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An autonomous speed control and object detection system for vehicles based on RF technology

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Abstract: This paper deals with an autonomous speed control system for the vehicles (ASCS), which helps us to reduce the number of road accidents and to maintain a disciplined traffic control system over the country. Here we are having two sections one is transmitter section and the other is vehicle (receiver) section. Say when a vehicle enters into a particular zone such as school zone then the Rf transmitter in the transmitter section will send the information to the vehicle section .Then the vehicle section based on the information reduces the speed of the vehicle due to embedded platform. Apart from this it is also having an in built object detector unit. So, if any object comes in front of the vehicle then the intimation will be given to the person who is in the vehicle. So that most of the accidents can be avoided. In case if any accident occurs automatically information will be send to the emergency unit through mobile communication (GSM).

Keywords: ASCS, object detector unit, radio waves, wireless communication.

I. INTRODUCTION

One of the major causes of road accident in the world is driving too fast, recent studies shows that one third of the serious road accidents are due to inappropriate speed, as well as change in road way (like presence of road work or unexpected obstacles).So in order to avoid such kind of accidents and to alert the drivers and to control their vehicle speed in such kind of places the highway department have placed the signboards.

But sometimes it may not to possible to view that kind of signboards and there is a chance for accident. So there is an utmost need to design a system which can control the speed of vehicles. Here we are designing a speed control system for vehicles which can intimate the driver about the zones and limit speed of the vehicle automatically by means of RF technology.

The main objective is to design a ASCS for vehicle's which can monitors as well as control the instantaneous speed of the vehicle based on different zones, which can run on an embedded system. Smart ASCS can be custom designed to fit into a vehicle's dashboard, and displays information on the vehicle. The project is composed of two separate units: zone status transmitter unit and receiver ASCS system.

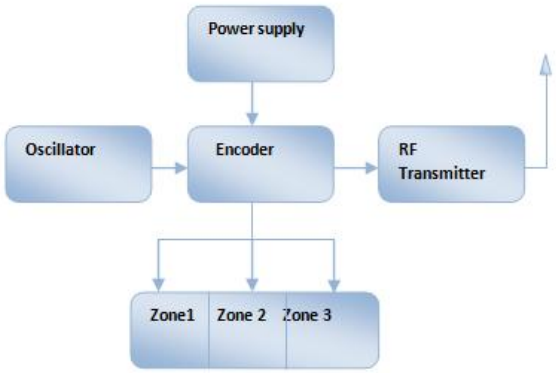

Figure 1: ASCS zone transmitter section

A part of the ASCS is showed in the above figure. This section will be kept in each and every area where some special care is needed. These units will be having a radio frequency transmitter. These transmitters will be having a range. Within that range if any vehicle comes with the RF receiver, then automatically this signal will be received by that vehicle. In real time, if in a school zone area a speed need to be maintained then this system have to be fixed around that area. So the vehicle if enters the area then,

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automatically the vehicle will go to a low speed according to the program.

These proposed ASCS zone transmitter sections continuously transmit the signal. So that if any vehicle enters in to the region at any time, then the signal will be received by that vehicle. The data will be unique for each and every area. So that the vehicle will set into different speed. This signal will be transmitted by the encoder. Here, an active type radio frequency generator is used. The other part of ASCS is shown in the figure 2. This unit will be fixed inside the vehicle. This unit will give the intimation to the driver regarding the detail like speed change, zone alert and so on.

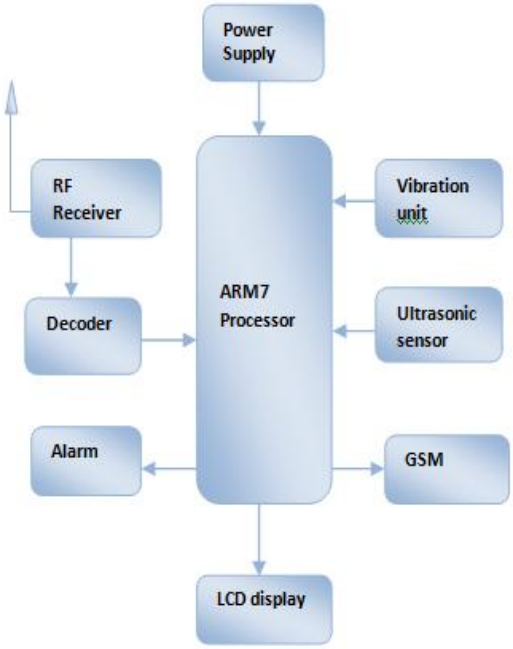

Figure 2: ASCS- Vehicle receiver section

This section consists of ARM7 processor, which will acts as a core processor. An RF receiver will be connected to this unit. Which will decode the signals when the vehicle enters a particular zone, then an unique RF signal will be received by this unit automatically. Then the received signal will be decoded by the receiver. This device continuously checks the vibration level of the vehicle. If the vehicle got any accident in the sense if the processor receives a heavy vibration then automatically it will send intimation to the nearest emergency unit. ASCS unit is having a obstacle detection sensor and it will sense any presence of object within a certain area. If it finds any object then automatically an alert will be given inside the vehicle.

The RF unit receives the unique signal and according to the unique signal the speed of the vehicle will be changed and at the same time display will be shown inside the vehicle. So that the person who is driving the car easily can understand the situation. In the display, zone type will also be shown. This will prevent lot of careless accidents over the school zone, U-Turn curve and so many places.

II. DESIGN AND IMPLEMENTATION

The RF transmitter fixed in each and every zone will be having a unique digital code. In an RF there are two factors one is the range of the radio wave and the other is address match between the transmitter and receiver. In this project we have used an RF with a range of 433 MHz The address of RF tx and the RF rx should be same.

In the vehicle section, an RF receiver is fixed. If the vehicle enters in to any particular area then the RF receiver will receive the signal and then it decodes to get the correct digital code? Then it compares the given digital code with the processor program.

If the received code matched with any of the digital code in the processor, then the processor will do the desired function that has been mentioned on the program. Accident intimation and the obstacle detection are also added with this system. RF based speed change and the zone information will be displayed on the vehicle display section. GSM communication is used in this system to send alert information to the emergency unit.

III.OVERVIEW OF THE ASCS UNIT

In the existing system, Post Accident Detection Systems were only possible and at the same time lack of Intelligence in the detection systems. One of the most drawback was the existing system fails to track the collision. But in the proposed ASCS design Pre accident detection is possible Tracking of collision can also be done easily. This is an intelligent system because it monitors the road zone and the respective zone will be displayed on the display section.

The ASCS system will display the current speed of the vehicle in the display part. The ultrasonic sensor is used to detect any object across the road. If it finds any object then it will give one intimation through the alert program. If the processor sends any abnormal vibration, then the GSM will be activated and it will send the information to the nearby emergency centre.

IV.SYSTEM HARDWARE

A. ARM Processor:

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors.

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The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.
The ARM7TDMI core uses a three-stage pipeline to increase the flow of instructions to the processor. This allows multiple simultaneous operations to take place and continuous operation of the processing and memory systems.

(1) Operating modes: The ARM7TDMI core has seven modes of operation

- User mode is the usual program execution state
- Interrupt (IRQ) mode is used for general purpose interrupt handling
- Supervisor mode is a protected mode for the operating system
- Abort mode is entered after a data or instruction pre fetch abort
- System mode is a privileged user mode for the operating system
- Undefined mode is entered when an undefined instruction is executed.

The interrupt settings of ARM support the DHLS to response to the interrupt coming from the server section.

(2) Interrupt controller: The Vectored Interrupt Controller (VIC) accepts all of the interrupt request inputs from the home server section and categorizes them as Fast Interrupt Request (FIQ), vectored Interrupt Request (IRQ), and non-vectored IRQ as defined by programmable settings. So ASRS system can able to separate the command signals and easily will select the speed in the vehicle.

B. **Vibration Sensor:**

Vibration sensors detect the vibration of the ground soil in case of a debris flow. Prior to installing a vibration sensor, it is extremely important to determine what level of vibration is appropriate to activate the sensor in case of a debris flow. It is also important to keep in mind the risk of unintentional activation caused by earthquakes, as well as areas in which there is construction traffic and other vibration causes that may activate the sensor.

- Machinery damage and costly production delays caused by unforeseen machinery failure can be prevented.
- When pending problems are discovered early, the plant engineer has the opportunity to schedule maintenance and reduce downtime in a cost effective manner.

Vibration analysis is used as a tool to determine machine condition and the specific cause and location of machinery problems. This expedites repairs and minimizes costs

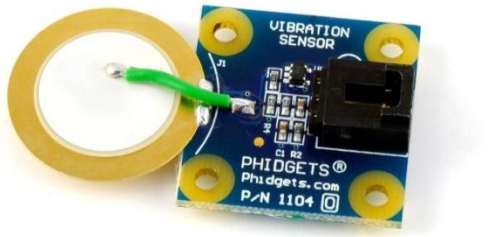

Figure 3: Vibration sensor

The figure shows the vibration sensor hardware. The piezo electric material inside the sensor will convert the sensor vibration in two electric voltages and then it will be send to processor.

Features:

- Simple to install and operate.
- Easy to integrate in test rig applications and existing control systems.
- Advanced digital signal electronics for lowest noise combined with highest sensitivity.
- 0.5 Hz to 22 kHz frequency response.
- Velocity up to ± 500 mm/s (3 ranges).
- Analog velocity output and digital S/P-DIF audio interface compatible with VIBSOFT-SP and other acquisition systems supporting the S/P-DIF standard.

C. **Ultrasonic Sensor:**

Ultrasonic rangefinder is capable of allowing the user to determine his or her distance from an object or wall. When deciding on what type of project to design and construct, we decided that we wanted to create something that would have some practical use in life.

At the heart of the receiver circuit is one of the ultrasonic transducers. The transducer converts an incoming sound wave and converts it into a voltage signal. This signal needs to be cleaned of noise, amplified, and turned into a TTL-type signal for the MCU. The signal from the transducer is fed through a capacitor to filter out noise and then through a voltage divider to centre the signal at 2.5 volts. From here, the signal needs to be amplified to guarantee true TTL levels. Initially, this was attempted using an LM358 op-amp.

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Figure 4: Ultrasonic sensor

There is provided an ultrasonic diagnostic system in which an ultrasonic probe is detachably connected thereto, and ultrasonic waves are transmitted from the ultrasonic probe into the subject to obtain received signals through receiving the ultrasonic waves reflected within the subject, thereby displaying for a diagnosis an image carrying information based on the received signals, and is also provided an ultrasonic module including a processing circuit for the received signals, the ultrasonic module being used in the ultrasonic diagnostic system.

The diagnostics system and the diagnostic module according to the present invention permit the more extensive patients to have an ultrasonic diagnosis, and also permit the operator to have a higher level of computer support. The ultrasonic module is connected through a general-purpose interface to a computer system. An ultrasonic module, which has, as a main element, an analog unit for performing an analog signal processing, is connected to another processor unit.

V.WIRELESS COMMUNICATION

A. RF communication

Radio Frequency, any frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. Many wireless technologies are based on RF field propagation

1. **RF Transmitter**: The TWS-434 extremely small, and are excellent for applications requiring short-range RF remote controls. The TWS-434 modules do not incorporate internal encoding. If simple control or status signals such as button presses or switch closures want to send, consider using an encoder and decoder IC set that takes care of all encoding, error checking, and decoding functions.

The transmitter output is up to 8mW at 433.92MHz with a range of approximately 400 foot (open area) outdoors. Indoors, the range is approximately 200 foot, and will go through most walls. The TWS-434 transmitter accepts both linear and digital inputs can operate from 1.5 to 12 Volts-DC, and makes building a miniature hand-held RF transmitter very easy.

Figure 5: RF Transmitter

2. **RF receiver:** RWS-434: The receiver also operates at 433.92MHz, and has a sensitivity of 3uV. The WS-434 receiver operates from 4.5 to 5.5 volts-DC, and has both linear and digital outputs.

A 0 volt to Vcc data output is available on pins. This output is normally used to drive a digital decoder IC or a microprocessor which is performing the data decoding. The receiver's output will only transition when valid data is present. In instances, when no carrier is present the output will remain low.

The RWS-434 modules do not incorporate internal decoding. If you want to receive Simple control or status signals such as button presses or switch closes, you can use the encoder and decoder IC set described above. Decoders with momentary and latched outputs are available

Figure 6: RF receiver

B. GSM

A GSM modem is a wireless modem that works with a GSM wireless network. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The

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reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS). The basic GSM network elements are shown.

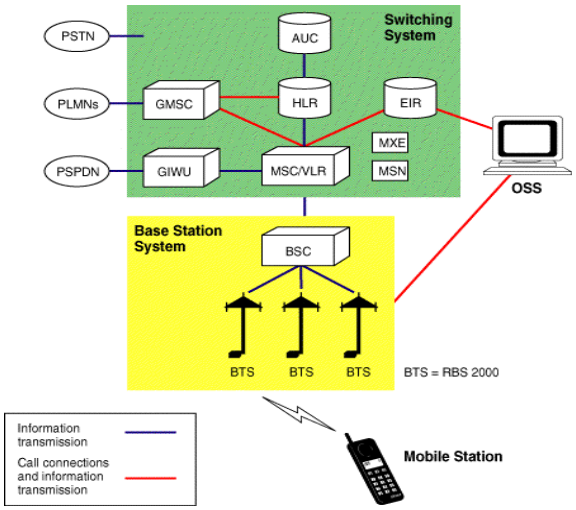

Figure 7: GSM network Topology

GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

VI. RESULT

. Here we have shown a speed control unit which is very useful in highway zones to limit speed of the vehicle and to avoid accident. The object avoidance unit in the vehicle will be very helpful at the time of careless driving. The GSM modem will be useful if any case accident occurs to report to emergency unit. So, as the whole ASCS unit is having the enough systematic functionality to prevent the accidents and to save the valuable life.

CONCLUSION

In this fast world accidents are becoming an unavoidable incident. This project of ASCS is having an enough method to prevent the accident happening in most of the sensitive zone of the road route. Here we have discussed a factor, accident intimation, which is very useful in highway zones. The object avoidance unit in the vehicle will be very helpful at the time of careless driving. So, the ASCS unit can be a useful system to avoid road accident and to maintain discipline traffic over the country.

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