays the lane speed limit and shows the number of times, speed was violated. A GSM module sends message to the nearest traffic personnel immediately after a violation occurs. Increase in the count of violation increases the penalty amount which can be collected in toll gates located nearby or any other place.

Vibration sensors are added to trigger our system, when the vehicle is met with accident. Whenever the moving vehicle meets with an accident the vibration sensor interfaced with the micro controller will detect the vibration and indicate the controller which will immediately activate the GPS and collects the location detail and sends the message to the respective numbers stored in the controller (the number may be hospital or police stations or car owner number).

5. Hardware Design

5.1 ARM Cortex-M3

The LPC17xx is an ARM Cortex-M3 based microcontroller for embedded applications requiring a high level of integration and low power dissipation. The ARM Cortex-M3 is a next generation core that offers system enhancements such as modernized debug features and a higher level of support block integration.

The LPC1768/67/66/65/64/63 operates at CPU frequencies of up to 100 MHz. The LPC1769 operates at CPU frequencies of up to 120 MHz. The ARM Cortex-M3 CPU incorporates a 3-stage pipeline and uses Harvard architecture with separate local instruction and data buses as well as a third bus for peripherals. The ARM Cortex-M3 CPU also includes an internal prefetch unit that supports speculative branches [6].

The peripheral complement of the LPC17xx includes up to 512 kB of flash memory, up to 64 kB of data memory, Ethernet MAC, a USB interface that can be configured as either Host, Device, or OTG, 8 channel general purpose DMA controller, 4 UARTs, 2 CAN channels, 2 SSP controllers, SPI interface, 3 I2C interfaces, 2-input plus 2-output I2S interface, 8 channel 12-bit ADC, 10-bit DAC, motor control PWM, Quadrature Encoder interface, 4 general purpose timers, 6-output general purpose PWM, ultra-low power RTC with separate battery supply, and up to 70 general purpose I/O pins [6].

5.2 GPS Module

The Global Positioning System (GPS) is a satellite based navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides the user with information. Using GPS technology, one can determine location, velocity and time, 24 hours a day, in any weather conditions anywhere in the world for free [7].

There is a set of 24 satellites that are continuously orbiting the earth. These satellites are equipped with atomic clocks and send out radio signals as to the exact time and their location. These radio signals from the satellites are picked up by the GPS receiver. Once the GPS receiver locks on to four or more of these satellites, it can triangulate its location from the known positions of the satellites [7]. It is a high performance, low power satellite based model. It is a cost effective and portable system which accurately detects the location.

A software standard for commercial GPS receivers is NMEA 0183. This is a serial protocol using ASCII sentences to convey information from the GPS receiver. According to NMEA-0183 protocol standard specifications, GPS receiver transmits the position and speed information to the PC and PDA etc. via the serial port. It is the most widely GPS receiver used protocol currently. The receiver sends multiple types of statements, only a few of letters in certain statements is valid, so it needs to parse the received data, separating out the required information.

5.3 GSM Module

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services. It is a digital mobile telephone system that is widely used in Europe and other parts of the world. GSM uses a variation of Time Division Multiple Access (TDMA) and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA. It operates at either the 900 MHz or 1,800 MHz frequency band. It supports voice calls and data transfer speeds of up to 9.6 kbps, together with the transmission of SMS (Short Message Service) [9].

The message sending module is SIM900, it is a complete Quad-band GSM/GPRS module designed by SIMCom. SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data and Fax in a small form factor and with low power consumption. SIM900 is designed as a DCE (Data Communication Equipment). It provides a full modem serial port, which is used for data transmission and for sending AT commands. The SIM900 is integrated with the TCP/IP protocol; extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications. Both GPS and GSM are interfaced to the control unit using serial communication protocol [9].

6. Software Structure

In order for the hardware to function, the firmware code for the system has to be written. Theoretically, software that resides in the non-volatile memory and handles the operation as well as function of a system is known as firmware. The firmware holds the information that the Microcontroller needs to operate or run. Thus, it needs to be free of bugs and errors for a successful application or product. There are various types of software that could be used to program ARM controller. Program can be written in a variety of languages such as C, Basic, Pascal or even Assembler. Proposed system is programmed using the Embedded C and debugged with keil-4 tool.

The flow chart for speed violation detection is shown in figure 3. The speed limit of a particular lane entered by the vehicle is acquired as an input variable. Current speed of the vehicle is compared with the speed limit and appropriate action is taken based on the result of conditional execution, and the GSM modem sends SMS to traffic police.

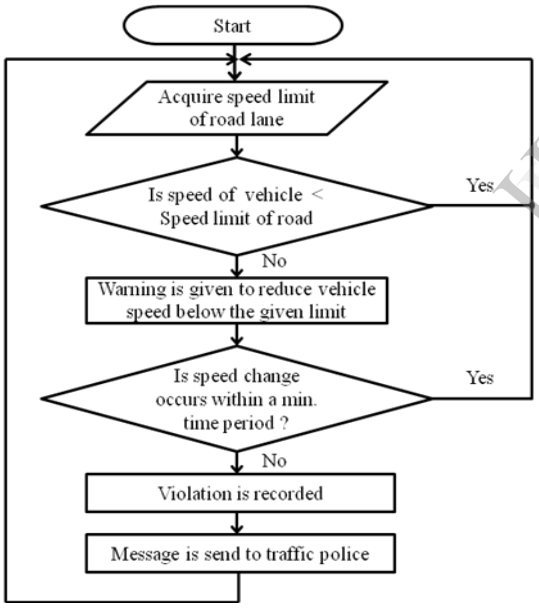

Figure 3: Flowchart for Speed Violation Detection

The flow chart for accident detection is shown in figure 4. It continuously checks whether the accident is occurred or not using vibration sensor interfaced with microcontroller. Then appropriate action is taken based on the result of conditional execution and the GSM modem sends location to the registered number.

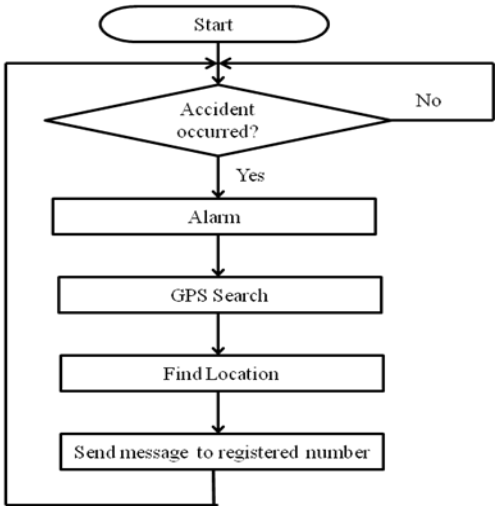

Figure 4: Flowchart for Accident Detection

7. Conclusion

There are many techniques available for speed violation and accident detection but they are still not able to reduce the number of accidents. We have to also place repeated receivers on the road at very short intervals. So it increases the system cost. Hence the proposed system uses the GPS module to get speed, time and location information which will be useful for traffic personnel to regulate the speed control and accident detection. Insurance schemes can be implemented based on the driving behavior. Comparing earlier implementations, this is a low cost method which is practically feasible because it uses only one module for speed violation detection as well as accident detection.

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