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Vehicle to Vehicle Communication with Collision Detection and Warning

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Abstract - Vehicle-to-vehicle communication is a technologythat enables communication among automobiles in motion. It permits vehicles to communicate information like speed and position with one another. Short-range dedicated communication is used for the communication. Drivers can be made aware of potential hazards by exchanging information with neighboring vehicles. Vehicle-to-vehicle communicationcan encounter a number of issues, including network congestion,system cost, and the legal and regulatory environment, as well as security and privacy concerns. Cellular network improvements including the rollout of 5G have also been made.The way things are now, problems like cost and congestion are addressed. The existing system makes plans to address issues like cost and congestion. To address the main issues with vehicle- to-vehicle communication, it comprises of a basic system designwith little hardware and connectivity.

Key Words: Vehicle-to-Vehicle Communication, short range communication, accidents, road safety, collision avoidance, warnings.

1.INTRODUCTION

Road safety continues to be a major concern in the framework of modern transport networks. The risk of collisions and accidents is an urgent issue that requires attention due to the growing number of vehicles on the road. Vehicle-to-vehicle (V2V) communication with collision detection and warning capabilities has emerged as a promising approach to reduce the risks related to road traffic in this regard. The vision of a future with fewer accidents, better traffic flow, and greater road safety influences the context for V2V communication with collision detection and warning. These systems open the way for a more connected and cooperative transportation ecosystem, where cars may collaborate to prevent crashes, save lives, and make journeys safer for all road users by exploiting modern communication technology and real-time data sharing. Road accidents have been a problem that is caused by a number of things, such as driver mistake, poor visibility, anderratic road conditions. There is a need for new proactive safety measures that can stop collisions from happening in thefirst place, even while traditional safety measures like seat belts and airbags have played a critical role in reducing the severity of accidents. This calls for a technology solution thatimproves drivers' situational awareness and sends out promptalerts about potential dangers. In today's fast-paced world, road safety has become a major concern due to the increasingnumber of vehicles on the road and the inherent risks associated with traffic jams and unpredictable driving behavior. The alarming statistics of accidents and collisions underscore the urgent need for innovative technologies that can improve road safety and reduce the occurrence of such incidents. In this framework, vehicle-to-vehicle (V2V) communication systems equipped with collision detection andwarning capabilities have emerged as a potential solution to address these challenges. Currently available road safety options have mostly concentrated on enhancing the safety features and driver aid systems of each specific car. These methods do not take into consideration the larger traffic environment and have inherent limitations because they rely only on the perceptual abilities of a single vehicle. Therefore,it is necessary to investigate cutting-edge technologies that rely on inter-vehicle communication to improve awareness and enable real-time transmission of crucial information among surrounding vehicles.

V2V communication systems with collision detection and warning have various benefits over conventional safety measures. These devices improve driver awareness and offera more thorough grasp of the road environment by extendingthe sensory capabilities beyond the particular vehicle. These systems' proactive nature also enables prompt interventions, giving drivers the ability to prevent potential incidents and enhance traffic safety results. The procedure starts as both cars start moving and simultaneously scan their immediate area. They are able to identify surrounding vehicles and determine their distance by using onboard sensors. When the gap between the two vehicles narrows below a predetermined limit, vehicle 1 initiates contact with Vehicle 2 and sends themeasurement of their separation. This enables both vehicles to constantly be aware of their respective situations. Vehicle 2 evaluates the environment in front of it after obtaining the distance information from vehicle 1. If it notices the presenceof another vehicle, it immediately communicates crucial information to vehicle 1 including the car's identity number. This information exchange makes sure that both cars are aware of the potential barrier and can adapt their driving style accordingly. The message allowing the overtake is sent to Vehicle 1 if vehicle 2 decides there is no obstruction up ahead. Vehicle 1 responds by acknowledging the message, which creates a coordinated understanding between the two vehicles. This V2V communication technology enables efficient coordination and information sharing between cars, enabling safe lane changes. Vehicles can proactively identify potential dangers and take the necessary precautions to avoid crashes by constantly monitoring their surroundings and exchanging pertinent data. The technical aspects, advantages, and difficulties of implementing V2V communication systems with collision detection and warning will be covered in more detail in the sections that follow, with an emphasis on how important these systems are for improving traffic safety and building a more secure transportation ecosystem.

2.LITERATURE REVIEW

Vehicle to Vehicle communication systems play an important role in safety and management of road traffic. There are a number of systems present which provide various models of vehicle-to-vehicle communication which provide collision detections along with warnings. In the modern era, the number of accidents is increasing drastically along with the death rate due to such accidents. To reduce this rate a number of technologies are being implemented using communication between the vehicles. Various challenges are there when it comes to networking of the traffic and building communication. Exchanging and infotainment information is required when it comes to roads and the safety of user.

Various network is present in the surroundings. One of which is the VANET network. Primarily, system needs to build the strong network. Vehicular ad-hoc networks helps to improve human safety against road collisions through passing the signals over the wireless network and optimizes the road transportation management. The applications and incorporations of the system needs to be enhanced on a higher level for better interfacing [1].

Network building is done as the basic to build communication but the trajectory of the vehicle should be monitored for analysis of the traffic and its movement using 5g technology. Data transmission from 5G is done at fast speed. The time lag is less when the data is transmitted. Just to solve various issues related to latency, reliability, security of the system and projection. The system does not provide feedback mechanism in the vehicles to avoid any such collision between two devices. So, using 5G technology alone is not sufficient [2].

The data transmitted by the 5G technology can help the system to store its data in the ZigBee. ZigBee can transmit the stored data to the vehicles. Displaying the stored data on the Arduino is done. The system measures the distance covered between the instant the brakes are applied till the vehicle gets stop while moving at variable speeds. The low transmission rate of data using ZigBee makes it hard to use it. Such data should have the fast communication possible [3].

Various technologies are built but building a communication is the main objective. Various keys to establish is to use the sensors. Sensors are used in the system for the instructions to be sent to the other vehicles which are in the proximity region. LEDs are used to for the warnings when detection takes place. The process takes quick response time which results in reduction of accidents on large scale. When the traffic is a lot scanning is the key mechanism gets failed. More traffic causes the transfer of signals to go to any vehicle on the same frequency [4].

Other communication technique for the system takes place using the LiFi. LiFi is used for communication of vehicles by means of light in order to avoid the collision. The vehicle emits light which is captured by the other vehicle to detect the presence using the light. As light travels faster, LiFi is almost 250 times faster than any other. The limitations to the project are that the light cannot pass through physical barriers. It has drawback as the system cannot work during day time [5].

There are various wireless communication technologies which are used in vehicle-to-vehicle communication system. Wireless communication technologies which are 4G-LTE, ZigBee, Bluetooth and many more are used with a focus on cellular range for communication. It uses the VANETs technology which overcome the issues like the traffic jams, car crashes, and emergencies. The main problem with this system is that there is no scalability, latency is the issue, and there is throughput and various topological variations [6].

The technology has been improved so that everyday improvements are made to the cars' ability to network with one another. Various strategies are used to establish communication between the two vehicles, but the actual execution is challenging. The market presents more obstacles than usual. For real-time communication on the roadways, we have created technology that allows the vehicle's actual data to be transferred among all of the systems. Data in real time is processed. In order to further control traffic, collisions are prevented.

3.SYSTEM SPECIFICATIONS

A. *Microcontroller (Atmega328p):* The high-performance microcontroller combines 32 KB ISP Flash memory with read-while-write capabilities, 1024B EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented Two-Wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

B. *LCD 16*2:* LCDs mostly LCDs mostly connected to the microcontrollers are 16x2 and 20x2 displays. That means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively. LCD having 16 pins for interfacing & signaling & VCCS & GNDS. There are three control lines are EN, RS, and RW etc. EN=Enable (It used for tell the LCD to sending data). RS=Register Select (When RS is High (1), then data being sent is text data) (When RS is Low (0), then data is treated as a command). R/W=Read/Write (When RW is low (0), then the data Read the data) (When RW is High (1), then the data write the data)

C. *Piezo Electric Buzzer:* A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or electronic. Typical uses of buzzers and beepers include alarms, timers and confirmation of user input such as a mouse click or keystroke. A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source. Sounds commonly used to indicate that a button has been press. Piezoelectricity is the ability of some materials (notably crystals, certain ceramics, and biological matter such as bone, DNA and various proteins) to generate an electric field or in response to applied mechanical strain. The effect is closely related to a change of polarization density within the material's volume. If the material is not short-circuited, the applied stress/strain induces a voltage across the material. However, if the circuit is closed the energy will be quickly released. So, in order to run an electric load (such as a light bulb) on a piezoelectric device, the applied mechanical stress must oscillate back and forth. For example, if you had such a device in your shoes, you could charge your cell phone while walking but not while standing. The word is derived from

the Greek piezo or piezein (πιέζειν), which means to squeeze or press.

D. *Motor Driver (L293D):* L293D Motor Driver Module is a medium power motor driver perfect for driving DC Motors and Stepper Motors. It uses the popular L293motor driver IC. It can drive 4 DC motors on and off, or drive 2 DC motors with directional and speed control. The driver greatly simplifies and increases the ease with which you may control motors, relays, etc. from micro-controllers. It can drive motors up to 12V with a total DC current of up to 600mA. You can connect the two channels in parallel to double the maximum current or in series to double the maximum input voltage. This motor driver is perfect for robotics and mechatronics projects for controlling motors from microcontrollers, switches, relays, etc. Perfect for driving DC and Stepper motors for micro-mouse, line-following robots, robot arms, etc. This device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors. To simplify use as two bridges each pair of channels is equipped with an enable input. A separate supply input is provided for the logic, allowing operation at a lower voltage and internal clamp diodes are included. This device is suitable for use in switching applications at frequencies up to 5 kHz.

E. *Ultrasonic Sensors:* Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self-parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology. In comparison to infrared in proximity sensing applications, ultrasonic sensors are not as susceptible to interference of smoke, gas, and other airborne particles (though the physical components are still affected by variables such as heat). Ultrasonic sensors are also used as level sensors to detect, monitor, and regulate liquid levels in closed containers (such as vats in chemical factories). Most notably, ultrasonic technology has enabled the medical industry to produce images of internal organs, identify tumours, and ensure the health of babies in the womb.

F. *Bluetooth Module HC05:* HC-05 6 Pin Wireless Serial Bluetooth Module is a Bluetooth module for use with any microcontroller. It uses the UART protocol to make it easy to send and receive data wirelessly. The HC-06 module is a slave only device. This means that it can connect to most phones and computers with Bluetooth but it cannot connect to another slave-only device such as keyboards and other HC-06 modules. To connect with other slave devices a master module would be necessary such as the HC-05 version which can do both master and slave.

4. BLOCK DIAGRAM

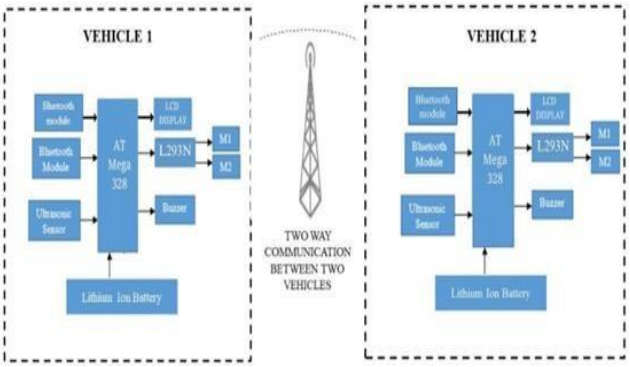


Fig -1: Block Diagram

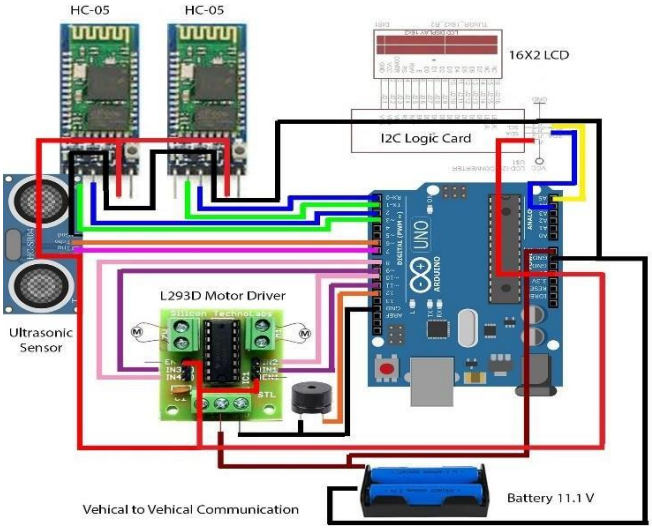


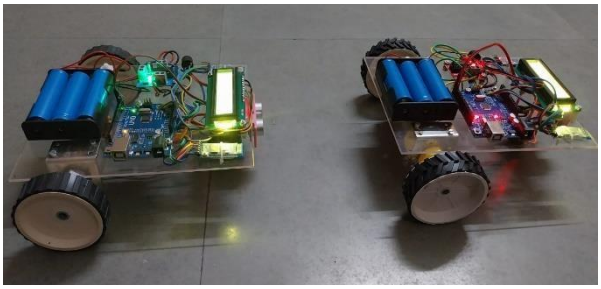
Fig -2: Connection Diagram

5. RESULTS AND CONCLUSION

Collision avoidance system is designed and mounted on a very simple and easily understandable model. The sensors can read distances that are at shorter range accurately. The system takes action automatically without any driver input. Hence this alerts the driver to either stop the car or slow down the speed of the car to avoid an accident.

There are various cases in the result of the project. The initial display on the LCD will show “N” since the vehicles will not be connected initially. Once the connection is established, “B” will be displayed. The LCD will also showcase the distance between the rear and front vehicles.

There are two parameters displayed on the LCD named MD and OD meaning my distance and other distance respectively. The MD for the left vehicle (refer the figure below) is the distance between the two vehicles which is also the OD for the right vehicle. The OD for left vehicle will be the MD from the right vehicle. These distances are transmitted using the Bluetooth modules.



When the distance between two vehicles will be less than 30cm, the buzzer will start beeping meaning to send an alarm to the drivers to take the necessary action.

Currently, the existing systems provide a limited service which sends warnings to drivers only. Our proposed system passes this stage and provides an advanced solution which includes automation. The next generation V2V system has been kept in while making our project. Vehicle to vehicle communication systems can save lives and enhance driving efficiency, which can generate massive improvements in lowering accidents. This system will have a major effect in cities across the globe. The system may also be useful in minimizing road congestion which will also contribute towards a better travelling experience.

6. APPLICATIONS

a) In smart city, the system can be implemented for automating vehicles.

b) Enables collision avoidance using real time information based on distance

c) Allows vehicles to communicate with each other and maintain safe distances and synchronous speeds

d) Provides intersection safety which in turn helps to avoid accidents

e) Facilitates emergency vehicle warning regarding presence of emergency vehicles like ambulances, fire brigades, etc.

f) Optimize traffic flow and congestion

7. FUTURESCOPE

1. For smart city, GSM Module can be added to the system so that if driver detects some bad road condition or problem, a warning message can be transmitted to other vehicles to generate speed recommendation or figure alternate route and this gets displayed on the LCD screen.
2. The entire system can be connected to a cloud database to prove more accurate real time information regarding roads and traffic.
3. Cameras can be added to the system to automate the vehicle using artificial intelligence and machine learning.

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