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Smart Vehicle: A Systematic Review

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ABSTRACT

This article gives a summary of the existing state of affairs and potential developments for smart vehicles while taking into consideration social, technological, and transportation aspects. Additionally, it examines the strategies for turning the smart into a generic vehicle, potential future developments, 5G, ADAS, and power source characteristics. This will make it possible for linked automobiles to take center stage in smart cities. Information may be exchanged between vehicles and road infrastructures as well as from one vehicle to another thanks to the vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication systems. It attempts to improve mobility, prevent or lessen auto accidents, and offer additional advantages for road safety. Motivations, open problems, and suggestions from other academics were taken into account to improve the knowledge of many contextual components and characteristics of the industry. All publications about data transfers in the V2I communication system were thoroughly searched. They employ DSRC and 5G, Bluetooth, and WIFI technology in that, however there is a range and data transmission rate issue. I exploited RF frequencies to spontaneously broadcast the data in order to get around that.

Keywords: smart vehicle, radio frequency, V2I and V2V communication

Introduction

Due to the increased number of cars on the road, accidents and traffic bottlenecks have increased dramatically. Messages are sent through multi-hop broadcasting, and connection of wireless multi-hop networks is crucial for the design, development, and assessment of vehicular ad hoc networks. (Zhao, Chen, & Gong, 2016). The primary component of the intelligent transportation system (ITS), the vehicular ad hoc network (VANET), is an expansion of the mobile ad hoc network, in which the nodes are moving objects. Vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian (V2P) communications are the three major forms of communication used by the VANET (Malik, et al., 2019). Vehicles and road infrastructures can communicate with each other via the vehicle-to-infrastructure (V2I) communication system. Due to its high implementation costs and ongoing maintenance needs, the V2I technology is not as widely used as vehicle-to-vehicle communication in vehicular ad hoc networks. To highlight the value of the V2I communication technology, several studies have been done on it (Malik, et al., 2019). Although manual vehicles lack this capability, V2V communication is frequently used to send data between vehicles. Therefore, V2I communication is required to transmit vehicle status information without modifying the interior systems of manual vehicles (Milanés, et al., 2010). This technology is designed to give drivers alerts such as lane change assistance, overtaking vehicle warning, and junction collision warning. Lane change assistance lowers the risk of lateral collisions for vehicles completing lane changes, and overtaking vehicle warning prevents collisions between vehicles in an overtake situation. Intersection collision warning reduces the risk of lateral collisions for vehicles approaching road intersections. When vehicle2 alerts vehicle1 to stop overtaking, a collision between the two vehicles is avoided. Head-on collision warning: By issuing early warnings to cars moving in the opposite direction, the danger of a head-on accident is decreased. This use case is also known as "Do Not Pass Warning" rear-end collision alert since it lessens the risk of accidents when there are obstacles or curves in the road (such as hills or bends). A probable danger of a rear-end accident is disclosed to the driver of a car (Lianghai, Liu, Weinand, & Schotten, 2017).

In addition, the relative system provides warnings such as "Do not pass warning" when there are obstacles or curved road areas. It also provides additional notifications for emergency vehicles, such as ambulances. Summaries of the same traffic signal alerts and other essential pedestrian notifications are also conditioned by this system (Lianghai, Liu, Weinand, & Schotten, 2017).

While Arduino-based smart vehicle systems can play a role in their actual implementation. An ultrasonic sensor used by an Arduino-based collision detection system estimates the distance between two cars and issues visual and audible alerts to help drivers avoid crashes. There are two settings for the automobile headlight bulb: high beam and low beam. Low beam has a shorter range and less brightness, but it is still enough for driving. High beam improves reach and increases light intensity, but the surplus light that strikes cars traveling in the other way might make it difficult to see. An accident avoidance gadget is created to solve this issue (Kaur, Das, Borah, & Dey, 2019).

Literature Survey

Malik, et al., (2019) has discussed in their research that By communicating with other cars and with other things, such as Traffic Management Systems, automobiles improve the surrounding situation. Supported by cutting-edge sensor and wireless technology, a replacement solution is proposed for managing traffic at junctions and lowering waiting times even when traffic is heavy. Wireless module and ultrasonic sensor on an Arduino Mega board are all connected to the automobiles. when the cars are detected by the ultrasonic sensor. The wireless modules linked within its range will signal to the driver the distance between the cars, their speed, and their priority (in the case of an ambulance or other emergency vehicles) (Malik, et al., 2019).

Where Jansons, Petersons, & Bogdanovs, (2012) has dicussed in their an experimental investigation of IEEE802.11n utilizing off-the-shelf devices in a vehicle-to-infrastructure scenario with reduced settings compared to the older system (i.e. IEEE802.11g). In their study, we offer an analytical model to characterize the goodput of WLAN-based networks utilizing Buzen's approach and Markov process in order to gauge V2I type of communication in the massive scale scenario (Jansons, Petersons, & Bogdanovs, 2012).

Karagiannis, et al., (2011) has also presented their work. Vehicle networking has the potential to allow applications for entertainment, efficiency, and traffic safety. The basic characteristics of vehicle networks, applications and needs, difficulties and solutions, and significant ITS programs and initiatives in the USA, Japan, and Europe are all covered in their survey and instructional article.

Jeffery Miller also did work in the system and found some critical respsonses. The vehicle-to-vehicle-to-infrastructure (V2V2I) architecture, a combination of the vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) designs, is discussed in this work. It takes use of the V2I architecture's quick queries and answers while also having the advantages of a distributed design without a single point of failure. A single vehicle is designated as the super vehicle in each of the zones of the V2V2I architecture, and only super vehicles are able to interact with the central infrastructure or with other Super Vehicles. The advantages of the V2V2I design over pure V2I or V2V architectures are described, along with the trade-offs encountered depending on the size and number of zones within a transportation network, in a study using FreeSim (Miller, 2008).

Lianghai, Liu, Weinand, & Schotten (2017) dicsueed the evaluation of 5G should use new key performance indicators (KPIs) as opposed to the conventional measure, such as throughput inside the legacy cellular networks, in order to meet criteria. In this study, they use network-controlled direct V2V connection for vehicle-to-vehicle information sharing. In this communication mechanism, packets are sent directly between cars in a U-plane without the need of network infrastructure.

If an important vehicle needs to be attended to from a distance, prioritizing cars and signaling become difficult. Given the volume of real-time traffic, the size of the search area, and the dynamic nature of the traffic, it is desired to have smart devices connected to cars that use high-speed and low-power signal processing algorithms. Sharp beams to a specific device are formed using beamforming (BF), which also creates nulls in the wrong directions. The cloud is accessed through Internet of Things (IoT) networks, which detect, gather, and send real-time data related to mobile vehicle terminals was said by (Ulhe, et al., 2020).

V2V communication is a wireless network that exchanges data between mobile nodes connected to cars using 5.9 GHz transmissions. Communication techniques must be employed for high speed and long distance applications since it is not practical for high priority vehicles like ambulances. Signal processing methods must be integrated with the communication modules in order to eliminate interferences. V2V communication greatly benefits from millimeter wave (MMW) beamforming (BF), which directs beams in the desired directions and nulls in the undesirable ones (Vochin & AL-Amily, 2017).

Problem Statement

Design and development of a system that transfers data between vehicles and infrastructure over long distances and with a minimal data transmission rate. Using this method, the information is broadcast, and another vehicle receives it. By employing this strategy, we may stop traffic and accident before they start.

Objective and Scope of Study

In vehicle-to-vehicle communication, data is sent in several ways between two or more vehicles.

- Choose the sensors to urge data like distance sensor, break level, pressure sensor, voltage sensor as an input and given it.
- Data collected through the sensor is given it to the microcontroller central unit.
- MCU identify it and generate warning.
- Radio frequency that transmitted to a special vehicle.
- Software Required: Keil software use during this technique.

Methodology

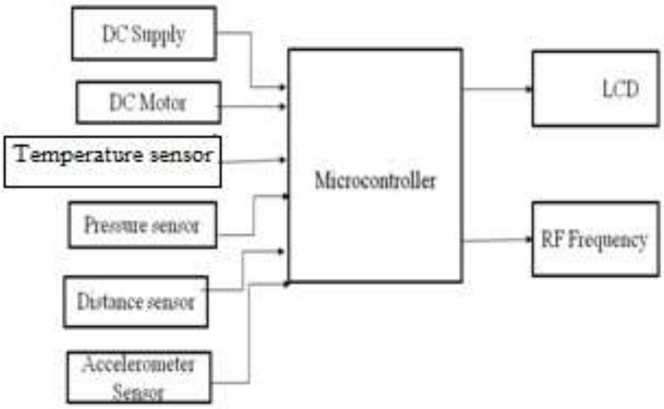

Figure 1: Proposed System

There are variety of components need to implement for the successful running of the system. Here author would like to discuss each element in brief with their operation of working and relative information.

DC Motor: DC motor is electrical motor it runs on DC electricity. It can operate directly from rechargeable batteries providing the facility for the primary electric power. DC motors where wont to run machinery, often eliminating the necessity for an area engine or combustion engine. Today DC motors are still found in applications also as small toys and DC drives. With power electronic devices modern DC motors are often operated in conjunction.

Power Supply: It provides supply to the circuit. We use 12v power supply in our project. It's wont to provide DC voltage to the components on board. 3.3V for lpc2138 and 4.2v for Wi-Fi module is apply from power supply. 5V is required for relay applied from power supply.

LCD: LCD can used to check the output of varied modules interfaced with the microcontroller. Thus LCD plays an important role to work out the output and debug the system modules wise just in case of system failure so on rectify the matter. Here we've used 16*2 LCD which indicates 16 columns and a couple of rows. So, we'll 16 characters in each line. So, total 32 characters we'll display on 16*2 display.

Distance Sensor: distance sensor is used for the measuring distance between two vehicle and any obstacle distance from vehicle. Uses distance sensor for long range sensing.

Accelerometer sensor: This sensor is used for the sensing lane change of automobile.

Radio Frequency: this is often utilized in system for wireless communication and broadcast the data of auto.

Working of System

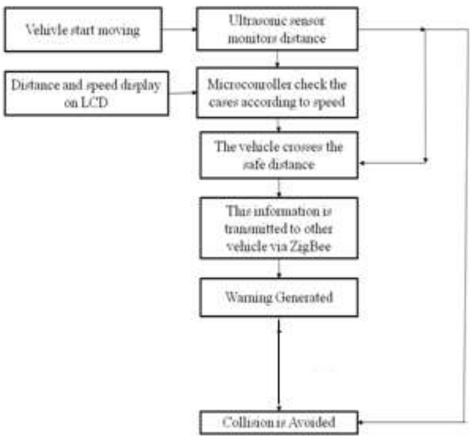

Figure 2: Flow Chart of Proposed System

The system's sensor detects the space, tire pressure, and lane change speed of the car as soon as it begins to move on the road. Then data was gathered by the sensor and sent to the microcontroller. Microcontroller evaluates the situation based on distance and speed. If a vehicle travels at a modest speed and distance, it is safe; otherwise, a warning is created and the speed of the car is controlled. And this information is transmitted publicly across the frequency, thereby preventing collisions or accidents.

Conclusion

The system architecture to provide direct V2X communication under network control is suggested in this study. Additionally, a resource distribution plan is created that can dynamically adjust to the real-time traffic demands of V2X communication. In addition, a number of important technologies are also suggested and assessed in order to enhance the direct V2V communication system performance. Last but not least, to provide accurate simulation results, a system level simulator is created and synchronized with reality. Our assessment study shows that in order to enable direct V2X communication and boost traffic efficiency and safety, all linked technologies need be built upon one another.

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