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Vehicle to Vehicle Communication for Collision Avoidance

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Abstract: *This paper presents the specific application of wireless communication, Automotive Wireless Communication also called as Vehicle-to-Vehicle Communication. The paper first gives an introduction to the Automotive Wireless Communication. It explains the technology used for Automotive Wireless Communication along with the various automotive applications relying on wireless communication. Vehicle-to-Vehicle communication is the wireless transmission of data between motor vehicles in a real time. The main aim of V2V communication is to prevent accidents by allowing vehicles in transit to send position and speed data to one another. The vehicle's driver may simply receive a warning should there be a risk of an accident or the vehicle itself may take preemptive actions as braking to slow down.*

Keywords: *ZigBee Communication, Vehicle to Vehicle, collision avoidance, Microcontroller 8051, wireless communication*

I. INTRODUCTION

The expeditious increase in the vehicle populace around the globe, Particularly in India has prompted inquire about in the specialty of Intelligent Transportation System (ITS). Vehicle-To-Vehicle (V2V) communication is a framework intended to transmit data amongst vehicles and different objects on the road in real time. V2V communication is more effective than current automotive original equipment manufacturer embedded system for lane departure, adaptive cruise control, blind spot detection, rear parking sonar and backup camera because V2V technology enables ubiquitous 360-degree awareness of surrounding threats. The main objective of the project is to alert the driver when he closes to the front vehicle. The idea is that, if collision avoidance systems can work between vehicles, then every car on the road will be safer by avoiding accidents before they can ever happen. The importance of autonomous or semi-autonomous vehicles for intelligent transport systems (ITS) is increasing. V2V technologies are simple to implement primarily because of their reliance on wireless communication. Having low power and information rate, ZigBee happens to be utilized broadly in V2V communication. In this paper, propositions are initiated towards enhancing road safety and handling traffic congestion.

II. ADVANTAGES AND DISADVANTAGES

Even with so much advancement, each year there are about 50 million injuries and deaths worldwide caused by road traffic crashes. A substantial part happens on road intersections due to the vehicle collisions. Moreover, since traditional intersections are managed by traffic lights and stops signs, there would be an excessive delay with autonomous vehicles. We rather consider an approach in which the two vehicles can communicate so as to know when one of them applies brake for collision avoidance, using sensors and V2V communication enabled ZigBee.

A. Some of the Major Advantages Are

- 1) The greatest benefit of connectivity is that it can transform a group of independent vehicles sharing a road into a cohesive traffic system that can exchange critical and demanding information about road and traffic conditions in real time.
- 2) Enhancing vehicle throughput.
- 3) This correspondence between self-sufficient vehicles to keep away from this impact discharge drivers from taking part in the physical and mental activities related with driving, enabling them to use this time on other gainful and productive activities en route.
- 4) Third world nations battle with an absence of transportation foundation, for example, streets, scaffolds, and open transport, which is blocking and hampering their financial advancement. Reception of this model by these creating nations may save them the expenses related with extending capital-serious foundation.

B. On the other Hand, This Designed Model Comes with An Equivalent Number of Drawbacks

- 1) Communication is stumped by harsh weather. Heavy rainfall interferes with sensors, and snow on the ground makes it hard for vehicles to read lines on the road. This affects the sensors and the range.
- 2) It will affect jobs because once communication between autonomous vehicles will come into play, taxi drivers could be hugely affected, potentially creating an unemployment crisis.
- 3) They are likely to be very expensive. Though competition between manufactures can help in cutting down the costs, but the upcoming of this system is surely going to affect the middle class.

III. BACKGROUND STUDY

A. Wireless Communication

Wireless communication, or sometimes simply wireless, is the transfer of information or power between two or more points that are not connected by an electrical conductor. The most common wireless technologies use radio waves. With radio waves distances can be short, such as a few meters for Bluetooth or as far as millions of kilometers for deep-space radio communications.

B. Vehicle to Vehicle Communication(V2V)

Vehicle-to-vehicle communication (V2V communication) is the wireless transmission of data between motor vehicles. The goal of V2V communication is to prevent accidents by allowing vehicles in transit to send position and speed data to one another over an ad hoc mesh network. Depending upon how the technology is implemented, the vehicle's driver may simply receive a warning should there be a risk of an accident or the vehicle itself may take preemptive actions such as braking to slow down.

C. Zigbee

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low data rate, and close proximity wireless network.

D. WAVE (wireless access in vehicular environment)

Wireless Access in Vehicular Environments (WAVE) Networking Services provides services to WAVE devices and systems. IEEE 802.11p is an approved amendment to the IEEE 802.11 standard to add wireless access in vehicular environments (WAVE), a vehicular communication system. It defines enhancements to 802.11 (the basis of products marketed as Wi-Fi) required to support Intelligent Transportation Systems (ITS) applications. This includes data exchange between high-speed vehicles and between the vehicles and the roadside infrastructure, so called V2V communication.

E. GPS

It is a space-based radio navigation system owned by the United States government and operated by the United States Air Force. It is a global navigation satellite system that provides geo location and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.

IV. TECHNOLOGIES USED

A. ZigBee

ZigBee (IEEE 802.15.4) is an amazing failure cost and low-control, low power remote PAN standard, proposed to address the issues of sensors and control gadgets. Regardless of the quantity of low information rates restrictive frame works. The information is moved in packets. These have a most extreme size of 128 bytes, taking into account a greatest payload of 104 bytes. Despite the fact that this may seem low when contrasted with different frameworks, the applications in which 802.15.4 and ZigBee are probably going to be utilized ought not to require high information rates.

B. Ultrasonic Sensor

An Ultrasonic sensor is a gadget that can quantify the separation by utilizing sound waves. The main purpose of using ultrasonic sensors was its ease and availability, its sensing capability to sense all type of materials The ultrasonic sensor continuously sends signals and monitors any car or other obstacles that are in front of the car. The distance up to which ultrasonic sensor can work may

be up to 4 - 10 meters. When any obstacle or vehicle is detected by ultrasonic sensor system, it will send signal to the embedded board. After receiving this signal, embedded board sends a signal to the motor to reduce the car speed automatically which can control the speed immediately. Vehicle is controlled automatically without any manual operation. In this proposed model, two sensors are supposed to be designed each on the front and back side of the vehicle at which the proposed model is to be implemented. The ultrasonic sensor is set to emit an electromagnetic field at a set distance of 10 meters which is the defined normal range. Whenever a vehicle is reaching behind within the normal range, automatically the sensor detects the presence of a vehicle and sends the signal towards the microcontroller. The microcontroller sends the respective warning message to the output LCD display.

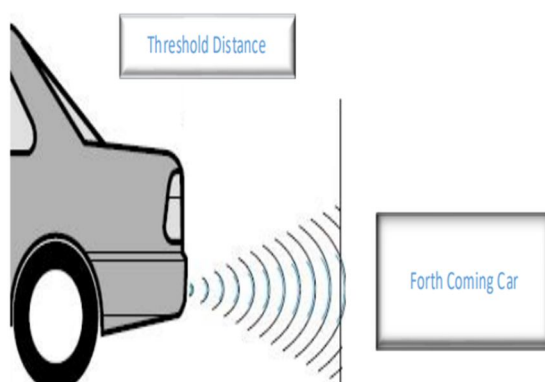


Figure 1: Working of ultrasonic sensor in the project

C. 8051 Microcontroller

A microcontroller is a little PC on a solitary IC that incorporates every one of the highlights that are found in the microchip. With a specific end goal to serve distinctive applications, it has a high convergence of on chip offices, for example, RAM, ROM, I/O ports, clocks, serial port, clock circuit and interferes. Microcontrollers are utilized as a part of different naturally controlled gadgets, for example, remote controls, car motor control frameworks, restorative gadgets, control apparatuses, office machines, toys, and other implanted frameworks.

D. LCD display

In this project, the output device is an LCD display which is fixed on the vehicle, at which the proposed system is implemented. The output device is connected to the microcontroller. When the microcontroller decides the type of warning message to be displayed, it sends the signal to the transmitter, the transmitter transmits the respective warning message. LCD basically displays the distance measured by the sensor for the microcontroller to display the required message.

V. METHODOLOGY

Our project presents an automatic braking system for collision avoidance using vehicle to vehicle communication. The communication protocol includes Zigbee to communicate the information between two vehicles. The distance measurement between two vehicles is done by Ultrasonic sensor. It consists of ultrasonic wave emitter and ultrasonic wave receiver. The ultrasonic wave emitter is provided which emits ultrasonic waves in a predefined distance and ultrasonic wave receiver which receive the reflected wave and is measured to get the distance between vehicle and other vehicle, objects etc. Then microcontroller is used to control the servo motor based on detection pulse information and the servo motor in turn automatically controls the braking of the car. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring), commonly known as Arduino IDE, the Arduino development environment (based on Processing). The microcontroller controls entire process, it is programmed to send a signal to buzzer and Zigbee when the distance range is obtained. Piezoelectric sound buzzer is used to warn the user. During night times some of the vehicles such as car, bus may break down at the highways. This vehicle now appears to be an obstacle to the vehicle that is coming behind of it. This causes greater chances of accident, the vehicle coming behind may hit hardly to the back of stationary vehicle and it may lead to the greater damage. For eg., if a car is approaching from back and there is no obstacle in the front then the microcontroller will accelerates the car by itself and also fog affects

visibility, the sensors would recognize another car and alert the driver of any dangers that lie ahead, giving the driver enough time to slow down, allowing him to escape from what could have been a bad accident.

VI. WORK STRUCTURE

A. Block Diagram

Following is the block diagram of the proposed architecture that has been used as the basic model for making this project:

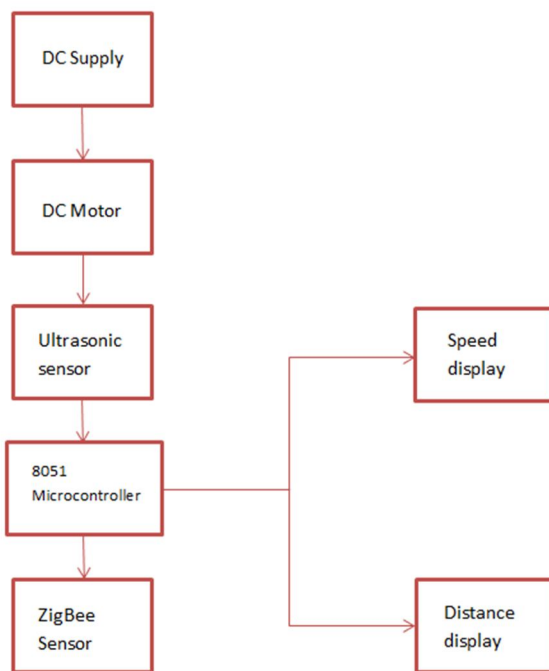


Figure 2: Block Diagram of the proposed Circuit

B. Flow Chart

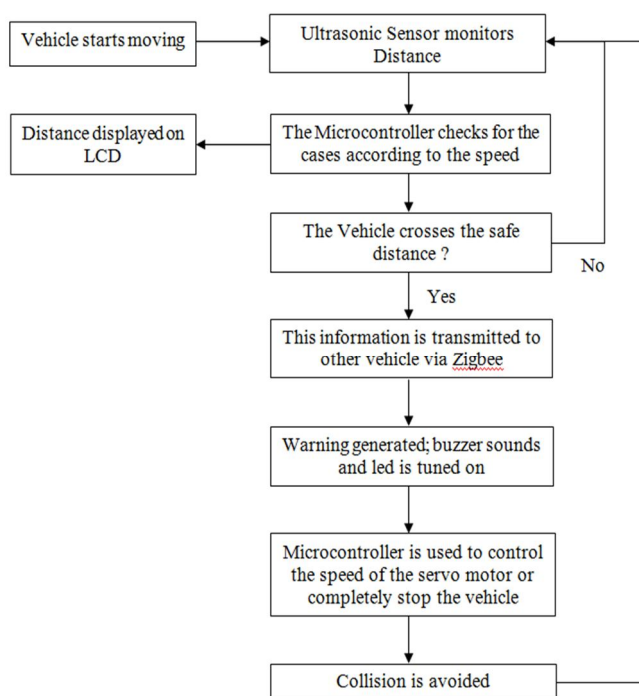


Figure 3: Flow Chart of the project

VII. HARDWARE REQUIREMENTS AND IMPLEMENTATION

Vehicle-to-vehicle communications subsists of an incorporated wireless network infrastructure in which the automobiles can send messages and signals to each and every vehicle about the information at which what is happening in real-time. These data may include speed of the vehicle, the location of the vehicle, travel direction of the vehicle and capacity of the vehicle and stability loss of the vehicle. The microcontroller can be defined as a microchip which consists of programmable input and output peripherals which is connected to a processor and a memory. These embedded chips are used due to its various advantages in this project. 8051 microcontroller is used to perform the complete tasks present in this methodology. The microcontroller is interfaced between all the components present in this system. Whenever it receives the input signals from the input devices, it checks whether the distance is in the same range as given to the sensor. Depending upon the type of inputs, it sends the commands to the activators that is the LCD screen. The system then acts according to the microcontrollers' commands. The vehicles can communicate about the current speed. The speed of the targeted vehicle in front of the vehicle is continually monitoring the speed. If the speed drops suddenly the car behind comes to know about it at that very moment and the breaks are applied avoiding a possible accident. These sensors are connected to the microcontroller. As they measure the distance between two vehicles, this measurement is sent to the microcontroller which compares the distance with the minimum required distance. If this distance is more than the one set in sensor, microcontroller sends a signal to apply brakes and this information is displayed on the LCD screen. Otherwise, the vehicle continues to move with the same speed as before. The same algorithm is for the case when the vehicle encounters any obstacle in front of it. The vehicle applies brake when the sensor detects the distance and the message is shown on the LCD screen.

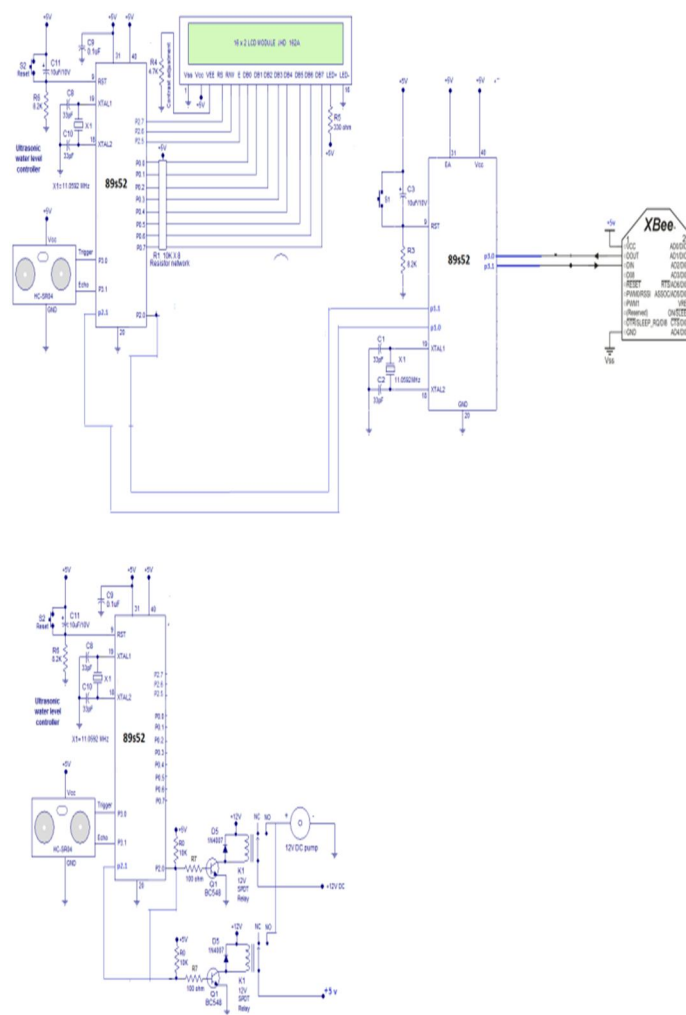


Figure 4: Circuit Diagram of Circuit 1

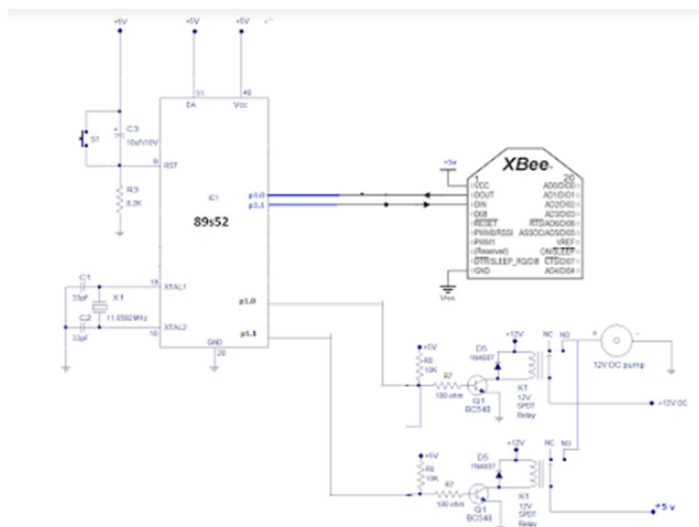


Figure 5: Circuit Diagram of Circuit 2

VIII. KEIL SOFTWARE

Keil Software, world's leading developer of Embedded Systems Software, makes ANSI C compilers, macro assemblers, real-time kernels, debuggers, linkers, library managers, simulators, integrated environments, and evaluation boards for the 8051, 251, ARM7, and C16x/ST10 microcontroller families. Keil Software implemented the first C compiler designed from the ground-up specifically for the 8051 microcontroller.

IX. RESULT

The project aims towards designing a system that can avoid collision in order to avoid vehicular accidents. The two cases up taken were:

- A. Communication between two vehicles so that whenever the one ahead suddenly stops, the sensor is able to detect the distance and send signals to microcontroller asking it to apply brakes.
- B. When an obstacle occurs in front of the vehicle and the vehicle has to apply brakes to prevent any kind of damage.

X. CONCLUSION

Communication has offered many new opportunities for the automotive industry. This paper proposes a technology to improve traffic congestion and road safety. Also we have analyzed situations like collision, delay and redundancy etc. which can be improved or overcome with simple warning message transmission. The contemplated system is designed into two small car models as a prototype to control the distance between the car and the preceding car and also distance between the front obstacles and initiates automatic braking.

XI. FUTURE SCOPE

A. Safety

Vehicle-to-vehicle or V2V communication is the wireless transmission of data between motor vehicles and the primary motive of this communication is to prevent accidents. This will enable the vehicles to know what oncoming vehicles are doing or vehicle those are around corners and out of sight. Cautioning of vehicle implosion can be transmitted all through the remote correspondence territory with the goal that the mischance can be avoided. This way, the ratio at which accidents occur on a daily basis will be reduced radically.

B. Road Condition Warning

If driver detects some bad road condition or problem, a warning message can be transmitted to other vehicles to generate speed recommendations or figure alternate route and this gets displayed on the LCD screen.



C. Future Advancement

With the headway in the V2V correspondence, the applications can be expanded in our day to day lives. A portion of the progression is utilization of radar or sonar sensor rather than ultrasonic sensor. With the utilization of radar and sonar sensor, the vehicle can act as indicated by the circumstance, condition and scene. The development is going in further advancements so that the vehicle can communicate to as many as possible at the same time which includes not only communicating with the vehicles nearby but also with the infrastructure.

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