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Design & Analysis of Vehicle Speed Control Unit Using RF Technology

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Abstract: Nowadays people drive very fast, accidents occur frequently and there is loss of property and life. In order to avoid such kind of accidents, to alert the drivers and to control their vehicle speed. RF technology is being used the main objective is to design a Smart Display controller meant for vehicle's speed control and monitoring of zones, which can run on an embedded system. Smart Display & Control (SDC) can be custom designed to fit into a vehicle's dashboard, and displays information on the vehicle. The project is comprises of two separate modules: zone status transmitter unit and receiver (speed display and control) unit. Once the information is received from the zones, the vehicle's embedded unit automatically alerts the driver, to reduce the speed according to zones, it waits for few seconds, and otherwise vehicle's SDC unit automatically reduces the speed.

Keywords: RF, Modules, Smart display &control, Zones.

I. INTRODUCTION

Road facilities are a major concern in the developed world. Recent studies show that one third of the number of fatal or serious accidents are associated with excessive or in appropriate speed, as well as changes in the roadway (like the presence of road-work or unexpected obstacles). Reduction of the number of accidents and mitigation of their consequences are a big concern for traffic authorities, the automotive industry and transport research groups. One important line of action consists in the use of advanced driver assistance systems (ADAS) [9], which are acoustic, hectic or visual signals produced by the vehicle itself to communicate to the driver the possibility of a collision. These systems are somewhat available in commercial vehicles today, and future trends indicate that higher safety will be achieved by automatic driving controls and a growing number of sensors both on the road infrastructure and the vehicle itself. A prime example of driver assistance systems is cruise control (CC), which has the capability of maintaining a constant user preset speed and its evolution, the adaptive cruise control (ACC), which adds to CC the capability of keeping a safe distance from the preceding vehicle .A drawback of these systems is that they are not independently capable of distinguishing between straight and curved parts of the road, where the speed has to be lowered to avoid accidents. However, curve Warning systems (CWS) have been recently developed that use a combination of global positioning systems (GPS) and digital maps obtained from a Geographical Information System (GIS) [10], to assess threat levels for a driver approaching a curve to quickly, Likewise, intelligent speed assistance (ISA) systems warn the driver When the vehicle‘s velocity is inappropriate, using GPS in combination with a digital road map containing information about the speed limits However useful, these systems are inoperative in case of unexpected road circumstances (like roadwork, road diversions, accidents, etc.), which would need the use of dynamically generated digital maps. The key idea offered by this paper is to use Radio Frequency Identification (RFID) technology to tag the warning signals placed in the dangerous portions of the road. While artificial vision based recognition of traffic signals might fail if visibility is poor (insufficient light, difficult weather conditions or blocking of the line of sight by preceding vehicles), RF signals might still be transmitted reliably. In the last years, RFID technology has been gradually incorporated to commercial transportation systems. A well-known example is the RFID-based highway toll collection systems which are now routinely employed in many countries, like the Telepass system in Italy or the Auto pass system in Norway. Other uses include monitoring systems to avoid vehicle theft, access control to car parking or private areas and embedding of RFID tags in license plates with specially coded IDs for automatic vehicle detection and identification. Placement of RFID tags on the road lanes has been proposed in order to provide accurate vehicle localization in tunnels or downtown areas where GPS positioning might be unreliable. In the work by RFID tagging of cars is offered as an alternative to traffic data collection by inductive loops placed under the road surface. The information about the traffic collected by a network of RE readers is then used to regulate traffic at intersection or critical points in the city. The work by Sato describes an ADAS, where passive RFID tags are arranged in the road close to the position of real traffic signals. An antenna placed in the rear part of the car and close to the floor (since the maximum transmitting range of the tags is about 40 cm) permits reading of the information stored in the tag memo and conveys a visual or additive message to the driver. Initial tests at low driving speeds (20 km/h) show good results The work described in this paper is collaboration between AUTOPIA (Autonomous Vehicles Group) [9] and LOPSI (Localization and Exploration for Intelligent

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International Advanced Research Journal in Science, Engineering and Technology
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Systems), both belonging to the Centre for Automation and Robotics (CAR, UPM-CISC). The aim of the research is to build a sensor system for infrastructure to vehicle (I2V) communt10n, which can transmit the information provided by active signals placed on the road to adapt the vehicle's speed and prevent collisions. By active signals we mean ordinary traffic signals that incorporate long range active RFID tags with information stored into them. This information is collected in real time by RFID sensors placed on board of the vehicle (an electric Citroën Berlin go), which we have modified to automatically change its speed to adapt to the circumstances of the road. In particular, we have implemented a fuzzy logic control algorithm acting on the longitudinal speed of the vehicle, with actuators which control the vehicle's throttle and brake to reach and maintain a given target speed.

A. Aim of the project

The aim of our project is to build a sensor system for infrastructure to vehicle (I2V) communt10n, which can transmit the information provided by active signals placed on the road to adapt the vehicles speed and prevent collisions. By active signals we mean ordinary traffic signals that incorporate long-range active RFID tags with information stored into them. This information is collected in real time by RFID sensors placed on board of the vehicle, which we have modified to automatically change its speed to adapt to the circumstances of the road. In particular, we have implemented a fuzzy logic control algorithm acting on the longitudinal speed of the vehicle with actuators which control the vehicles throttle and brake to reach and maintain a given target speed.

B. Objectives

The objectives of our project are vehicle speed control vehicle using wireless Technology.
1. To design and analyze modular, lowest wireless technology.
2. SDC to utilize road accident.
3. To explore the features and functionality of ARM7.

C. Applications

1. Speed control through RF technique.
2. Speed control at humps.
3. U curves safety indications.
4. Low power transmitter is enough for operation.
5. Lot of accidents possible is avoided.
6. Suitable for all kinds of vehicle safety system.
7. Less man power is required.
8. Driver alertness will be more.
9. Controlling the horn of the vehicles across schools, hospitals etc.

II. SYSTEM APPROACH

In our proposed project we used transmitter and receiver to communicate the signals. In transmitter section we used micro switches as input signals. These signals are encoded by the encoder and later encoded signals are transmitted through the transmitter. Block diagram is as shown in the figure 1.

1) Transmitter

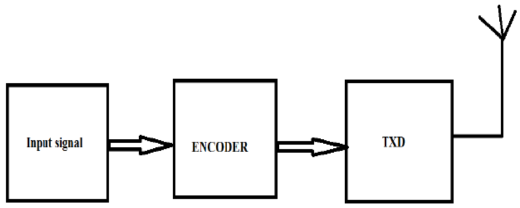
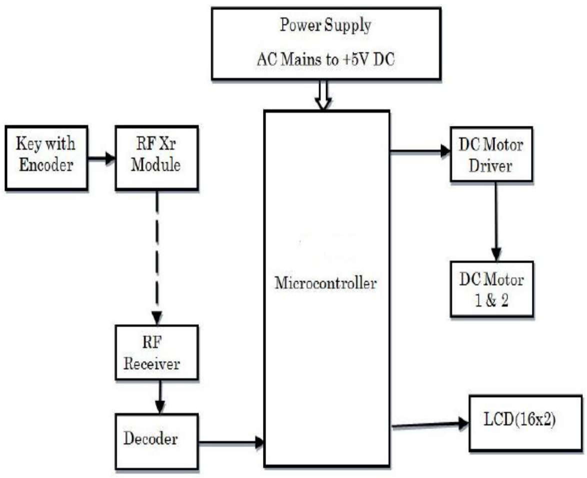


Figure 1: Block Diagram of Transmitter

In the receiver section, RF receiver receives the transmitted signals and decodes those signals by using decoder logic and later sends to microcontroller. By using microcontroller the decoded signals are displayed on LCD. Then the data or information sends it to the DC motor 1 & 2, by using DC motors drivers which is connected to the microcontroller. The block diagram of receiver is shown in figure 2.

2) Receiver



A. METHOD OF AUTOMATIC VEHICLE SPEED CONTROLLER

In general, the speed of the automobile is varied according to the accelerator's Pedal position. The variation in the Pedal position is fed to the Electronic Control Unit (ECU) .ECU determines the position of the throttle based on the accelerators pedal position and the inputs received from the other sensors. Adjustment of throttle position causes the change in the variation of automobiles speed. Such type of hardware scheme is shown in figure 3.

Whereas in the proposed automatic vehicle speed controller model accelerator pedal position is given to the microcontroller unit and then it is fed to the Electronic Control Unit. If the automobile is in the active mode, microcontroller transfers the manipulated pedal position to the ECU that will not increase the automobile speed greater than the maximum speed specified in the data packet.

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B. Hardware scheme in normal Automobiles

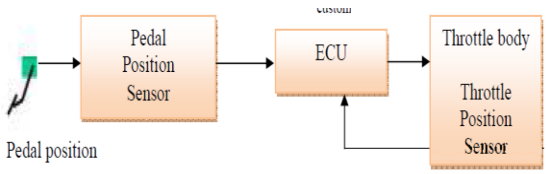


Figure 3: Block Diagram of Hardware scheme in normal Automobiles

C. HARDWARE SCHEME OF AUTOMOBILE IN OUR PROPOSED DESIGN

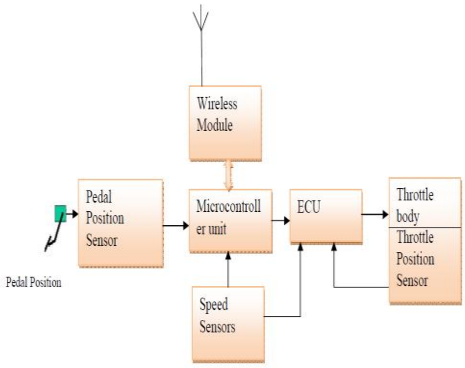


Figure 4: Block Diagram of Hardware scheme of automobile in our proposed design

D. WIRELESS MODULE

A wireless module that is compatible with the microcontroller is embedded on the automobile. This module acts as a receiver. Similar wireless module is also interfaced with the Microcontroller which acts as the transmitter is shown in figure 5.

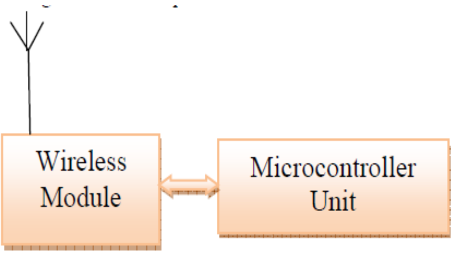


Figure 5: Hardware scheme of transmitter on remote place

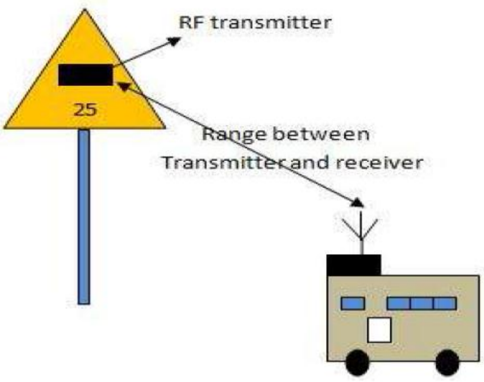


Figure 6: Control of vehicle

The transmitter is to be fixed to the top of the pole at the locations where speed of the automobile needs to be controlled as shown in figure 6.

The job of the transmitter is to transmit the frames that specify the maximum speed and the time for which the speed limitation must be implemented. Whenever the vehicle passes nearby transmitter, receiver in the automobile detects the frame and gets ready to receive the frame. After completion of receiving the frame it generates interrupt to microcontroller. Then the microcontroller process the frame received from the wireless module and then enters in to the active mode.

III. IMPLEMENTATION

1. LINE FOLLOWER ROBOT BASED ON ATMEGA16A MICROCONTROLLER.
2. WIRELESS REMOTE TO INCREASE OR DECREASE THE SPEED.
3. SPEED ZONE 1 WITH IR SENSOR BASED ON ATMEGA 16A MICROCONTROLLER.
4. SPEED ZONE 2 WITH IR SENSOR BASED ON LPC2138 MICROCONTROLLER.

A. LINE FOLLOWER ROBOT BASED ON ATMEGA16A MICROCONTROLLER.

CIRCUIT DIAGRAM OF ROBOT

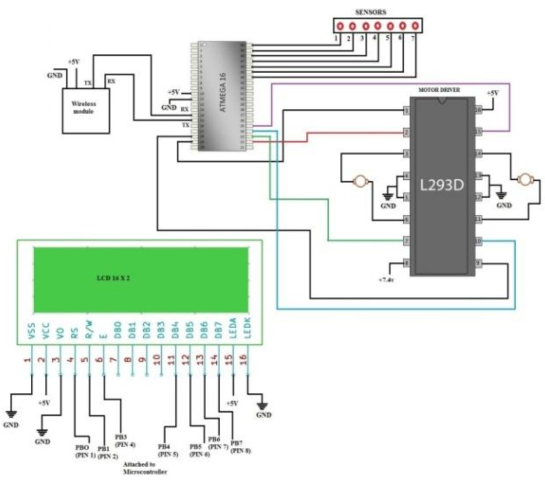


Figure7: Circuit diagram of Robot

This is the circuit diagram for developing the robot with 2 DC motors interfaced with microcontroller we use L293D. L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, DC.

All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo- Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active in phase with their inputs.

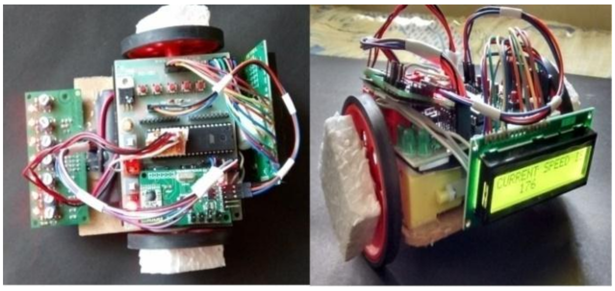
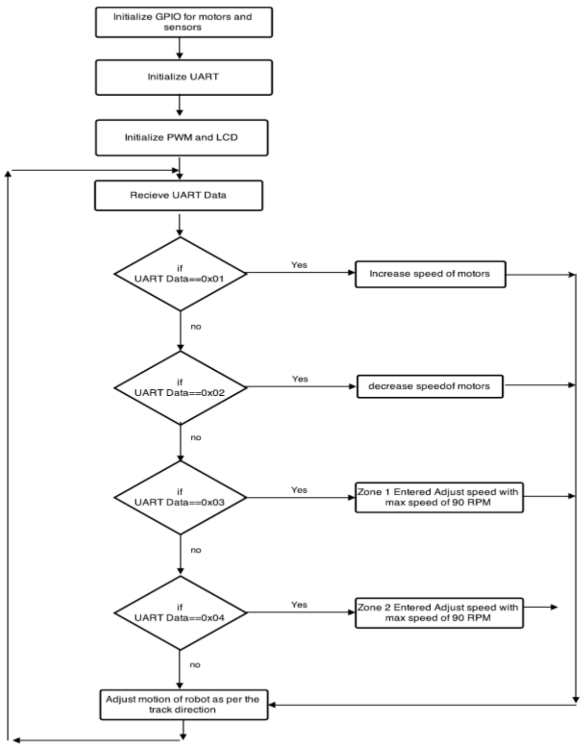


Figure 8: Robot model developed

When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state.
In which the robot is interfaced with the line following sensors. This is an infrared based sensor array which can be used in advanced line following and grid navigation robots. The array has 7 individual sensors placed next to each other. Each sensor has its own digital output and can sense the presence of a line and indicate it with a 5V logic output. On reading the digital state of the seven sensors, the user can not only detect the line but also get to know how far the center of the robot is from the line. When all sensors sense the line, the robot is on an intersection.

Flow Process



Indeed robot is connected to the LCD to display the current speed of the robot and to display the zone and we can see the speed is reduced while entering into the zone.
Then the microcontroller is interfaced with the wireless module which is the RF 2.4GHz serial link module. It is ideal for connecting to all electronic products that require medium range full-duplex, high-speed and reliable communication. RF 2.4HGhz Serial Link module is an embedded solutions providing wireless end-point connectivity to devices. These modules use a simple proprietary networking protocol for fast point-to-multipoint or peer-to-peer networking.

They are designed for high-throughput applications requiring low latency and predictable communication timing. It should be connected to any TTL/CMOS logic serial RXD and TXD lines and can support baud-rate of 9600bps, 19200bps, 38400bps and 57600bps. It also supports 4 unique RF channel selections to reduce congestions on the same channel during peer-to-peer communication.

Then the robot is demonstrated by following the black line by sensing the line sensor intender. The robot speed is increased or decreased by the remote control. As we are making line follower type robot just because automatically without remote my robot can run on specified path.

B. WIRELESS REMOTE TO INCREASE OR DECREASE THE SPEED.

Circuit Diagram

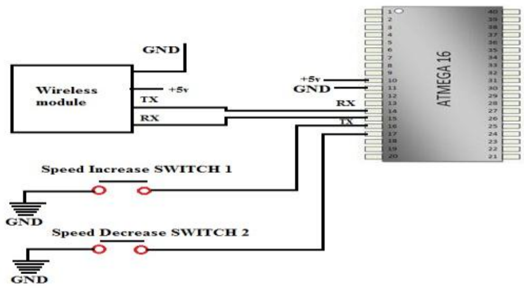


Figure 9: Circuit Diagram of Wireless Remote control

This is the circuit diagram for developing the wireless remote control which helps to increase or decrease the speed of the robot

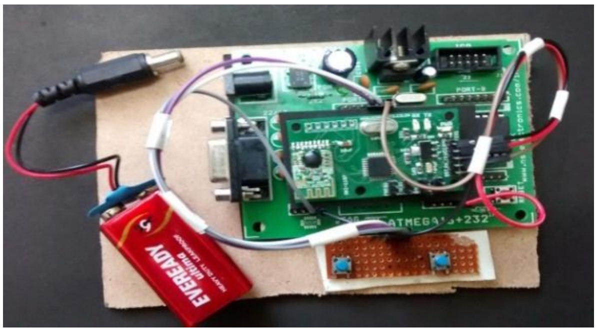


Figure 10: Wireless remote control developed

First we have to initialize the UART so that the microcontroller should interface with the robot to control the speed of robot. If we pressed the switch 1 then robot speed is increased and if we pressed the switch 2 then the speed of the robot is decreased. When we give power supply then both the RX & TX should not light glow as there is no receiving of signals.

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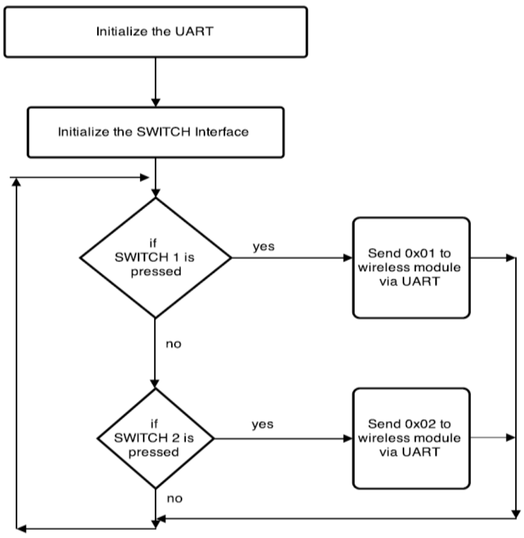
Vol. 2, Issue 8, August 2015

Flow process



C. SPEED ZONE 1 WITH IR SENSOR BASED ON ATMEGA16A MICROCONTROLLER.

Circuit Diagram

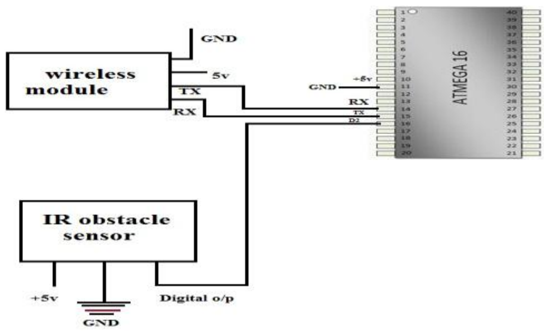


Figure 11: circuit diagram of sensor node based on ATMEGA16A Microcontroller

This the circuit diagram for developing the SPEED ZONE 1 with IR sensor based on ATMEGA16A microcontroller which the sensors are applied to detect the obstacle or to make the RFID so that to control the speed of the vehicle and if the speed of the robot is maximum then 90 rpm then the speed is automatically reduced by interfacing with the IR sensor or by RFID technology. If the speed is less than 90 rpm then it is stable to move from that zone.

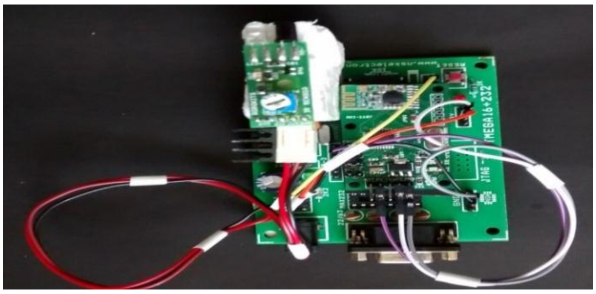
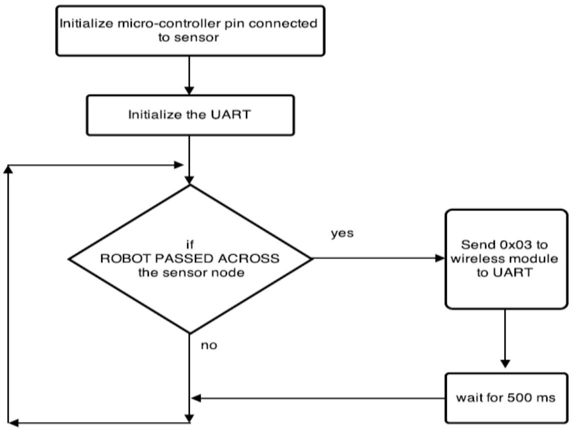


Figure 12: Sensor node based on ATMEGA16A

Flow process



D. SPEED ZONE 2 WITH IR SENSOR BASED ON LPC2138 MICROCONTROLLER.

Circuit Diagram

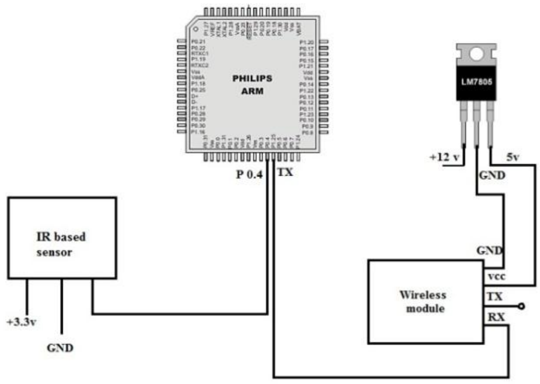


Figure 13: Circuit diagram of sensor node based on LPC2138 Microcontroller

This the circuit diagram for developing the SPEED ZONE 2 with IR sensor based on LPC2138 microcontroller which the sensors are applied to detect the obstacle or to make the RFID so that to control the speed of the vehicle and if the speed of the robot is maximum then 90 rpm then the speed is automatically reduced by interfacing with the IR sensor or by RFID technology. If the speed is less than 90 rpm then it is stable to move from that zone. Here in ZONE 2 it has long distance setup to cover the vehicle speed control so has to distinguish that the interface of ZONE 1 & ZONE 2. Here we can clearly see that up to how much range we can control the speed of control.

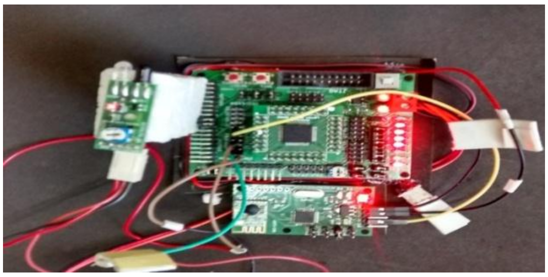


Figure14: Sensor node based on LPC2138 Microcontroller

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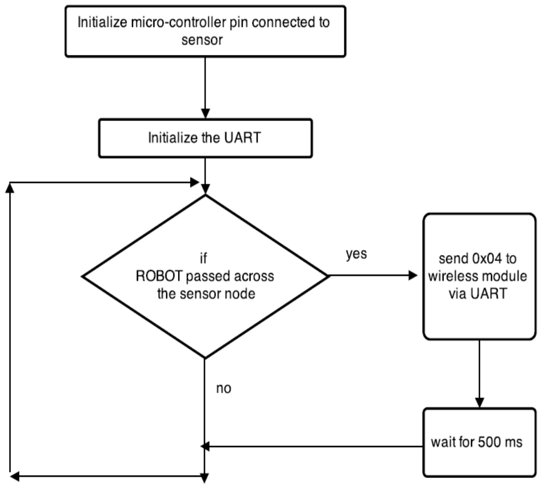
Vol. 2, Issue 8, August 2015

Flow Process



IV. RESULT AND DISCUSSION

To have a theoretical study on our design, we consider an atmel's microcontroller with an operating frequency range of 16MHZ and wireless module. It is a 2.45GHZ radio transceiver. It can operate in the temperature range of -40 degree centigrade to 85 degree centigrade. At86rf230 in the transmitter section will be either in the transmission state or sleep state and the at86rf230 in receiver section will be in the receiving state.

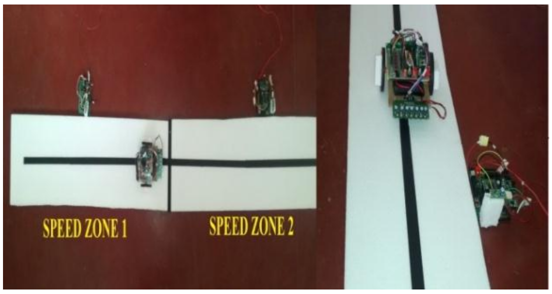


Figure 15: Schematic view of ZONE and Robot is passing over ZONES

Let the automobile equipped with our architecture is moving maximum speed at ZONE 1 is about 176rpm and the minim speed is about 35 rpm and the IR sensor are kept at 35cm aw Let the receiver can detect the frame at 35cm away from transmitter. From the above considerations, the automobile v be in the range of transmitter for minimum time period of milliseconds. This can be deduced from the formula

Distance = speed * time

Figure 15 shows speed v/s distance for which the automobile will be in the range of transmitter at different speeds. So that in ZONE 1 the maximum limit of speed is 90 rpm if the robot is moving maximum of 90 rpm then the sensor will interface and then the speed will be reduced. We have taken a reading of speed rate of robot for every 5cm so that when it enters to ZONE 1 that is the range of about 90 cm and we placed sensor at 35 cm away and started testing as we can clearly observe that it will reduces the speed of robot and then after finishing the ZONE 1 we can accelerate the robot speed and in between the zone if we accelerate then also the speed is not increased but we can slow down the robot

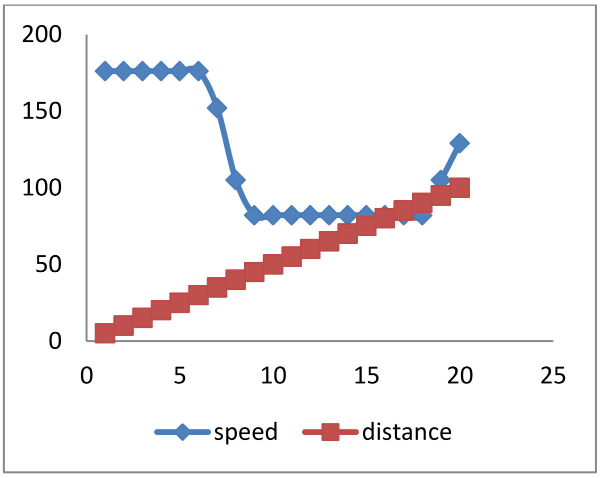


Figure 16: speed v/s distance graph in ZONE 1

Figure 16 shows speed v/s distance for which the automobile will be in the range of transmitter at different speeds. So that in ZONE 2 the maximum limit of speed is 90 rpm if the robot is moving maximum of 90 rpm then the sensor will interface and then the speed will be reduced. We have taken a reading of speed rate of robot for every 10cm so that when it enters to ZONE 1 that is the range of about 195 cm and we placed sensor at 65 cm away and started testing as we can clearly observe that it will reduces the speed of robot and then after finishing the ZONE 2 we can accelerate the robot speed and in between the zone if we accelerate then also the speed is not increased but we can slow down the robot. Here it has maximum signal strength so that it can cover large area to control the speed

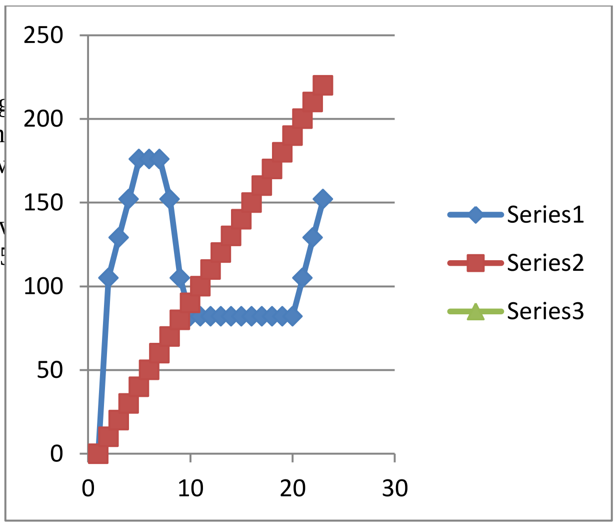


Figure 17: speed v/s distance graph in ZONE 2

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V. CONCLUSION

It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Thus the data to be sent is encoded within the transmitted signal so that a well designed receiver can separate the data from the signal upon reception of this signal. The decoded data can then be used to perform specified tasks.

Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

A low-cost and simple system to ensure the safety of passengers and pedestrians. It certainly provides a hope for bringing down the alarming rate of road accidents. The proposed system is capable of simply displaying the traffic signals in an LCD screen inside the vehicle. In future, provisions may be included to cut out the fuel supply to the engine to provide a smooth deceleration if the speed of the vehicle exceeds a threshold value.
This is a very useful technique to control the vehicle speed automatically.

- By using Microcontroller , we Controlled the speed of the vehicle according to zones
- It is mainly useful in the areas where high rate of accidents are recorded.
- As in city traffic control to conserve the fuel and implement the traffic rules.

It presents architecture for automatic adaptation of the longitudinal speed control of a vehicle to the circumstances of the road which can help to decrease one of the major causes of fatalities: the excessive or inadequate vehicle speed. Our approach is based on a combination of three different sensor technologies:
RFID tagging of traffic signals to convey their information to the car,. Sensor fusion is applied to the information received by these subsystems, and used to adjust the longitudinal speed of the vehicle with a fuzzy controller. The proposed on-board architecture is portable and easily adaptable to any commercial car with minimal modifications. The system shows promising results, since active RFID technology permits to detect the presence and identity of the traffic signals reliably and sufficiently in advance, so corrective actions on the vehicle's behaviour can be taken. In the empirical trials in our installations, the vehicle's speed was successfully changed as a result of the detection of the signals, increasing the driver's safety. The technology developed can assist human drivers in difficult road circumstances, as well as a complement ISA or CWS systems if the car is already equipped with them. In our experiments, only the test vehicle was present on the road. In normal driving situations, we can expect other vehicles circulating nearby and possibly blocking or attenuating some of the RFID transmitting signals, especially with large vehicles like trucks. In this aspect, more experimentation is needed to know how this circumstance will affect the vehicle's control performance. A possible solution is the use of redundant RFID tags (since their cost relatively low), placed at different locations near the traffic signal, to guarantee RF signal reception in unfavourable conditions. The results suggest that an automatic intelligent speed control system can be used to prevent any unexpected traffic circumstance and improve the safety of the occupants of the vehicle.

ACKNOWLEDGMENT

I express my sincere thanks to **Dr K.Chandrashekara**, Professor, Department of Mechanical Engineering, SJCE, Mysuru for his constant and valuable guidance in completing this project.

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