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Advanced System for Driving Assistance in Multi-Zones using RF and GSM Technology

Niranjan L
Assistant Professor
ECE Dept. RRIT College
Bangalore-90

Sreekanth B
Assistant Professor
ECE Dept. RRIT College
Bangalore-90

Suhas A R
Assistant Professor
ECE Dept. RRIT, College
Bangalore-90

Mohan Kumar B N
Assistant Professor
ECE Dept. RRIT, College
Bangalore-90

***Abstract* - This paper explores the possibility of providing traffic control signals through radio frequency (RF) transmission or by other means of wireless data communication and thereby reduce road accidents. Additional advantages can be reducing the car speed or stopping car at speed breakers, no entry zones or police barricade. This system if adopted by some state can effectively reduce the number of road accidents caused by speeding vehicles losing control of the vehicle at speed breakers or by driver's negligence towards traffic signals [1]. The primary model of this system consists of a microcontroller controlled RF transceiver module, electronic controller unit (ECU) used in vehicles. In the system proposed the traffic sign boards including control signals are replaced with RF transmitters transmitting the specified coded data (about the traffic signal) for the traffic control receiver unit integrated in the in the car where the receiver unit is connected to the ECU and to display unit on the dashboard of the car which on coming in vicinity of the particular traffic signal. For some specific signals, like the speed breaker, police barricade. In these zones if the response of the driver within specified time duration is not achieved such as to reduce speed or stop down, then the controller unit takes control of car transmission and performs the specified operation. In this paper a novel approach is described to embed a hardware system into a vehicle, for a transmission range of 50mts to control the vehicle in the various zones. The experimentation provides complete the hardware description and working model for dynamic driving assistance.**

Index Terms-- wireless, speed control, accident prevention, hamming code, repetition code

I. INTRODUCTION

The advancement in the processor technology and micro-controllers has opened up a whole lot of application areas of these controllers. This project is about a new system designed to prevent the accidents caused due to negligence of drivers in seeing traffic signals alongside the road [1] and the bumpy speed breakers on the roads. It is based on providing signal through radio frequency (RF) with an additional advantage of controlling speed of car. According to a survey most of the deaths happen due to drunken drivers loosing balance at speed breakers and negligence of traffic signboards are most prominent.

II. DESCRIPTION

This project consists of two separate modules, a transmitter and a receiver. The transmitter module is attached to a traffic sign board which transmits the data continuously. In Fig. 1 the transmitter keeps on sending the data continuously with or without a minimal time delay in a coded form, the range of transmitter used should be around 50 meters [2]. Although it must be adjustable for heavily crowded areas or having multiple transmitters situated in the close proximity. The transmitters used should be arranged in such an order that two of them do not interfere with each other i.e. at a particular point one should not receive data from two separate transmitters simultaneously. The code for encoding data used here is hamming code as well as repetition code [3]. The coding is used instead of direct serial transmission for the reason that there might be kinds of noises in the environment affecting the transmitted signal and these codes are encoded in such a way that they could be decoded unambiguously even after getting affected by noise. In Fig. 2 the receiver module is attached to the car's electronic control unit (ECU) which controls the fuel injection, car speed etc. The receiver on coming in the range of transmitter starts receiving data from the transmitter. This data is first processed and decoded to actual message value. This decoded data is then displayed on display screen attached on the dashboard of the car thus getting immediate attention of the driver who might have missed the traffic signal [4]. A buzzer is attached to the dashboard which starts to give an alert beep whenever a signal is received and it needs to be turned off by the user. If the driver does not respond in the required manner, the controller unit takes control of car transmission and performs the specified operation .The receiver module keeps track of the speed of the car through a data input from the digital speedometer of the car in case the driver approaches a speed breaker it starts getting signal of speed breaker on the display unit on the dashboard and is required to reduces its speed to a certain predefined speed limit.

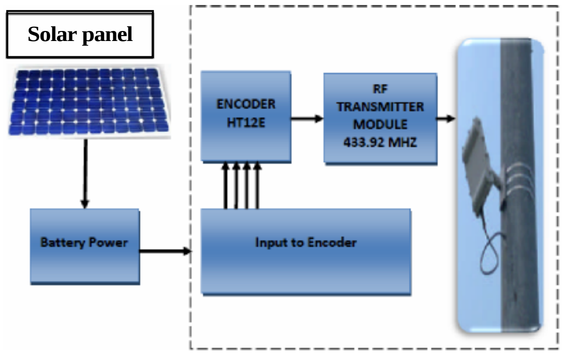

Fig. 1. Transmitter section at road side

The 4-bit encoded value is transmitted as via the RF transmitter module. The information for every signs is unique and is transmitted. The power supply unit has both solar power and batter backup.

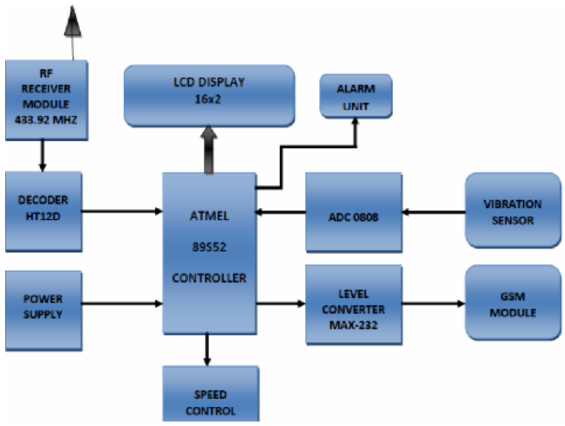

Fig. 2. Receiver section in vehicle

The Receiver information is decoded and the 4-bit value is composed in the microcontroller. Depend on the 4-bit combination the particular zone is detected and is displayed. If the vehicle is not slowing down, it is automatically controlled by the ECU.

III. BASIC CONCEPT & THE IMPLEMENTATION OF THE SYSTEM

The concept is implemented using the radio transceiver module [4]. Emphasis being given to presentation of idea. The implementation is based around the well known microcontroller originally designed by Intel but the chips that we are using were manufactured by the Atmel corp. Although any other microcontroller could be used without any major change. The only direct impact will be only in the software or the assembly code written for the particular microcontroller. The project uses the simple transmitter section designed using the USART [5] method and the TxD pin of the microcontroller was directly interfaced to the radio transmitter. Similarly for the receiver section the receiver pin of the microcontroller was directly attached to the RxD pin of the microcontroller. For the illustrative purpose the receiver was interfaced with the experimental liquid crystal display (LCD) maintaining the simplicity. Of course the implementation can be very easily extended with little modifications and simple interface with the ECU of the vehicle [5]. This deals directly with the electronic controls generated by it. In our first implementation we transmitted four messages. These messages are continuously transmitted by the transmitters. On receiving end these messages are sensed and then displayed on the display unit attached in the dashboard. According to the practical implementation and experimentation the repetition codes showed better performance than the hamming codes [6]. The benefit of using the hamming code is that the code rate increases to 4/8. But in our application as receiver is not assumed to be a high performance data receiving system a lower code rate but with increased security is much more important [7]. Although this depends entirely on the quality of the transmitter and receivers used in the system.

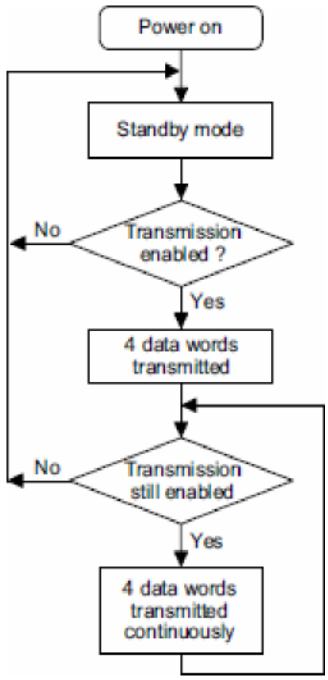

Fig .3. Encoding Flow diagram

The 212 encoders are a series of CMOS LSIs for remote control system applications. They are capable of encoding information which consists of N address bits and 12_N data bits. Each address/ data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF transmission medium upon receipt of a trigger signal. The capability to select a TE trigger on the HT12E or a DATA trigger on the HT12A further enhances the application flexibility of the 212 series of encoders.

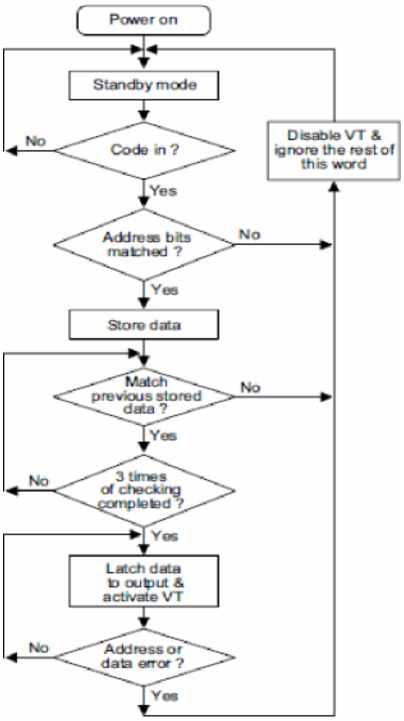

Fig. 4. Decoding Flow diagram

The decoders receive serial addresses and data from a programmed 212 series of encoders that are transmitted by a carrier using an RF transmission medium. From Fig. 4 we compare the serial input data three times continuously with their local addresses [8]. If no error or unmatched codes are found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission [9]. The 212 series of decoders are capable of decoding information's that consist of N bits of address and 12_N bits of data of this series, the HT12D is arranged to provide 8 address bits and 4 data bits, and HT12F is used to decode 12 bits of address information.

IV. EXPECTED RESULTS

A. Normal Situation

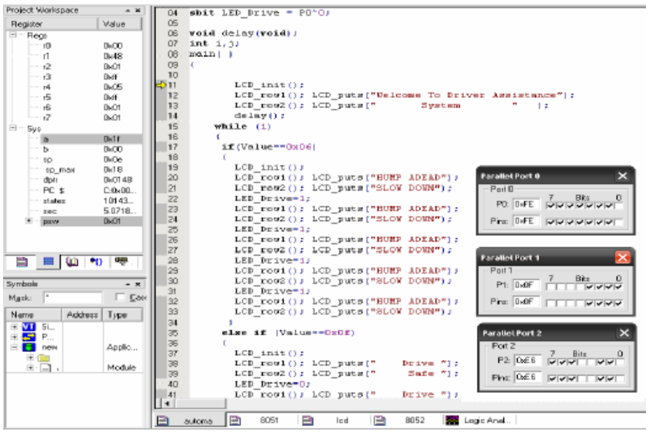

Fig. 5. Simulation of Normal Situation

In the Normal scenario the output of each port is described in Fig. 5 and Fig. 6, the port 0 which specifies the triggering of the alarm and activating the ECU for the speed control. Here a relay is connected to change over the speed of the motor of the toy car. In this scenario the relay directly connected to the motor which runs in high speed, which specifies that no zone is in its vicinity [10]. The P0 is used to control the speed of the vehicle through the relay, P1 works as an input port, for getting data from RF from different Zones. P2 is used for the displaying the information of Zones and for the alarm.

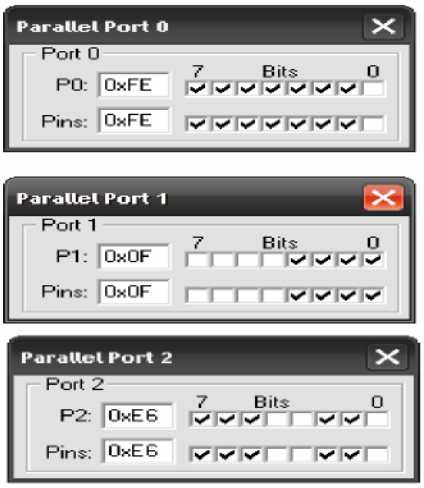

Fig . 6. Simulation Result without zone consideration

B. Real time Situation

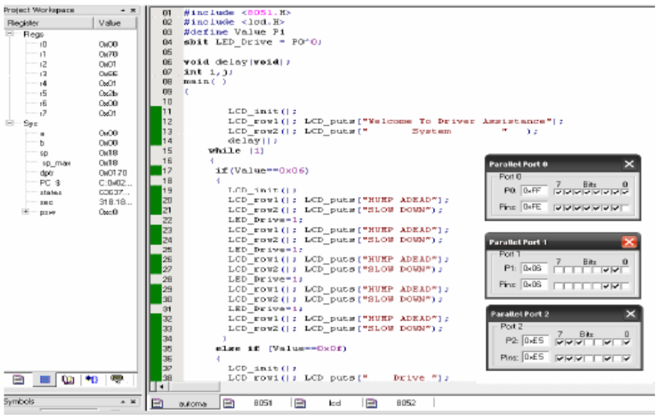

Fig. 7. Simulation of Real-time Situation

In the Real-Time scenario the output of each port is described in Fig. 7 and Fig. 8, the port 0 which specifies the triggering of the alarm and activating the ECU for the speed control. Here a relay is connected to change over the speed of the motor of the toy car. In this scenario the relay connected via a series of resistors which runs the motor in low speed for particular zones. For each zone the speed limit is different [11]. Different values of resistors for different Zones.

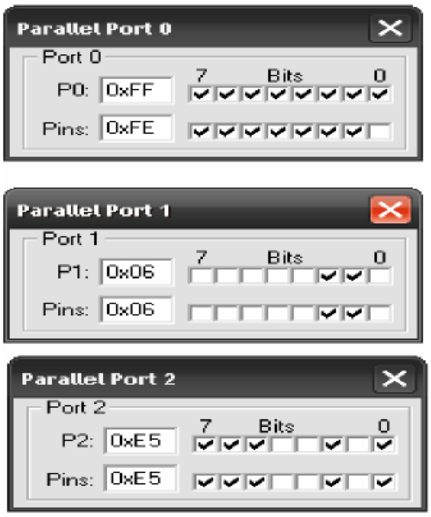

Fig. 8. Simulation Result for Zone tracking

As we can see here the port 0 is activated at the pin P0.0 where the relay is activated and the connection is through the resistor depend on the zone which is near its vicinity. The port 1 is the value from the particular zone i.e. Hump in our project, which is of 0x06h and the corresponding output on the display is via port 2 which displays Hump ahead slow down.

C. AT Commands to GSM

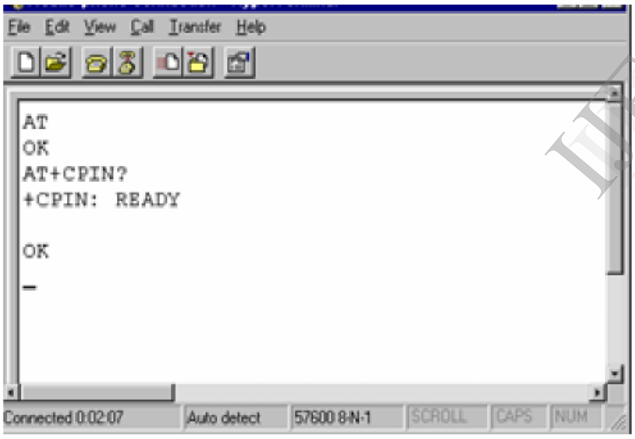

Fig. 9. Response from the GSM modem

The GSM modem is used to send the SMS to the nearest hospital and to nearest Police station when there is an accident of the vehicle, the predefined message which is stored in the SIM is invoked and sent [12]. The collision is detected by the vibration sensor which is calibrated to detect the collision of the vehicle [13]. This information is sent to the microcontroller there by invoking the commands for the GSM modem to send the SMS.

Fig. 10. Connectivity of GSM modem

GSM modem is connected via a serial cable, i.e. RS-232 where the information is send as the commands [14] followed by the AT, via the Tx pin of the microcontroller and to the Rx pin of the GSM from GSM it's from the Tx pin to the RX pin of the microcontroller.

V. REAL-TIME SETUP

1. Microcontroller 89S52
2. Encoder HT12E (4-bit)
3. Decoder HT12D (4-bit)
4. RF Receiver Module (433.92Mhz)
5. RF Transmitter Module (43 3.92Mhz)
6. Number of Antennas (2no's),17cms long, which is wound to get a circular antenna)
7. Power supply used is 5vts.
8. Solar plate at the zones with the charger and the backup battery.
9. GSM module.

VI. ZONE CODES

TABLE I

Zone Codes

Code	Zone Name	Symbols
0001	Hump	
0010	Slippery Road	
0011	Railway Crossing	
0100	School Zone	

Each zone is unique as specified in the Table I, as per the code the receiver displays information.

VII. EXPERIMENTAL RESULTS

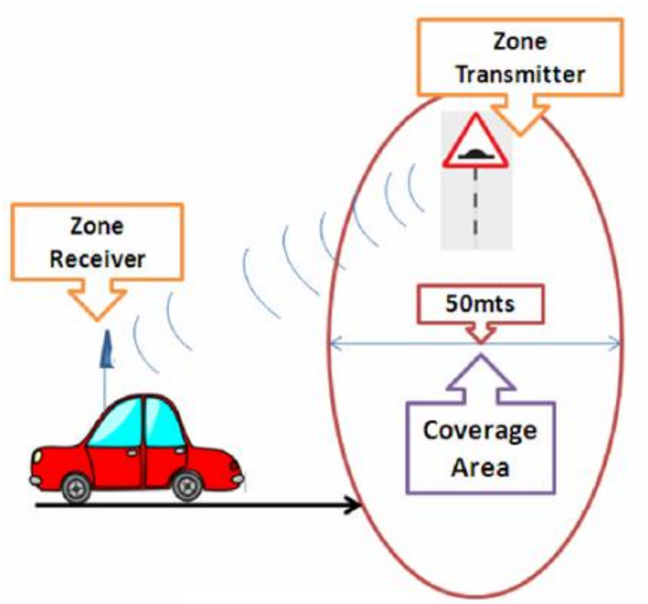

TABLE II
SIMULATION VS REAL-TIME

Task	Simulation Results	Result In Real-Time	Difference
Display	1.9S	2.6S	0.7S
Buzzer	2.4S	3.46S	1.06S
Relay	5.4S	6.86S	1.46S
Vibration Sensor	0.72S	1.12S	0.4S

TABLE III
RF MODULE IN REAL-TIME

Operating Frequency	Antenna Length	Sensitivity
433.92Mhz	17Cms	103dbm
Operating Voltage	Operating Current	Coverage Area
4.5-5.5	3.5mA	50Mts

From the Table II, the simulation and the real time values are compared, and the corresponding difference is note downed.. The Table III gives the brief information about the RF module used and the range it works.

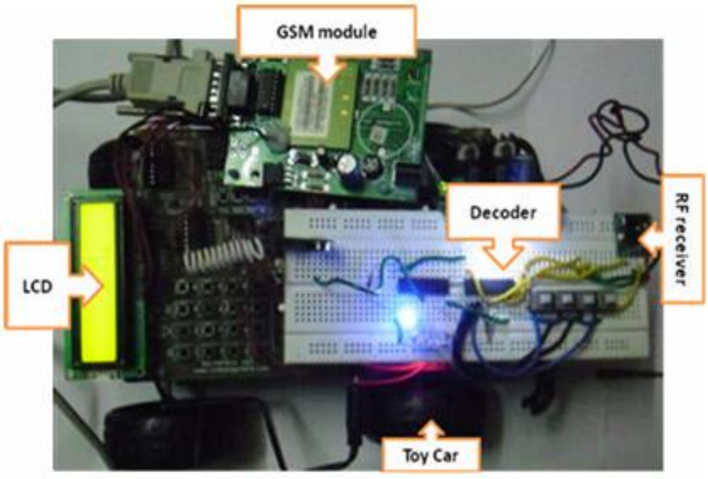

Fig. 11. Toy car with the relevant modules

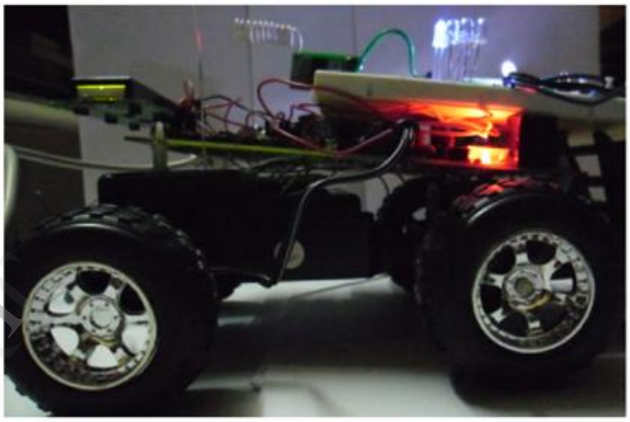

Fig. 12. Complete view of the proposed system

IX. CONCLUSION

This paper describes our proposed system for car accident Prevention. The main functionality is based on emergency Wireless signal messaging providing critical information about forthcoming Zones. The different zones trigger the modules present in the car dashboard, there by covering a wide range of situations. In addition, as it is described in the experimental section, the maximum covering range provides sufficient time to drivers in order to act and avoid accidents. This low cost and low power consumption system can be easily installed and integrated to any vehicle, old or new, as it operates independently of the rest vehicle's electronic systems. Belonging to the active safety systems, in case of false alarm, which cannot be eliminated in wireless communications, the proposed system does not take further actions, like emergency braking systems, but triggers driver's attention and relies on driver's reactions. Furthermore, the proposed architecture enhances the vehicle with information about the nearby environment. Thus, already developed vehicle technologies can be advantaged by this extra information in order to provide more accurate results. By using the data output interface, based on standard communication, the integration with other electronic systems can be easily facilitated. Moreover, the system can take advantage of the vehicle's screen (if it is equipped with) presenting information about the zones. Considering our system as a more universal emergency messaging device, it can accompany traffic signs in case of bad road conditions, traffic jams, road works in progress etc. On the other hand, the main disadvantage of the system is that it cannot operate as a standalone system like most of the active safety systems based on cameras, image processing and use of radars. Although global installation is not obligated for the functionality of the proposed architecture, the effectiveness of our system relies on the mass acceptance of it. Our further steps include more experiments that should take place so as to cover as more as possible different environment conditions. Finally, the data output interface should be in compliance with the well-established CAN BUS which is dedicated to the vehicle systems communication.

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Niranjan L completed his diploma in Electronics and Communication Engineering from Private Polytechnic, Vidya Vikas Education Trust, Bangalore in 2005 and subsequently received Bachelor Degree in Telecommunication from M.V.J College of Engineering, Bangalore under V.T.U in 2008. He has obtained a Master Degree in Digital Electronics and Communication from A.M.C College of Engineering, Bangalore under V.T.U in 2011. He is currently working as Assistant Professor in Department of Electronics and Communication, R.R Institute of Technology, Bangalore, India. He has published many journals and attended many Conferences in National and International Level. His research areas are Embedded Systems, Robotics and Ad-Hoc Networks.

Sreekanth. B completed his bachelor of engineering in East West Institute of Technology under VTU in 2009. He has obtained a master degree in Digital Electronics and Communication from AMC College of Engineering under VTU in 2011. He is currently working as Assistant professor in Department of Electronics and communication, at RR Institute of Technology, Bangalore, India. He has published many journals and attended many conferences in National and International level. His research areas are Embedded system and communication.

Suhas A.R completed his bachelor of engineering in Shridevi Institute of Engineering and technology under VTU in 2009. He has obtained a master degree in Digital Electronics and Communication from MVJ collage of Engineering under VTU in 2011. He is currently working as Assistant professor in Department of electronics and communication, at RR Institute of Technology, Bangalore, India. He has published many journals and attended many conferences in National and International level. His research areas are Signal processing, a
nd communication.

Mohan Kumar BN completed his bachelor of engineering in Bangalore institute of technology under VTU in 2009. He has obtained a master degree in VLSI and Embedded system from Bangalore institute of technology under VTU in 2012. He is currently working as Assistant professor in Department of electronics and communication, at RR Institute of Technology, Bangalore, India. He has published many journals and attended many conferences in National and International level. His research areas are VLSI Design and Embedded system.