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GPS and GSM Enabled Embedded Vehicle Speed Limiting Device

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Abstract

Objective: This paper aims to offer simple and effective solution for controlling the speed of the vehicle automatically. **Methods/Analysis:** The framework makes utilization of ARM microcontroller which is the core device. **Findings:** An expansion to the current system was enhanced in this paper which naturally controls the speed of the vehicle based on its location determined by the GPS coordinates and a switch initially present in on state enters into off state where the user uses this in crisis situation allotted by sending a message to nearby traffic control unit with usage of GSM. **Novelty/ Improvement:** Based on the obtained GPS values the speed of the vehicle is controlled.

Keywords: ARM Microcontroller, GPS, GSM, Latitude, LCD, Longitude

1. Introduction

INDIA is the second most extreme crowded nation and is a fast growing economic body. Intelligent Traffic control framework is utilized to lessen the negative effect of the congestion. ISA (Intelligent Speed Adaptation)[1] technology guarantees that vehicle speed does not cross a safe or lawfully enforced speed. In general, there are two types of ISA systems: passive as well as active. These two sorts of ISA frameworks differ in that passive systems basically caution the driver of the vehicle to regulate the given instructions which are in form of visual display or auditory advises, while active bodies involve and naturally adjust the vehicle's speed to a particular limit[2]. This method utilizes data about the roads to decide the required speed and data can be acquired from the vehicles position, considering the speed limit known form the location.

GPS technology is a method of speed adaptation where the position of the vehicles can be determined based on its location. The position can be identified by using the GPS receiver. GPS radio receivers get these transmissions and, by comparing the signals from a few satellites, can be able to identify the receiver's location by using a process called Trilateration[3].

This paper aims to offer simple and effective solution for controlling the speed of the vehicle automatically within the given geographical limit based on its GPS coordinates and a switch which helps in emergency condition by communicating with the GSM module.

2. Intelligent Speed Adaptation

ISA is actually an aggregate term for different distinct frameworks. Field trials and driving test system studies show some real outcomes on behavior of speed and expect valuable safety impacts. A few studies report negative symptoms of ISA, yet there is lack of knowledge in measure of these believable negative reactions and their outcomes.

2.1 Types of ISA

Passive frameworks permits the chauffer to settle on a decision on what move ought to be made. These can go from an auditory advices or ocular cautioning (a blazing light or a beep) to a more complex interface home machine. Few ISA trials have utilized tactileinput, where the accelerator agent pedal got to be stiffer or vibrated at the point when the vehicle beats the speed limit[3]. Another

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option is to turn off accommodation things, for example, the radio or ventilation system when speed points are surpassed for delayed periods.

Active frameworks diminish the vehicle's rate naturally, without interruption from the chauffer. Strategies are framed to accomplish the incorporated throttle, brake application, motor management framework control, fuel restricting or a blend of these. Adaptive Cruise Control (ACC) can be modified to keep up vehicle speed to that noted and examines sign acknowledgment as a method for deciding speed limits. Manyof the active ISA frameworks permit the driver to override the ISA when regarded vital; this is thought to upgrade acknowledgment and security, so that the client can disable the system[4].

A regularly unrecognized aspect of both active and passive ISA frameworks is that they can serve as on-board vehicle information recorders, holding data about vehicle area and execution for later checking and speed management purposes.

3. Technologies

To work, the ISA framework needs to identify the location of the vehicle, precise to a short distance. The location data can be connected to a digital map which contains data for example, speed limits, and speed bumps placed at special locations like schools, courts, etc...[5] New advanced ISA has a limit for real time to incorporate data on ranges where speed points of confinement ought to be lessened because of climate conditions (rain, fog, mist, snow, ice) or around accidents areas and road scenes.

There technologies available in the market for identifying the location and decide the speed of the vehicle without intervention of speedometer are:

3.1 Radio Beacons

Roadside Radio Beacons works by transmitting information to a receiver. The signals continually transmit information, where receiver grabs as it passes through each beacons. This information could incorporate school zones, nearby speed limits, traffic conditions (street works, climate, and so on). The radio beacons could be placed in the roadside itself. Mobile beacons can be used during climatic conditions, special occasions, and also for other events. The main disadvantage of this beacon technology is the vehicle should be within the range of the specific beacons to follow the speed limit. Because of this reason we need more number of beacons for different speed limits.

3.2 Dead Reckoning

Dead reckoning (DR) utilizes a mechanical framework connected to the vehicle's driving association, to anticipate the vehicles way. By calculating the things, for example rotation, angle we can estimate the vehicles speed and also location can be identified. More precise frameworks depend on particular sensors. This system needs to begin at the fixed point where there is a result of inaccuracies. These errors can be corrected by using a new resource point. So for this reason this system has to work with another backup system called GPS.

3.3 Optical Recognition

This framework requires the vehicle to send a speed sign for information. As the framework perceives a sign as far as speed information is gotten and contrasted with the vehicle's speed. The framework would utilize as far as speed from the last sign went until it perceives a speed sign with an alternate breaking point. Likewise with beacons, if speed limits[9] are not discovered framework does not work. So this technology remains problematic in ISA. This system uses complex algorithm and uses more number of resources.

3.4 GPS

The Global Positioning System (GPS) receiver continuously monitors numerous satellites and figure out mathematical statements to decide the accurate position of the receiver and its deviation.

Out of 31 satellites, minimum four satellites are in perspective of the receiver for it to process four obscure amounts. Many of the receivers have trackers algorithm which helps in measuring different satellite timings, by making advantage of fact that immediate receivers position can be close to each other. After all these estimations made by the satellites the receivers position can be determined very easily. The operation depends on a technique called Trilateration.

In spite of its popularity, GPS is liable to various essential issues identified with the accuracy of the decided position. Besides, the fact is that GPS depends upon a signal transmitted from a satellite in orbit it doesn't work when the receiver is grounded or in a channel and the signal can become weak when buildings, trees and heavy clouds comes in between the satellites and receiver[10]. New advances being made to the GPS satellite system and receivers will helps GPS dependability and precision however to overcome the drawbacks of GPS devices.

4. System Structure and Description

In this project we are using two communication technology based modules and one control unit with display unit. The communication modules are connected through serial data cable which is called rs232. In this the data transmission is done by bit by bit. The data which was received from these two modules was with TTL logic. So we are converting that data into required digital format by using max232 ic. The received data will display in LCD section. Here we are using 4*16 LCD which specifies 4 rows and 16 columns where the data will be displayed in LCD by using data pins.

Refer Figure 1 Structure of proposed method

The vehicle set speed increasing or decreasing executed by using PWM technology. The remaining mode of execution will be done by using the switch control technique. The switch initially present in off state enters into on state where the user uses this in emergency situation. By using GSM module the user has to sent a message to traffic control unit where they accepts the request and sent a message to the user so that the user can avoid the set speed for some extent. Finally this paper provides a simple solution for controlling the speed of the vehicle.

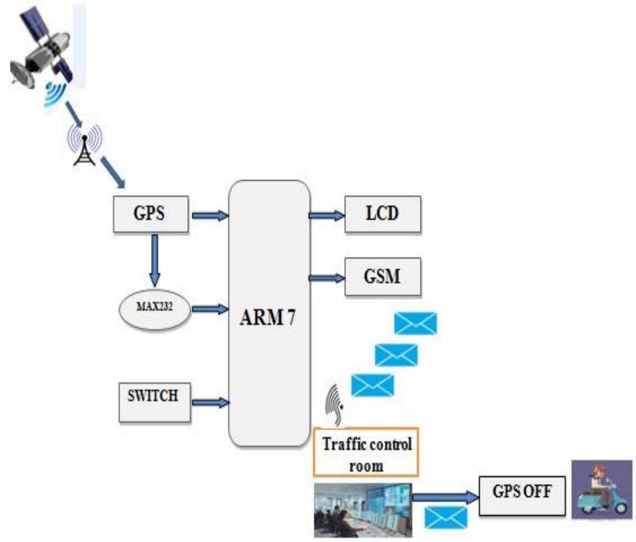

Figure 1. Structure of proposed method.

5. Hardware Description

5.1 ARM7 Processor

The microcontroller we have used in this project is of ARM7 core which is of 32 bit embedded RISC machine. The main advantages of using this board is that provides high performance in embedded applications with low power consumption and also occupies less space with tiny LQFP64 package. The microcontroller unit has 40 kB of on-chip static RAM and 512 kB of on-chip flash memory where we can store the data as well as the code[13]. It will operate at 1MHz to 25 MHz with the help of external crystal oscillator.

5.2 GPS

By using UART the information which we have received from the satellite have been transferred to the microcontroller ARM7. The serial information is taken from the GPS module through MAX232 into the SBUF register of LPC2148 microcontroller. The co-ordinates of the location have taken from the string called GPGGA. An example for the output string of the GPS is given below.

$GPRMC, 092327.000, A, 1626.6107, N, 08037.2187, E, 0.20, 0.00, 211215, , , A*66

The above output string helps to provide the information of location co-ordinates

5.3 GSM

The GSM is interfaced with ARM7 board for SMS communication. For communication we used only three signals transmitter, receiver and ground. To transmit the message from microcontroller the serial port of microcontroller is connected to the TXD of GSM while for receiving the signal from GSM we need to connect RXD of GSM to serial port of microcontroller. The GSM module uses AT commands to read, write, delete, send and receive the messages. To keep the GSM in text mode we use a command AT+CMGF=1 where as to send the message we need a command AT+CMGS along with mobile number.

5.4 LCD

The LCD which we have used in this project is of 4*16 having 4 rows and 16 characters for each line. Here the LCD helps us to display information about latitudes and longitudes and also provides the speed of that particular path where the user is travelling. The data pins of LCD are connected to port pins 0 and 1. The read write pin have been connected to P0.12 and enable as well as select pin was connected to P0.11 and P0.13. Each character was displayed in LCD module directly by sending bit patterns.

5.5 Other I/O Devices

The system having a switch which is of single pole double throw acts as input for the core device. This switch generally having two modes one normal mode and emergency mode. In normal mode the GPS will be in ON condition where we can have the speed control of the vehicle and emergency mode there is no control of speed for vehicle so that the user can maintain their own speed limit.

RS-232 is mainly used for transmitting the data through serial communication. While interfacing GPS Receiver-RS232 Serial/USB with ARM7 need level shifter called max232 because microcontroller and GPS Receiver RS232 Serial/USB are different logic levels. Reading GPS information through RS232 port requires outside power. When we associate GPS Receiver-RS232/USB through USB requires no outer power. Power is taken from USB port itself.

This microcontroller mainly operates at 5V supply. To convert from 12V battery to 5V specification voltage regulator will be used. This helps in increasing the life time of the battery.

6. Test Location

Here we have chosen the campus roads of the KL University in vaddeswaram to test the speed control of the vehicle. Figure demonstrates the path of the vehicle where we have assigned different speed limits for different locations which are indicated with different colors. The test area was selected to test the speed limiting feature at both the higher and lower limit. For example the blue color was indicated to be maintaining the lowest speed where as the green color will having the highest speed limit. The process can be done by using the GPS coordinates.

Refer Figure 2 Location of test area

6.1 Speed Zone Determination

After the paths are identified the microcontroller uses the location coordinates which have been taken from GPS. The whole process can be done by comparing the current values with the values present in the date base. When this process is completed then automatically the vehicles enters in to assigned speed limit. Each location is given with different colors for easy identification of different speed limits. The latitude and longitudes of the some of the speed limits are shown in below table.

Refer Table 1 Test area location co-ordinates

6.2 Process for Execution

The project will start with giving the power supply. The power supply required for this project is 3.3v, but normally we are getting 230v. So we are converting the voltage to required voltage by using rectifier and capacitive filters and regulator circuits. After receiving the power supply we are enabling GPS circuit. Then it will get the signals from the satellite and reads the latitude and longitude values. The received values from satellite will display in LCD display. The GPS

Figure 2. Location of test area.

Table 1. Test area location co-ordinates

REGION COLOUR	LATITUDE,LONGITUDE	SPEED
Green	1626.6130,N,08037.2180,E,092326.0 1626.6223,N,08037.3084,E,092822.0 1626.6047,N,08037.4196,E,093338.0	50MPH
Blue	1626.5363,N,08037.3576,E,095718.0 1626.5385,N,08037.3932,E,100007.0	5MPH
Maroon	1626.5455,N,08037.3493,E,095106.0 1626.6043,N,08037.3421,E,095352.0	15MPH
Yellow	1626.4360,N,08037.4091,E,093023.0 1626.5271,N,08037.3937,E,094133.0 1626.6033,N,08037.3876,E,093641.0	60MPH
Red	1626.4170,N,08037.3575,E,092331.0 1626.5288,N,08037.3476,E,094514.0	30MPH
Pink	1626.5226,N,08037.2636,E,091527.0 1626.5376,N,08037.3399,E,094901.0	10MPH

values will be received through serial communication. In ARM7 the serial communication will support 2 serial communication ports. In our project we are using 1 port for GPS and another port for GSM. The 2 modules will transmit the signals by using bit by bit data transmission. Now in our project we are operating the entire things with 2 modes by using a switch. This mode of operation will be decided by using GSM technology. The fist mode will operate with manual speed control. That is when the user wants to go in particular direction. But in other mode which is automatic mode there is no chance for user selecting the particular speed for the vehicle. Based on his/her requirement he can drive the vehicle. In this we required switching condition control or reduce or increase the speeds of the vehicle. The entire process is done by using control unit. The process of displaying values in LCD depends on the receiving the interrupts from the controller to LCD connection.

7. Snap Shots

Refer Figure 3 Motor at low speed
Refer Figure 4 Motor at medium speed
Refer Figure 5 Motor at high speed

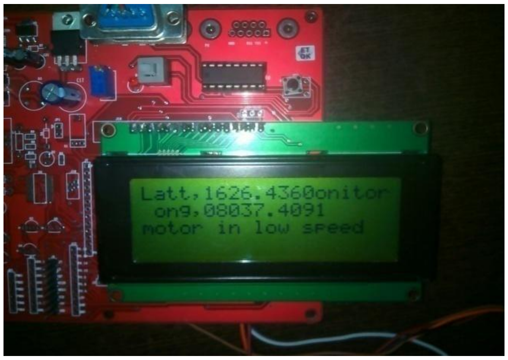

Figure 3. Motor in low speed.

Figure 4. Motor in medium speed.

Figure 5. Motor in high speed.

8. Conclusion

By using this system the speed of the vehicle is limited according to the speed limit given by the highway authorities, by this we can avoid over speed driving by which fatal accidents occurs. The method which we have framed in this paper may have several ways but we believe that using GPS makes our way very simple and also more effective. The GSM helps in sending and receiving the messages. This method finally finds a simple way by limiting the speed of the vehicle with cost effective. Further implementation can be done in real time applications for better improvements.

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