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Vehicle to Vehicle Communication for Crash Avoidance System Based on CAN Bus

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Abstract: *Controlled Area Network (CAN) architecture has been implemented to avoid accidents that are happening around the world. The benefits of CAN based bus network over other communication protocols will offer increased flexibility for future technology insertions. 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 pre-emptive actions as braking to slow down.*

Keywords: *Collision Warning System, CAN Protocol, Vehicle to Vehicle Communication, Atmega Controller.*

I. INTRODUCTION

Cars on the same direction in highway usually keep a safe distance one another with a similar speed. However, due to the driver's distraction, long-time driving fatigue, flake out, or even a sudden deceleration of the previous car, a serious collision accident may occur if the driver can not react in time to brake. On the other hand, drivers need the mirrors to know other approaching cars from two-side or from the rear end. Even the driver checks around carefully, he cannot take an immediate respond, except push the horn, to a sudden approaching car and an accident is thus unavoidable. Therefore, developing a front obstacle warning system and a rear end collision avoidance system subject to all directions are important in collision avoidance. For the front-end collision avoidance subsystem, Ultrasonic sensor is adopted to measure the distance with respect to the previous car.

For rear-end end collision avoidance subsystem, the currently available ultrasonic sensors for vehicles are adopted for approaching cars with relatively low speed. While the rough reading of distance data cannot be applied directly, an intelligent approach is proposed to process the raw distance readout of sensors to produce appropriate warning signals. When there are more electrical control devices in the modem cars, such as power train management system, antilock braking system (ABS), and acceleration skid control (ASC) system, etc, the functionality and wiring of these electric control units (XU) are getting more complicated. Therefore, it is of great concern to upgrade the traditional wire harness to a smart & car network. In 198Os, a Germany car component Robert Bosch Co. introduced an in-car network; the controller area network (CAN) bus, to replace the complex and expensive traditional in-car wiring [5]. In this study, a high-level protocol CAN open is adopted to interconnect those CAN nodes with reliable communications among sensors.

A Collision Avoidance System is also known as an advanced driver-assistance system designed to prevent or reduce the severity of a collision. In collision warning system monitors the distance between the vehicles to provide a warning to the driver if the vehicles get too close, potentially helping to avoid a crash. LIDAR sensors are used to detect an imminent crash. Rear-end Vehicle and Pedestrian are detected to avoid Collision to activate the vehicle braking system to decelerate the vehicle speed to avoid a collision. As considered in some research projects Collision avoidance system is the interaction between lidar and Breaking ECU through the high-level CAN Protocol. The CAN Transceiver is used to interconnect those CAN nodes with reliable communications among sensors ECU and Breaking ECU.

II. LITERATURE SURVEY

Development of Autonomous Emergency Braking control system based on road friction

I-Chun Han discussed about the AEB is one of the important vehicle active safety functions to avoid or mitigate a collision. In general, the AEB system employs a Time-To-Collision to measure the potential danger of impact into obstacles. Time-To-Collision is the smaller threshold to activate the braking system. road condition is intricate and can change at any time. The estimated peak road friction is then used to obtain the braking threshold of TTC. Since road friction can be identified in real-time, the proposed AEB algorithm can adapt to different road surfaces. The simulation results show that the proposed control strategy has better performance than that of the conventional one.

Control system design for an Automatic Emergency Braking system in a sedan vehicle

O. Garcia-Bedoya discussed the Automatic Emergency Braking (AEB) system in vehicles is one of the technologies suggested by NHTSA to be included in vehicles by default. This article presents the dynamic model of the vehicle that should be considered to design control of the EAB system. After that, the design of a classic controller is presented, following some results of simulations, which let to identify variables to measure the comfort of automatic braking, and when and in which conditions the ABS systems act over the action of AEB.

Can-Based Accident-Avoidance System

Mayur Shinde discussed about Safety is generally the most significant property of automotive systems, and it is further improved by Advanced Driver Assistance Systems in modern automotive systems. To support advanced autonomous functions are connected. From the perspective of in -vehicle architecture communication. The Controller Area Network (CAN) protocol has been the focus of automotive security studies and has no direct support for security projection. A collision avoidance system is an arrangement of sensors, microcontrollers, and buzzers that are placed within a car to alert its driver of any dangers that may lie ahead on the road.

Research in the field of V2V communication for crash avoidance systems based on the CAN bus is ongoing, and there are numerous studies available on this topic. Some notable studies Include:

1. **Vehicle-to-Vehicle Communication for Crash Avoidance:** Implementation and Experimental Evaluation by E. Ozguner, M. Xu, and M. R. Napolitano. This study presents a V2V communication system for crash avoidance that is based on the CAN bus. The system was tested in a simulated environment, and the results showed that it was effective in preventing collisions.

2. **Vehicle-to-Vehicle Communication for Enhanced Road Safety:** A Surveyby L. Cheng and M. Huang. This study provides an overview of V2V communication for road safety and discusses the challenges and opportunities associated with this technology.

3. **Experimental Study of Vehicle-to-Vehicle Communication for Intersection Collision Avoidance**: by M. W. S. Cheung, K. H. Ng, and S. H. Ho. This study evaluates the effectiveness of a V2V communication system for intersection collision avoidance based on the CAN bus. The system was tested in a simulated environment, and the results showed that it was effective in reducing the number of collisions.

4. **Vehicular Ad-Hoc Networks for Crash Avoidance Systems**: by Thomas D.C. Little and Rajgopal Kannan: This paper provides an overview of V2V communication and its potential for crash avoidance systems. It discusses the technical challenges associated with V2V communication, such as reliability and security, and presents different solutions for addressing them.
5. **Vehicle-to-Vehicle Communication:** Readiness of V2V Technology for Application" by the National Highway Traffic Safety Administration: This report provides an overview of V2V communication technology and its potential

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benefits for enhancing road safety. It discusses the current state of V2V technology, including its readiness for implementation and the challenges associated with deployment.

III. PROPOSED SYSTEM

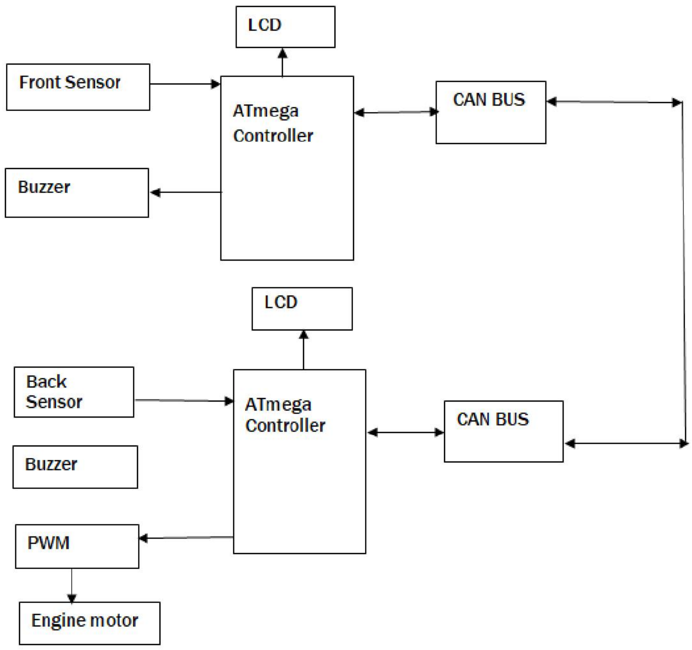

Figure 1: Block Diagram

As shown in block diagram in our demo project has two nodes are installed in vehicle and communication between nodes takes place control area network (CAN) bus At every node we can connect different types of sensors and actuators It is observed mostly when collision between vehicle takes place speed of vehicle play important role in result damage if the speed of vehicle is low damage is not severe. In this particular project when the any other vehicle or object is closed to our vehicle ultrasonic sensor sense the vicinity of object and accordingly give instruction to microcontroller to take suitable action. If any vehicle is near to our vehicle in the range of 10-to-20-meter microcontroller gives alarm and also by controlling PWM signals speed of engine motor can be control to increase or decrease the speed of vehicle. This module is proposed module in electrical vehicle.

A.ATmega328 Controller

ATMEGA328P is high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards.ATmega328 has 1KB Electrically Erasable Programmable Read-Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply.

Moreover, ATmega-328 has 2KB Static Random Access Memory (SRAM). ATmega 328 has several different features which make it the most popular device in today's market. These features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software secu*rity, throughput up to 20 MIPS etc.

- ATmega328 is an 8-bit, 28-Pin AVR Microcontroller, manufactured by Microchip, follows RISC Architecture and has a flash-type program memory of 32KB.

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- Atmega328 is the microcontroller, used in basic Arduino board's i.e., Arduino UNO, Arduino Pro Mini and Arduino Nano.
- It has an EEPROM memory of 1KB and its SRAM memory is 2KB.
- It has 8 Pins for ADC operations, which all combine to form PortA (PA0 - PA7).
- It also has 3 built-in Timers, two of them are 8 Bit timers while the third one is 16-Bit Timer

Figure 2: ATmega 328

B.CAN MCP2515Module

Communication protocols like UART (Serial), I2C and SPI are very popular because several peripherals can be interfaced with Arduino using these protocols. CAN (Controller Area Network) is another such protocol, which isn't very widely popular in general, but find several applications in the automotive domain.While going into the details of CAN bus is beyond the scope of this article, you can find the relevant information here. However, here are a few things you should know −

- CAN is a message-based protocol (i.e., the message and content are more important than the sender). A message transmitted by one device is received by all devices, including the transmitting device itself.
- If multiple devices are transmitting at the same time, the device with the highest priority continues transmission, while others back off. Note that since CAN is a message-based protocol; IDs are assigned to messages and not the devices.
- It uses two lines for data transmission CAN_H and CAN_L. The differential voltage between these lines determines the signal. A positive difference above a threshold indicates a 1, while a negative voltage indicates a 0
- The devices in the network are called nodes. CAN is very flexible in the sense that newer nodes can be added to the network, and nodes can be removed as well. All the nodes in the network only share two lines.
- Data transmission happens in frames. Each data frame contains an 11 (base frame format) or 29 (extended frame format) identifier bits and 0 to 8 data bytes.

Now, Arduino Uno doesn't support CAN directly like it supports UART, SPI and I2C. Therefore, we will use external module, MCP2515 with TJA1050 transceiver, that interfaces with Arduino via SPI, and the transmits the message using CAN.

Fig.3. CAN Transceiver Module

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C. LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

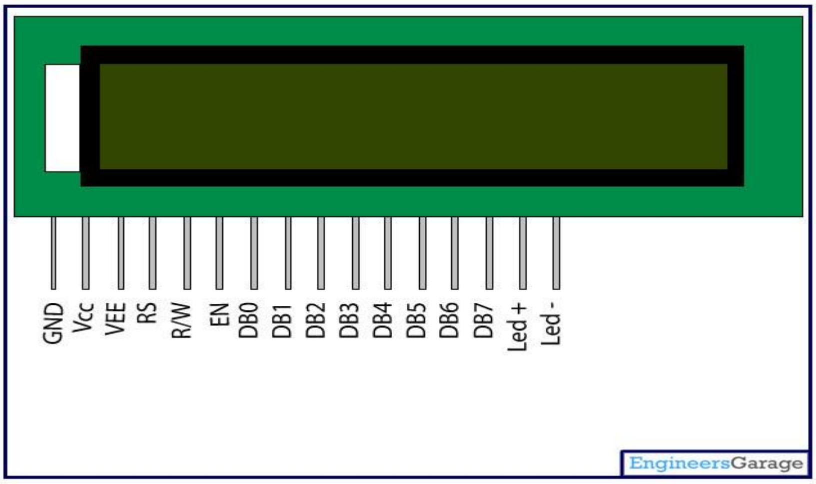

Figure 4: LCD Display

D. Ultrasonic Sensor

The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object. This sensor reads from 2cm to 400cm (0.8inch to 157inch) with an accuracy of 0.3cm (0.1inches), which is good for most hobbyist projects. In addition, this particular module comes with ultrasonic transmitter and receiver modules.

Features

Here's a list of some of the HC-SR04 ultrasonic sensor features and specs—for more information, you should consult the sensor's datasheet:

- Power Supply:+5V DC
- Quiescent Current: <2mA
- Working Current: 15mA
- Effectual Angle: <15°
- Ranging Distance: 2cm – 400 cm/1″ – 13ft
- Resolution: 0.3 cm
- Measuring Angle: 30 degrees
- Trigger Input Pulse width: 10uS TTL pulse
- Echo Output Signal: TTL pulse proportional to the distance range
- Dimension: 45mm x 20mm x 15mm

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Figure 5: Ultrasonic Sensor

E.LDR Sensor

Photoresistors, also known as light dependent resistors (LDR), are light sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity. In the dark, their resistance is very high, sometimes up to 1 MΩ, but when the LDR sensor is exposed to light, the resistance drops dramatically, even down to a few ohms, depending on the light intensity. LDRs have a sensitivity that varies with the wavelength of the light applied and are nonlinear devices. They are used in many applications, but this light sensing function is often performed by other devices such as photodiodes and phototransistors. Some countries have banned LDRs made of lead or cadmium over environmental safety concerns.

LDR (Light Dependent Resistor) as the name states is a special type of resistor that works on the photoconductivity principle means that resistance changes according to the intensity of light. Its resistance decreases with an increase in the intensity of light. It is often used as a light sensor, light meter, Automatic Street light, and in areas where we need to have light sensitivity. It is also called a Light Sensor. LDR are usually available in 5mm, 8mm, 12mm, and 25mm dimensions.

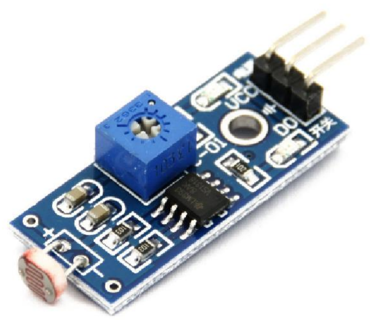

Figure 5: LDR Sensor

IV.CONCLUSION

In conclusion, the development of a vehicle-to-vehicle communication system for crash avoidance based on the CAN bus has the potential to significantly improve road safety and reduce the risk of collisions caused by human error or other factors. The system would exchange information such as speed, direction, and position between vehicles to detect potential collisions and take appropriate action to avoid accidents. The advantages of this system are numerous, including improved road safety, reduced risk of collisions, automatic control in emergency situations, real-time and accurate data sharing, and a user-friendly interface. The system has direct applications in the automotive industry, smart transportation systems, fleet management, and emergency services, among others.

The success of this project could increase the adoption of vehicle-to-vehicle communication systems in the automotive industry, leading to further advancements in this area. Therefore, the development of a reliable and effective vehicle-to-vehicle communication system for crash avoidance based on the CAN bus is an important step towards improving road safety and efficiency in transportation systems. The major objective of this is to the development of the accident-avoidance system for automobiles using CAN protocol.

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