Research Paper

Providing Location Privacy of Vehicle through a Real Time Implementation of Short Range Communication

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Abstract

In vehicular ad-hoc networks, based on its transmissions it is possible to locate and track a vehicle, during communication with other vehicles or road-side transportation. This tracking leads to threats on location privacy of vehicle's user. This work solves the problem of providing privacy location in VANET by allowing vehicles; prevent tracking of their broadcast communications. Firstly, this identifies unique characteristics of VANET which is considered when designing suitable location security solutions. By considering these observations, this work implements a Short Range Communication in VANET, and evaluates the security enhancement achieved by some existing standard constraints of VANET applications.

Keywords: Vehicular Ad-hoc Network; Inter-Vehicle Communication Network; Dedicated Short Range Communication

1. Introduction

Vehicular Ad-hoc Networks is emergent technologies that they deserve attention of academic institutions and the industry [1-2]. The numerous initiatives of the research that improve the security and efficiency of transportation system which supply for acknowledgement of conditions such as snow, fire, traffic in the road conditions such as emergency, construction sites [3].

The wireless infrastructure such as access point or base stations, existing in Wi-Fi, Wi-Max, GSM or UMTS are the main characteristics of the VANET. The communication of nodes reaches beyond of the transmission of radio in multi-hops through intermediate nodes distribution. The topologies of this network can move dynamics due to inoperative features. The other side says that media without wire and in absence of infrastructures, multi-hops routing transforms these networks in potential targets of diverse attacks. Sensory mobile vehicle supplies sufficient electric power. Energy consumption is a secondary factor in inter-communication vehicles. In Inter-Vehicle Communication systems security and privacy are critical factors. This work gives more emphasis aspects related to security and Inter-Vehicle Communication network (IVCN) which is a new paradigm of VANET [4].

2. Literature Review

Traffic accidents and highway congestion continues to remain a serious problem world-wide. Active safety applications, that use autonomous vehicle sensors such as radar, camera, etc., are being developed and deployed in vehicles by automakers to address the crash problem. Moreover, the FCC has recognized the importance of having a dedicated wireless spectrum for improving traffic safety and highway efficiency. In the US, the FCC has allocated 902 MHz band as Dedicated Short Range Communication (DSRC) for the primary purpose of improving transportation safety and highway efficiency. The reliability of DSRC vehicle-to-vehicle communication is adequate since packet drops do not occur in bursts most of the time. Results show the application level reliability of VSC applications based on DSRC communication is quite satisfactory. Significant characteristics of DSRC communication for highly mobile vehicle-to-vehicle wireless network, which will contribute to better design and evaluation of

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communication protocols for VSC applications in future [3]. Short range sensors with LOS links are used to detect vehicles or lane boundaries adjacent to the host vehicle. Applications include forward collision warning, adaptive cruise control and lane keeping. Longer-range vehicle safety systems are needed to help reduce accidents originating from more distant emergency events, roadway impediments, blind corners, and cross traffic. To detect these remote events, such systems may require up to 1000 meters of LOS coverage, and NLOS coverage to detect dangerous events ahead, but out of view.

In many cases, the ability to detect an emergency event occurring at some distance ahead is limited by the inability of drivers to see past the vehicle in front of them. The inability of drivers to react in time to emergency situations often creates a potential for chain collisions, in which an initial collision between two vehicles is followed by a series of collisions involving the following vehicles. The smaller frequency standard of DSRC i.e. 902 MHz can provide real-time alerts to drivers who cannot see remote or oncoming safety hazards [1]. The communication between two vehicles is governed by wireless protocol 802.11 [4-7]. Requirement of implementation of CCA is in vehicle-to-vehicle wireless network at the Medium Access Control (MAC) and routing layer [2]. The 802.11 standard adopts the method of Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) and provides two access methods, Distributed Coordination Function (DCF) and Point Coordination Function (PCF) [5]. DCF is a random access scheme based on carrier sense multiple accesses with collision avoidance (CSMA/CA). Before data transmission, it will detect the channel state in clearance or not. DCF is a required procedure of the 802.11 standard. In the DCF scheme, all stations content for the medium. If the medium is busy, each station runs a back-off algorithm to avoid collisions [9]. PCF is optional procedure of the 802.11 standard. In PCF scheme, there is central Point Coordinator (PC). The PC send beacon message to inform all stations to stop their DCF activities. As the PCF used, the medium will be partitioned into contention-free period (CFP) and contention period (CP) that CFP is coordinated by PCF and CP is DCF. The PC then polls each station for data transmission. During this Contention Free Period (CFP), stations are not allowed for data transmission until they are polled [6].

3. System Overview

In this project, three methodologies are used to implement vehicle to vehicle communication as well as vehicle to RSU communication. The first method is the basic term of VANET called Dedicated Short Range Communication (DSRC) and the Second one is MAC protocol used for synchronized trans-reception [7,8].

DSRC (Dedicated Short Range Communication):

This paper discusses the technical requirements of new wireless standard, Dedicated Short Range Communications (DSRC), and its applications in supporting with ITS. In recognition of this need, Federal Communication Commission (FCC) allocated 12 MHz spectrum in the 902MHz band for DSRC in 1998. The DSRC standard supports vehicles with on-board device (OBD) to communicate with a roadside unit (RSU) or other traveling vehicles. FCC provides several examples of DSRC applications such as traveler's alerts, automatic toll collection, traffic congestion detection, emergency dispatch services and electronic inspection of moving trucks through data transmissions with roadside inspection facilities. Work classify these applications into single cast (one sender and one receiver) verses broadcast (one sender and many receivers) and RSU-to-Vehicle (R2V) verses Vehicle-to-Vehicle (V2V) [9-10].

The DSRC standard supports vehicles with an on-board device (OBD) to communicate with a roadside unit (RSU), or other traveling vehicles.

The block diagram shows interconnection of various VANET components. This diagram is common for every node present in VANET that is either a vehicle or the base station. The microcontroller PIC16F877A is best suitable for implantation of VANET due to its distinguishing features which are described later in this paper. The power supply is obtained from simple 78XX regulator IC due to its simplicity. The obstacle detector circuit is made up of 555 IC with IR transmitter & receiver pair. The transmitted IR light is reflected back by the obstacle and it is catches by the IR receiver and the signal is sent to the microcontroller as an interrupt and accordingly the further operation is performed.

Table1. Legacy and New DSRC Standards

Items	Legacy	New
Band	909-928 MHz	5.850-5.925 GHz
Spectrum	12 MHz	75 MHz
Data Rate	0.5 MHz	1-54 MHz
Max. Range	100 m	1,000 m
Min. Separation	100 m	500 m
Non-Overlapping Channel	1 or 2	7

The forward, reverse, left, right motion of wheels is controlled by a DC motor and for that purpose driver circuit is made by using transistors. LCD display is used to show the status of the various parameters of vehicle and signals. Both the amplifiers are the simple transistor amplifiers used to amplify the signals before sending to the transmitter and after the signal are received. The 433MHz transceiver module is used for transmitting and receiving the various signals and messages from other vehicles and/or base stations.
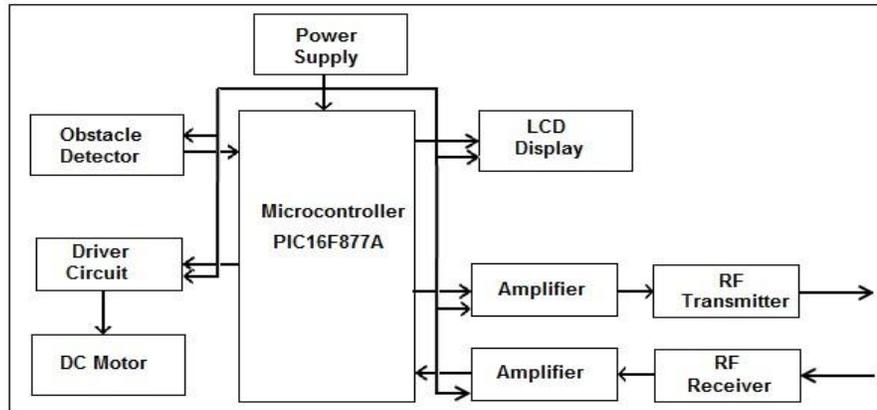
Block Diagram (Vehicle Side):

Figure 1. Block diagram

3.1 Obstacle Detector

This unit consists of IR sensors which mean the IR transmitter and IR receiver. As table multivibrator is used at the input side
of the IR transmitter. This as table multivibrator will make the IR ray to emit continuously. IC555 timer is used as an as table multivibrator. IR receiver is provided with the 5-volt battery. When the IR is intermittent then an obstacle is detected. Couples of resistors, transistors and operational amplifier, IR LEDs are included in it. For the purpose of detection, a standard IR transmitter receiver pair is used. As the circuit is extremely simple and understandable so it is easy to build. In all IR proximity sensors same principle is used. The infra-red light through IR-LEDs is send which is reflected by object in front of sensor. This is done by sensing the change in the voltage at the IR receiver circuit & accordingly pulse is given to Microcontroller.

3.2 RF Transmitter & Receiver Section:

3.2.1 Amplifiers

There are two amplifier circuits are used in the block diagram:

3.2.2 Amplifier circuit before RF transmitter:

- Work requires supply of 9V to RF transmitter and the input signal to the amplifier is either 5Volts or 0Volts as the signals coming from the IC 16F877A is digital in which 1 is equivalent to 5V & 0 is equivalent to 0V. So circuit has to use amplifier circuit before RF transmitter.

3.2.3. Amplifier circuit after RF transmitter:

- Strength of the received signal transmitted from the RF transmitter has been reduced. Therefore, it is necessary to regain it by means of amplification.

3.2.4 Specifications:

Receiver Frequency: 315 / 433.92 MHz
Typical sensitivity: -102dBm
Supply Current: 3.5mA
Operation temperature range － 20℃～＋70℃
Operation voltage: 5 Volts.
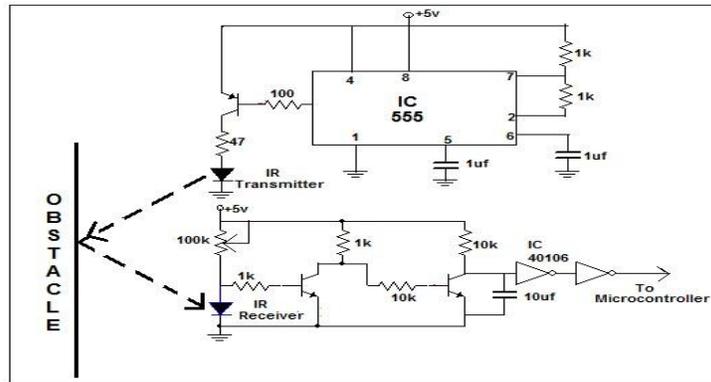Available frequency at: 315/434 MHz Low power consumption.
Easy for application.

Figure 2. Circuit Diagram of Obstacle Detection Unit
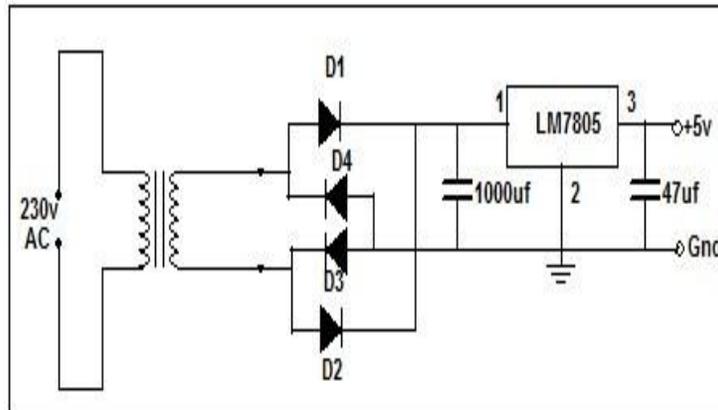
Power Supply (7805 regulator IC):

Figure 3. Circuit of power supply

This circuit is useful in digital electronics. The circuit give +5V output at 150 mA current and this can be increased to 1A when good cooling is added in 7805 regulator chip. Overload and terminal protection is provided to circuit. The capacitors have high voltage rating to safely handle input voltage given to the circuit. If other voltages are needed, then modified circuit is used with different output voltage from regulator 78XX chip family. In this input voltage must be at least 3V otherwise regulator will not work well.

3.2.5 Display Data RAM (DDRAM):
The character (ASCII CODE) is sends to display data RAM which can be seen on the LCD screen. The display data represented in 8 bit is stored in DDRAM. 80 characters (bytes) is its capacity. DDRAM has address layout of a 2X16 LCD. So if you want to display the text at a specific position of LCD, results manipulate address and then to set cursor position accordingly.

4. Conclusion

With the improvement of technology by lightning speed there is a need of safety measures. With the implementation of this project in real time it can assure safety of driver and others along with luxury and speed. This work presents operational concept on 902 MHz short range communication safety stack diagram. In particular using this work the basic idea regarding communication and controlling of vehicles in Ad-hoc scenario is cleared. The fundamental nature of broadcast messaging oriented safety communication system is examined.

5. Future Work

This work has used a small standard of DSRC with the frequency of 902 MHz which provide a range of 500 meter. But the

frequency standard that is currently available is 5.9 GHz which can provides a range of 1000 meters. In this it can increase the number of channels for communication link establishment. There is a provision of four extra keys on one vehicle (in current system) which can be programmed to send more messages to front vehicle (IVC) or to the base station. One-way communication established here in this work it can be made by two ways, making use of both transmitter and receiver

station in each vehicle as well as to the base station. Further the use of GPS (Global positioning system) in the communication setup can provide us display of exact position of vehicles and the shortest way to destination.

Again the communication can be made safer by applying some cryptography algorithm like RSA and user authentication can

be established by using digital signature or identity based cryptography.

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