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Car Convoy Communicator: Active Control Noise Reduction in Vanet Using Wireless Sensors

[1]Sonal Umare, [2]Gaurav Mahule, [3]Prateek Chandra, [4]Rajesh Kr. Jaiswal, [5]Manish P. Tembhurkar
[1, 2, 3, 4] UG Student Dept. of CSE, GHRCE, Nagpur, Maharashtra, India
[5]Assistant Professor, Dept. Of CSE, GHRCE, Nagpur, Maharashtra, India

Abstract- The issue of noise pollution is very paramount in India, especially cites with huge traffic. One of the major reasons for noise pollution is increasing vehicular honking. Therefore we intend to aid in vehicular honking by bringing in a hardware that involves an individual vehicle to communicate with the other vehicle and blow the horn for the vehicle in front but the horn's sound will be heard only by the person inside the vehicle. The implementation of directing the horn is achieved through sensors mounted on the vehicles. The vehicles will communicate using Vehicular AdHoc Network (VANET). The use of microcontroller, LCD Display, keypad, sensors and some other electronic devices coupled together will help in accomplishment of our project. Here, we are using transmitters and receivers to form network. Each transmitter and receiver has its own power, range and angle for transmitting and receiving signals. The transmitter will send a signal to the receiver, if the signal is received by the receiver then an acknowledgement is sent to the transmitter, which is indicated by the blinking of a light. On the receiver side, sound is generated by the speaker. If acknowledgement is not received then secondary horn is blown for the concerned person. LCD Display is used for communication between the two vehicles with a standard set of options defined.

Keywords- ATmega32, Sensors, Transceiver, Vehicular AdHoc Network, Zigbee,

I. INTRODUCTION

A. VANET

Vehicular Ad Hoc Networks [1], VANET is a kind of special wireless ad hoc network. It has the characteristics of high node mobility and fast topology changes. The VANET can offer wide variety of services, ranging from safety-related warning systems to improved navigation mechanisms in addition to information and entertainment applications.

VANET is groundwork of the envisioned Intelligent Transportation Systems (ITS). Vehicular networks will contribute to safer and more efficient roads by providing timely information to drivers and concerned authorities, by enabling vehicles to communicate with each other via Inter-Vehicle Communication (IVC) as well as with roadside base stations via Roadside-to-Vehicle Communication (RVC).

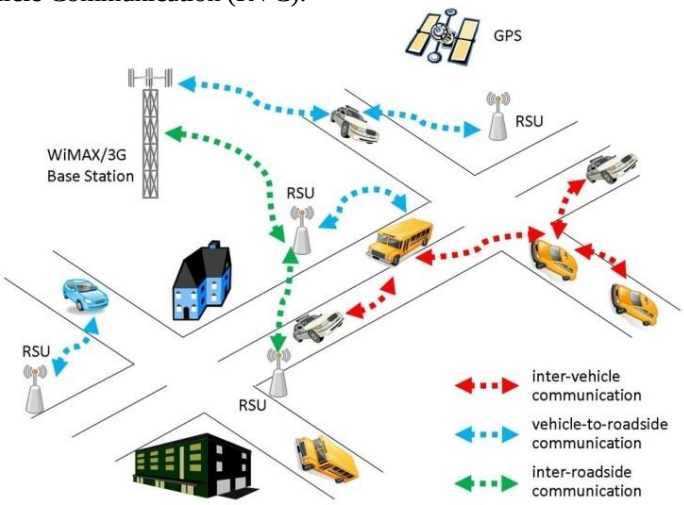

Figure 1. A typical VANET scenario [1]

A vehicular ad hoc network (VANET) uses cars as nodes to form a network. A VANET creates a network by turning every participating car into a wireless router or a node. It allows cars within the range of 100 to 300 meters of each other to connect.

One of the major reasons for noise pollution is increasing vehicular honking. With increasing traffic noise produced by horns increases exasperation to those for whom the horn is not meant. We usually horn towards the vehicle that is in front of our vehicle but everyone is able to hear the sound despite of the fact that the horn is not intended for them.

Keeping in mind the increasing honking we are working on a project that deals with the reduction of noise pollution caused by vehicles due to horns. The proposed idea to deal with this is to direct the horn for the particular vehicle for which it is intended i.e. sound is heard inside the vehicle. The implementation of directing the horn is achieved through sensors mounted on the vehicles. The vehicles will communicate through VANET.

Here, what we are doing is that, we are using transmitters and receivers to form network. Using embedded c language for Microcontroller, we are giving the instruction to the transmitters and receivers. Each transmitter and receiver has its own power, range and angle for transmitting and receiving signals. The transmitter sends a signal to the receiver, if the signal is received by the receiver then an acknowledgement is sent to the transmitter, which is indicated by the blinking of a light. On the receiver side, sound is generated by the speaker. If acknowledgement is not received then secondary horn is blown for the concerned person.

B. Aim

The aim of the project is to reduce noise produced by horns in VANET using wireless sensors mounted on each vehicle.

C. Objective

- To detect neighbour vehicle by using wireless sensor.
- To establish connection between two vehicles using transceiver.
- The buzzer inside the vehicle is able to create the alert sound as soon as it get the request of honking from neighbour vehicle.
- To provide the vehicle status information to the driven by using LCD (Liquid Crystal Display).
- To use display placed inside which can be used for further communication.

D. Limitations of existing system

In India needless vehicular honking is the main reason for noise pollution. The problem is most terrible at traffic signals where drivers start honking without waiting for the signal to turn green or for traffic to move. Drivers hardly follow the law that prohibits the use of horn at traffic signals and other silent zones such as areas near hospitals, schools, religious places and residential areas. In cities vehicular honking has reached at an alarming level and contributes approximately 70% of the noise pollution in our environment.

Most of the drivers blow horns perhaps due to lack of awareness regarding the negative effects of noise but most likely it is because of the lack of civic sense. The unwanted sound can affect human health and behaviour such as causing annoyance, depression, hyper-tension, stress, hearing loss, memory loss and panic attacks. In a recent publication, the World Health Organization categorized noise pollution under the list of critical health hazards, said that high-decibel noise can increase the risk of cardiovascular diseases.

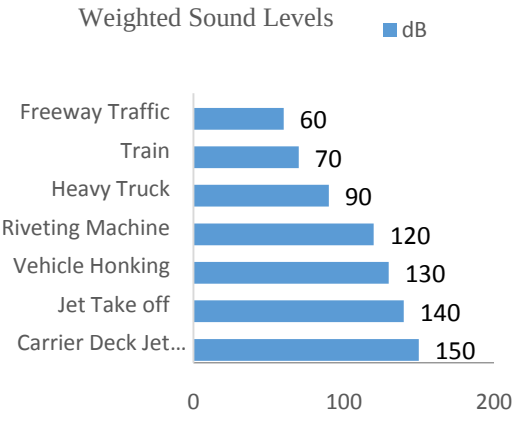

Figure 2. Weighted Sound Levels *[3]*

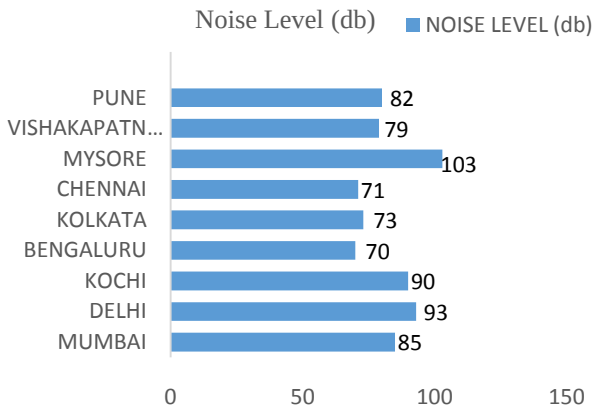

Figure 3. Noise Levels in major cities *[4]*

A few NGO's have initiated a crusade against honking due to the increasing noise pollution and its affects, to make people understand the actual purpose of the horn i.e. "emergencies". A noise study conducted by an NGO in Gurgaon some time back, recorded level of noise on some of the busy stretches of the city went well towards the 60-70dB group, when the acceptable range for the human ears is of around 40-50dB.

II. METHODOLOGY

A. Proposed System Architecture

In the project, we are using sensors to form network. Using Embedded C or Assembly Language in Microcontroller, we are giving the instruction to the transmitters and receivers. Each transmitter and receiver has its own power, range and angle for transmitting and receiving signals.

The transmitter sends a signal to the receiver, if the signal is received by the receiver then an acknowledgement is sent to the transmitter, which is indicated by the blinking of a light. On the receiver side, sound is generated by the buzzer. If

acknowledgement is not received then secondary horn is blown for the concerned person. An LCD screen is also used if the transmitting vehicle wants to communicate any further with the targeted vehicle.

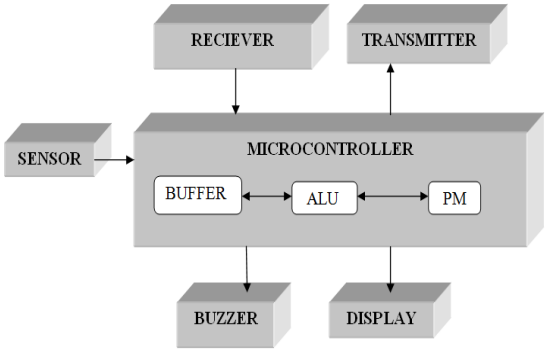

Figure 4. System architecture

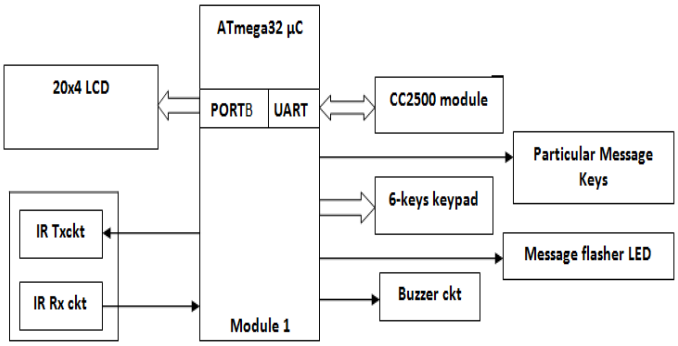

Figure 5. Convoy Communicator

1) Sensors: Wireless sensors are standard measurement tools equipped with transmitters to convert signals from process control instruments into a radio transmission. The receiver interprets the radio signal which then converts the wireless signal to a specific, desired output, such as an analog current or data analysis via computer software. In the proposed architecture, sensors are used to detect the targeted vehicles. As soon as the transmitting vehicle detects the targeted vehicle, it sends the signal through the transmitter.

2) Microcontroller: Microcontroller interconnects all the other subsystems and some additional peripheries within the architecture. Its main purpose is to execute instructions regarding sensing, communication and self-organization. After the sensor has detected the targeted vehicle, the signals are transmitted to the microcontroller for further processing. Programming for proper working of the module is burned into the microcontroller.

3) Transceiver: A transceiver is a device comprising both a transmitter and a receiver which are combined and share common circuitry or a single housing. The objective of the design is to bring digital domain closer to the antenna, both at the receiver and transmiter ends using software defined radio (SDR).

In the architecture, the transceiver is used for communication. After the microcontroller processes the signal from the sensor, it sends another signal to the transceiver, where the transmitter sends address to the targeted vehicle and waits till the receiver receives the address of the other vehicle.

4) Buzzer: As soon as the communication is established by both ends, buzzer produces sound inside the targeted vehicle.

5) LCD Display: LCD Display is used for any further communication between the vehicles apart from placing horns. This system enables the passengers of adjacent cars to communicate via text messages, the vehicles in the convoy will also be able to coordinate their movements properly. A six key keypad will be used to select options from the LCD for communication.

B. Tools And Techniques

1) Tools:

- *ATmega32 Microcontroller[17]:* ATmega32 is an 8-bit high performance microcontroller of Atmel's Mega AVR family. Atmega32 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Atmega32 can work on a maximum frequency of 16MHz. ATmega32 consists of 32 KB programmable flash memory, static RAM of 2 KB and EEPROM of 1 KB. Atmega32 has a total of 40 pins.
  Atmega32 can be programmed by In-System Programming via Serial peripheral interface or by Parallel programming. Programmer must make sure that SPI programming and JTAG are not disabled using fuse bits; if the programming is to be done using SPI or JTAG.

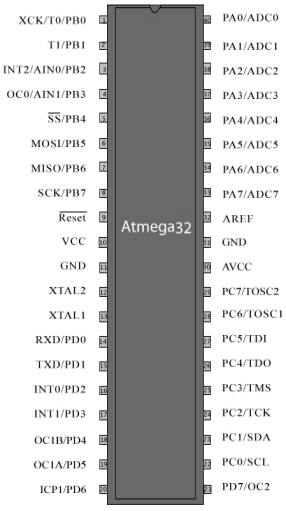

Figure 6. Pin Diagram of AVR ATmega32 Microcontroller [17]

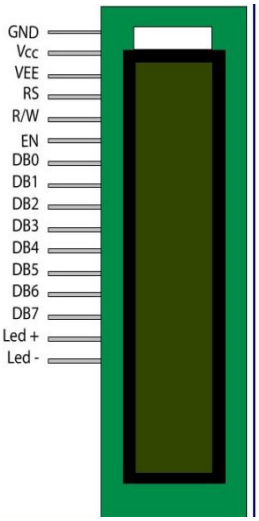

Figure 7. Pin Diagram of 20x4 LCD [18]

- *20x4 Text LCD[18]:* LCD (Liquid Crystal Display) screen is an electronic display module and finds a wide range of applications. A 20X4 LCD means it can display 20 characters per line and there are 4 such lines. In 20x4 LCD each character is displayed in 5x7 pixel matrix. It has two registers, specifically, Command and Data. The command instructions given to the LCD are stored in the command register. A command is an instruction given to the LCD to do certain predefined tasks like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data to be displayed on the LCD is stored in the data register. The data displayed on the LCD is the ASCII value of the character.
- *Buzzer:* A buzzer or beeper is an audio signalling device. It can be mechanical, electromechanical, or piezoelectric. Buzzers and beepers can be used in alarm devices, timers and confirmation of user input such as a mouse click or keystroke.
- *CC2500 Transceiver Module [10]:* The CC2500 is a low-cost 2.4 GHz transceiver deliberated for very low-power wireless applications. It is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The modem has a configurable data rate up to 500 kBaud. CC2500 provides wide-ranging hardware support for data buffering, burst transmissions, packet handling, clear channel assessment, link quality indication and wake-on-radio. The main operating parameters of CC2500 and the 64-byte transmit/receive FIFOs of this transceiver can be controlled by an SPI interface. In a classic system, the CC2500 is used with microcontroller and a few additional passive components.

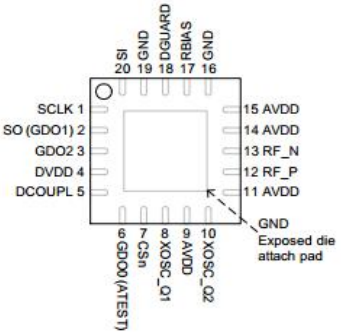

Figure 8. Pin Configuration of CC2500 IR Sensor [10]

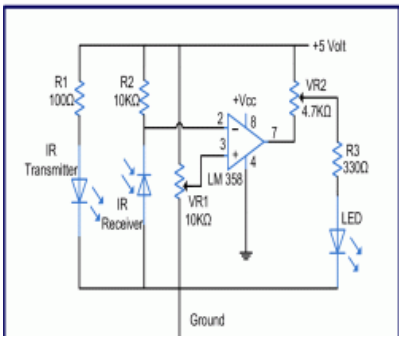

Figure 3.7 Circuit Diagram of an IR circuit [15]

- *IR Sensor[15]:* The transmitter part of the sensor is an Infrared (IR) Led which transmits continuous IR rays to the receiver that is received by an IR receiver. The receiver's output varies depending on its response to IR rays. Since this variation cannot be analyzed, therefore this output is fed to a comparator. In IR circuit operational amplifier (op-amp) of LM 339 is used as comparator.
  When the IR receiver does not receive signal the potential at the inverting input goes higher than the one at non-inverting input of the comparator (LM 339). Therefore the output of the comparator goes low and the LED does not glow .When the IR receiver receives signal the potential at the inverting input goes low. Thus LED starts glowing as the output of the comparator (LM 339) goes high.
- *USBASP:* It is a cheap and simple USB programmer used by Atmel AVR's. It mostly consists of an ATMega88 or ATMega8 microcontroller and a handful of passive components. It is used to transfer the compiled .hex file to the microcontroller.

2) Software tools:

The following softwares were used in the making of this project.

- *AVR Studio4 [21]***:** It is an IDE (Integrated Development Environment). Atmel (the producer of the microcontroller being used) offers AVR Studio for free. It has a built in editor, compiler, uploader, emulator, simulator, etc. all in one package. Thus, AVR Studio is used to write, simulate, debug and emulate the code.
- *WinAVR [21]:* WinAVR is an open source software development tool for the Atmel AVR series of RISC microprocessors hosted on the Windows platform. WinAVR includes the GNU GCC compiler for C and C++. It consists of all the tools for developing on the AVR. This includes avr-gcc (compiler), avrdude (programmer), avr-gdb (debugger), and more.
- *Extreme Burner:* It is a GUI (Graphical User Interface) for use with USBasp programmer.
- *Proteus Design Suite 8.1 [22]:* The Proteus schematic capture module is far more than just another schematics package. It has a powerful design environment with the ability to define many aspects of the drawing appearance. Proteus Capture is the tool for complex designs for simulation, PCB layout and the creation of attractive schematics for publication.
- *Express PCB [23]:* Express PCB circuit board layout program is spontaneous to learn and use. Designing PCB Layouts is easy, even for the first time user. If you link your schematic file to the PCB, then the *Express PCB* program highlights the pins that should be wired together in blue. Making changes is simple using standard commands for instance Cut, Copy and Paste. It helps by rearranging the parts by dragging them with the mouse. Traces stay connected to their pins, even they are moved around. By double clicking on the traces you can set the properties of items in your layout.

3) Techniques:

ZigBee [7] is a requirement for a suite of high-level communication protocols used to create personal area networks built from low-power, small digital radios. ZigBee is based on an IEEE 802.15.4 standard. Its low power consumption limits transmission distances to 10 to 100m line-of-sight, depending on environmental characteristics and power output. Its devices can transmit data over stretched distances by passing data through a mesh network of intermediate devices to reach more isolated ones. ZigBee is normally used in low data rate applications which require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250kbit/s, best suited for intermittent data transmissions from a sensor or any input device. Its applications include electrical meters with in-home-displays, traffic management systems, wireless light switches and other consumer and industrial equipment that require short-range low-rate wireless data transfer. ZigBee technology specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), for instance Bluetooth or Wi-Fi.

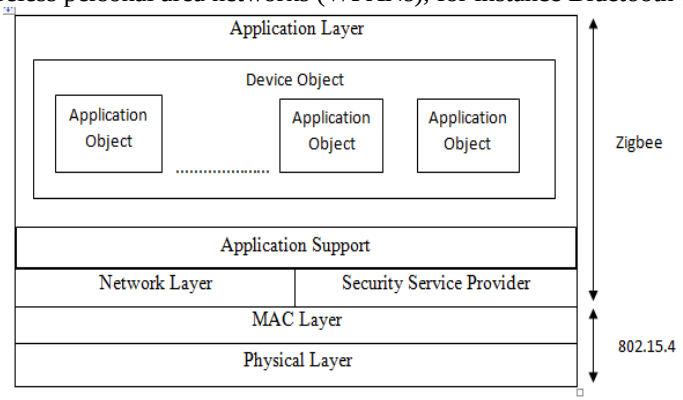

Figure 9. Zigbee Protocol Stack [15]

III. ACNR (ACTIVE CONTROL NOISE REDUCTION)

A. Circuit Diagram

The first and the most important step before designing the PCB is circuit design. We need to first draw individual components circuit diagram and then combine them into a single schematic with proper connections. To perform these tasks we have used Proteus Design Suite 8.1 Software and circuit simulation is also performed on the circuit using the same software.

1) Interfacing LCD and Keypad with Microcontroller: The alphanumeric LCD that we are to interfacing is a 16x2 alphanumeric LCD. There are two methods to interface any alphanumeric LCD with AVR ATmega32 microcontroller: 8-bit and 4-bit interfacing method. We are using 8-bit interfacing method, in which all the eight data pins of the LCD are used to send 8-bit data or commands to the LCD from the microcontroller.

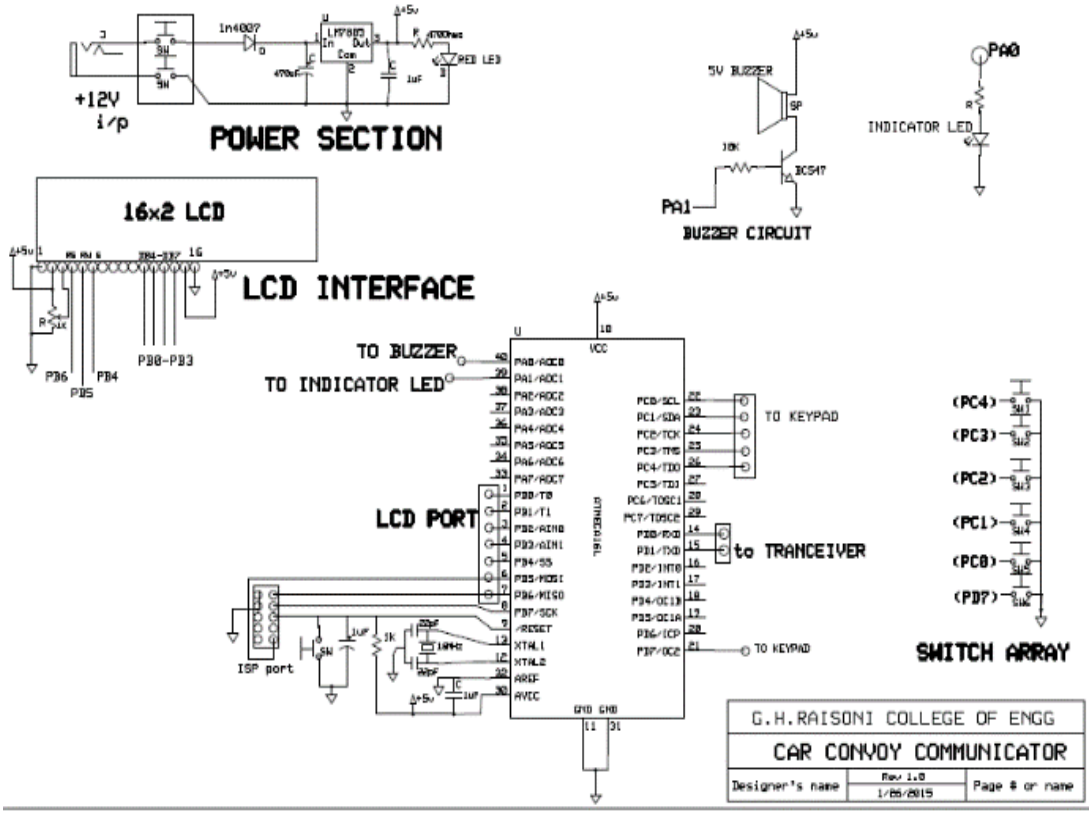

Figure 10. Car Convoy Communicator Circuit Diagram

All the data pins from D0 to D7 of LCD are connected with the I/O pins of PORTB from PB0 to PB7 of the microcontroller. Connect pin 1 of the LCD module to ground, pin 2 to +ve supply. A resistor (2 to 5 K Ohm) is connected across the supply and ground. Middle pin of the resistor is connected to pin3 of LCD module. To light up the back light, we need to connect –LED pin to ground. +LED pin of the LCD is connected to the +ve supply using a resistor. To display the value of pressed keys in the LCD, the microcontroller should know if any key is pressed or not and if pressed then which key is pressed. To know this, microcontroller is interfaced with the keypad. We are using 6 switches as keypad. 5 switches are connected to PORT C from PC0 to PC4 and the 6^{th} switch is connected to pin PD7 of PORT D of the microcontroller.

The microcontroller scans the switch array continuously. When any key is pressed, the read function returns the value of the pressed key and the microcontroller displays it in the LCD.

2) Interfacing CC2500 with ATmega using SPI: The CC2500 is connected to the UART pins i.e with pin PD0 and PD1 which are also TXD and RXD pins of microcontroller.CC2500 is configured via a simple 4-wire SPI(Serial Peripheral Interface) compatible interface (SI, SO, SCLK and CS) where CC2500 is the slave and Atmega32 is used as master. Register access and commands are given serially to CC2500 by atmega8 with SPI interface. Master generates clock and chip select signal in SPI. Data is shifted from master to slave and slave to master in circular manner in synchronous with clock generated by master, data in master register and slave register is exchanged at the end of shift operation.

There are total 47 configuration registers in CC2500. After each time the chip is reset it has to be programmed with SPI interface. CC2500 can enter into transmitter or receiver mode or decide data transmission rate and type of modulation by programming these registers. Similar to the configuration register there are tx and rx FIFO registers. Data has to be written into tx FIFO in similar way as we write data in config register, to transmit data wirelessly.

Similarly, whenever CC2500 receives some data, it gets stored in Rx FIFO. Whenever interrupt is generated on GD0 pin ATmega32 reads data from Rx FIFO. Two bytes are sent by atmega32 to read data from CC2500 register again. One is address byte and second one is data byte.

3) Interfacing Buzzer and Led with microcontroller: The Buzzer is connected to pin PA1 of PORT A and the push button is connected to PORTD 7. When the switch is pressed buzzer will turned on, otherwise the buzzer is in off state. Led is connected to pin PA0 of PORT A.

B. PCB Layout

A layout is a design which interconnects the components according to the schematic diagram (circuit diagram).This is usually done by converting your circuit's schematic diagram into a PCB layout using PCB layout software. After simulating the circuit, the PCB Layout for the circuit is designed in Express PCB software.

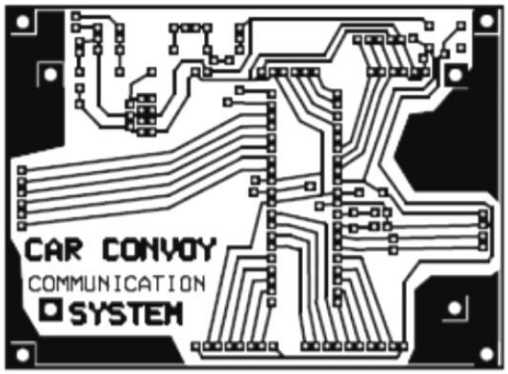

Figure 11. PCB Layout of project module

C. Circuit Board

After PCB fabrication, printed circuit board has pre-designed copper tracks on a conducting board. The predefined tracks reduce the wiring thus reducing the faults arising due to lose connections. Merely place the components on the PCB and solder them.

Figure 12. LCD and Microcontroller Module on the PCB

Figure 13. 6 key keypad and Transceiver Module

IV. RESULTS

Fig 14. Complete Circuit

Fig 15. Initial State Module(1)

Fig 16. Initial State Module(2)

Fig 17. Transmitting Message (Module 1)

Fig 18. Message Received (Module 2)

V. CONCLUSION AND FUTURE WORK

As a result of the substantial advances in the wireless technology, vehicular communication is becoming a part of the global network. Vehicular networks will not only provide safety and lifesaving applications, but they are a powerful communication tool for their users. This project develops a module which works on vehicular ad hoc network. This project enables vehicle to vehicle communication which will result in reducing the noise produced by honking. We can communicate with other vehicle using the LCD Display which will help in proper coordination between other vehicles and this may even reduce the need for blowing horns.

Problems regarding programming for LCD interfacing in AVR Studio4 were encountered. Problem was solved by adding a header file for LCD which solved all the errors produced whenever a new function for LCD was created.

At present we are using an external power source but for future, an in built power source can be used for the working of modules.

REFERENCES

[1] Yue Liu1,Jun Bi2, Ju Yang , "*Research on Vehicular Ad Hoc Networks",* Chinese Control and Decision Conference (CCDC) , E-ISBN : 978-1-4244-2723-9 , 2009.

[2] Fabien Mieyeville, Wan Du, Idris Daikh, David Navarro Ecole Centrale Lyon, "*Wireless Sensor Networks for active control noise reduction in automotive domain",* IEEE14th International Symposium , E-ISBN : 978-2-908849-26-4 , 2011

[3] "Noise pollution due to honking", Times of India, May 2014 http://timesofindia.indiatimes.com/city/gurgaon/70-noise-pollution-due-to-honking/articleshow/21473250.cms

[4] The noise pollution (regulation and control) rules – *Official Website* , 2012 http://admis.hp.nic.in/himpol/Citizen/LawLib/C0187.HTM.

[5] Atmel, 8-bit Atmel with 8KBytes In-System Programmable Flash, ATmega8 ATmega8L datasheet, Rev.2486AA–AVR, 2013. http://www.atmel.com/Images/Atmel-2486-8-bit-AVR-microcontroller-ATmega8_L_datasheet.pdf

[6] Atmel, atmel 8-bit microcontroller with 4/8/16/32kbytes in-system programmable flash, ATmega48A/PA/88A/PA/168A/PA/328/P, Atmel-8271I-AVR- ATmega-Datasheet, 2014. http://www.atmel.com/Images/Atmel-2486-8-bit-AVR-microcontroller-ATmega328_L_datasheet.pdf

[7] Atmel, 8-bit AVR Microcontroller with 32KBytes In-System Programmable Flash ATmega32, ATmega32L datasheet, 2503QS–AVR , 2011. http://www.atmel.com/images/doc2503.pdf

[8] Texas Instruments, CC2545 datasheet, System-on-Chip for 2.4-GHz RF Applications SWRS106B –JUNE 2012–REVISED FEBRUARY 2013. http://www.ti.com/lit/gpn/cc2545.pdf

[9] Texas Instruments, CC2543 datasheet, System-on-Chip for 2.4-GHz RF Applications, SWRS107 –APRIL 2012. http://www.ti.com/lit/ds/swrs107/swrs107.pdf

[10] Texas Instruments, CC2500 datasheet, Low-Cost Low-Power 2.4 GHz RF Transceiver, SWRS040C, 19 May 2009 http://www.tij.co.jp/jp/lit/ds/swrs040c/swrs040c.pdf

[11] Karunakar Pothuganti and Anusha Chitneni, "*A Comparative Study of Wireless Protocols: Bluetooth, UWB, ZigBee, and Wi-Fi*", Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 4, Number 6, pp. 655-662, 2014.

[12] Singh, R. , Mishra, S. , Joshi, P., "*Pressure monitoring in wireless sensor network using Zigbee transceiver module*". Computer and Communication Technology (ICCCT), 2011 2nd International Conference,15-17 Sept. 2011.

[13] Yoonmyung Lee, Yejoong Kim, Dongmin Yoon, David Blaauw, Dennis Sylvester, "*Circuit and System Design Guidelines for Ultra-Low Power Sensor Nodes",* Design Automation Conference, 49th ACM/EDAC/IEEE, ISSN : 0738-100X , 2012.

[14] GolamMostafa , "*Development of an 8-Bit RISC Microcontroller Learning Kit using Atmel ATmega32 Architechture" ,* Proceedings of 2013 2nd International Conference on Advances in Electrical Engineering (ICAEE 2013), 19-21 December, 2013.

[15] Ramya, C.M. ; M.E. Pervasive Comput. Technol./CCT, Anna Univ. of Technol., Tiruchirappalli, India ; Shanmugaraj, M. ; Prabakaran, R., "*Study on ZigBee technology",* IEEE, Electronics Computer Technology (ICECT), 2011 3rd International Conference, volume 6, E-ISBN :978-1-4244-8679-3, 2011

[16] AVR910: In-System Programming - *Official Site,* 2015 http://www.atmel.com/images/doc0943.pdf

[17] ATmega32 Microcontroller -A Beginners Guide Introduction – *Official Website,* 2014 https://www.newbiehack.com/MicrocontrollerTutorial.aspx

[18] 16x2 LCD Didplay http://www.engineersgarage.com/sites/default/files/LCD%2016x2.pdf

[19] IR Sensor Circuit – *Official Website,* 2012 http://www.engineersgarage.com/electronic-circuit/infrared-ir-sensor

[20] AVR I/O Ports – *Official Website,* 2012 http://www.engineersgarage.com/contribution/expert/avr-io-ports

[21] Working with AVR Studio - *Official Website,* 2012 http://www.engineersgarage.com/tutorials/avr-studio4-working

[22] PCB Designing in Proteus Design Suite 8.1, *Official Website,* 2012 http://www.theengineeringprojects.com/2013/09/pcb-designing-in-proteus-ares.html

[23] PCB layout Design Using ExpressPCB – *Official Website,* 2015 http://www.expresspcb.com/expresspcbhtm/HowWorks.html

