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Arduino Based Can Protocol Implementation In Vechicle Control System

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Abstract: Based on requirements of modern vehicle, in- vehicle Controller Area Network (CAN) architecture has been implemented. In order to reduce point to point wiring harness in vehicle automation, CAN is suggested as a means for data communication within the vehicle environment. The benefits of CAN bus based network over traditional point to point schemes will offer increased flexibility and expandability for future technology insertions. This paper presents the development and implementation of a digital driving system for a semi-autonomous vehicle to improve the driver-vehicle interface. It uses an ARDUINO based data acquisition system that uses ADC to bring all control data from analog to digital format and visualize through LCD. The communication module used in this project is embedded networking by CAN which has efficient data transfer. It also takes feedback of vehicle conditions like Vehicle speed, Engine temperature etc., and controlled by main controller.

Keywords: Control Area Network(CAN), collision avoidance system

I. INTRODUCTION

Nowadays accidents occur due to mistakes done by driver. An intelligent system needs to be developed to overcome these mistakes. So this system is proposed where mistakes done by driver are eliminated. Most of the intelligent car systems have monitoring system only. Antilock brakes, speed sensors and other automatic systems are present in sports cars and other luxury cars only. But these cars are not affordable to everyone. So, a system needs to be developed which can be implemented in every car.

A collision avoidance system is a system of sensors that is placed within a car to warn its driver of any dangers that may lie ahead on the road. Some of the dangers that these sensors can pick up on include how close the car is to other cars surrounding it, how much its speed needs to be reduced while going around a curve, and how close the car is to going off the road.

The system uses sensors that send and receive signals from things like other cars; obstacles in the road, traffic lights, and even a central database are placed within the car and tell it of any weather or traffic precautions. A situation that provides a good example of how the system works is when a driver is about to change lanes, and there is a car in his blind spot. The sensors will detect that car and inform the driver before he starts turning, preventing him from potentially getting into a serious accident.

Ultrasonic sensor is adapted 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. Also an alcoholic sensor is included in the car to monitor the person in the car; if the person appears to be drunk the transmission will be automatically switched off. If accident occurs then bump sensor detects accident and immediately sends SMS to hospitals and police station about location of accident.

II. OVERVIEW OF CAN PROTOCOL

Controller area network (CAN) provide high reliability and good real-time performance with very low cost. Due to this, CAN is widely used in a wide range of applications, such as in-vehicle communication, automated manufacturing and distributed process control environments.CAN bus is a serial data communication protocol invented by German BOSCH Corporation in 1983. CAN is a network protocol which is designed for the car industry [1]. Since data communication in car often have many sensors transmitting small data packets, CAN supports data frames with sizes only up to 8 bytes as shown in Figure 1. Meanwhile, the 8 bytes will not take the bus for a long time, so it ensures real-time communication. CAN use a large amount of overhead, which combined with a 15-bit CRC makes CAN very secure and reliable. CAN is a LAN (Local Area Network) controller CAN bus can transfer the serial data one by one. All participants in the CAN bus subsystems are accessible via the control unit on the CAN bus interface for sending and receiving data. CAN bus is a multi-channel transmission system. When a unit fails, it does not affect others. The data transfer rate of CAN bus in a vehicle system is different.

Start of Frame	Arbitration Field	Control Field	Data Field (up to 8 bytes)	CRC Field	ACK Field	End of Frame

FIG 1. CAN Data Frame

The CAN Standard

CAN is an International Standardization Organization (ISO) defined serial communications bus originally developed for the automotive industry to replace the complex wiring harness with a two-wire bus. The specification calls for high immunity to electrical interference and the ability to self-diagnose and repair data errors. These features have led to CAN's popularity in a variety of industries including building automation, medical, and manufacturing.

The CAN communications protocol, ISO-11898: 2003, describes how information is passed between devices on a network and conforms to the Open Systems Interconnection (OSI) model that is defined in terms of layers. Actual communication between devices connected by the physical medium is defined by the physical layer of the model.

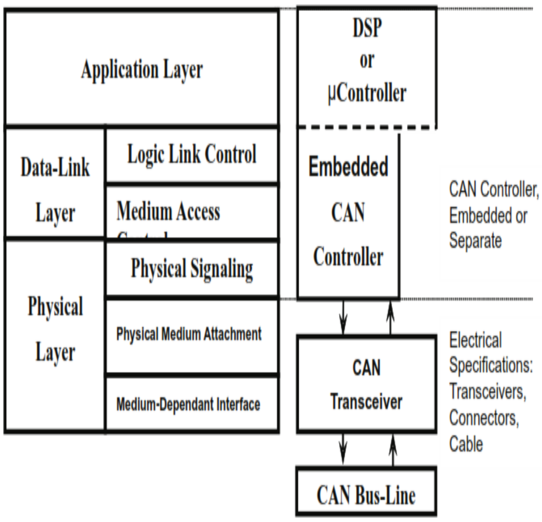

FIG 2. The Layered ISO 11898 Standard Architecture

III. HARDWARE DESIGN

The proposed block diagram for CAN bus communication system is as shown in Figure 3. In this system the ultrasonic sensor is mounted on the front and backside of the car for measuring the distance between the two cars and if the distance is less then to avoid accident warning signal will be given to the driver on the LCD.

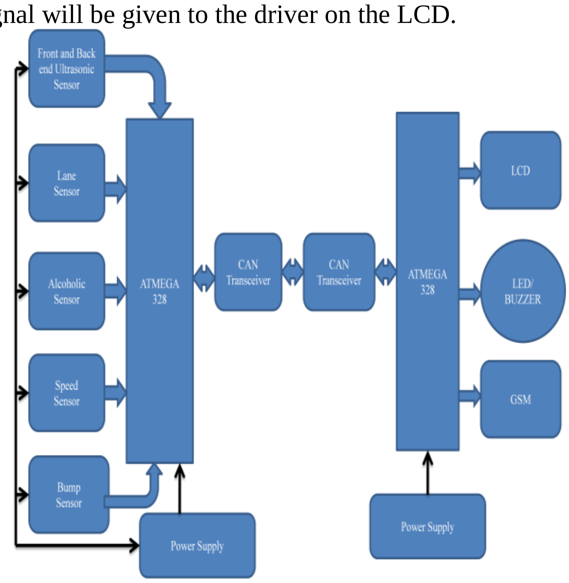

FIG 3.Block Diagram

The alcoholic sensor will sense whether the driver is drunk and if the driver is drunk then the driver will not be allowed to start the car. If the car accidently changes its lane then it will be detected using an IR sensor and buzzer will be turned on. The speed sensor will monitor the speed of the car and if found high then warning will be given to the driver using an alarm. Here the sensors will communicate with the output devices using CAN (Control Area Network) protocol which will be implemented in the AVR controller.

A. Ultrasonic sensor

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar, which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. It is used to measure the distance with respect to the previous car. While the car is in motion the distance of another car is measured and accordingly warning signals are given to the driver.

B. Alcoholic sensor

The alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyser. It has a high sensitivity and fast response time. Alcoholic sensors in it to monitor the person in the car. If the person appears to be drunk the transmission will be automatically switched off.

C. Speed sensor

A wheel speed sensor or vehicle speed sensor (VSS) is a type of tachometer. It is a sender device used for reading the speed of a vehicle's wheel rotation. It usually consists of a toothed ring and pickup.This sensor monitors the speed of the car and if the speed is found to be more than a prescribed level then a warning signal will be given to the driver.

D. Lane sensor

In road-transport terminology, a lane departure warning system is a mechanism designed to warn a driver when the vehicle begins to move out of its lane (unless a turn signal is on in that direction) on freeways and arterial roads. These systems are designed to minimize accidents by addressing the main causes of collisions: driver error, distractions and drowsiness.

E. Bump Sensor

The bump sensor detects accidents and if accident is detected then a message is send a message to hospital and police station about location of accident.

F. Microcontroller

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

G. Transceiver

CAN transceiver MCP2551 adapts signal level from the bus to level that the CAN controller expects and has protective circuitry that protects the CAN controller. It converts the transmit-bit signal received from the CAN controller into a signal that is sent onto the bus.

IV. PROPOSED ALGORITHM

Algorithm for the proposed system is divided in two parts as follows: Transmitter and Receiver

A. Transmitter

Algorithm for transmitter side which consists sensors, AVR microcontroller and CAN (MCP2515) is as follows:

1) Initialize SPI (Serial Peripheral Interface).
2) Initialize LCD.
3) Initialize CAN (MCP2515).
4) Provide impulse to ultrasonic sensor.
5) Measure distance from other car and display on LCD.
6) Transmit distance via CAN (MCP2515).
7) If alcohol sensed send X else go to step 8.
8) If lanes cutting detected send Y else go to step 9.
9) Sense speed and if speed goes beyond range send Z else go to step 10.
10) Check for impact and if impact detected sends A else go to step 4.

B. Receiver

Algorithm for transmitter side which consists output devices, AVR microcontroller and CAN (MCP2515) is as follows:

1) Initialize SPI (Serial Peripheral Interface).
2) Initialize LCD.
3) Initialize CAN (MCP2515).
4) Send acknowledgment to the transmitter.
5) Receive distance data from CAN of transmitter and if distance is less then display warning signal on LCD.
6) If X is received then display “Car cannot be started” else go to step 7.
7) If Y is received then display “Wrong lane” else go to step 8.
8) If Z is received then turn on buzzer else go to step9.
9) If A is detected then send SMS through GSM else go to step 5.

V. DESIGN SCHEME OF COMMUNICATION PROTOCOL

The design scheme of communication protocol is explained in this section. Identifier of the message is the unique character for the application program to distinguish messages. In this communication system, when a node receives a message correctly (until the last bit of the EOF area is right), the configured filter box message, and then save the messages with matched ID in receiving box. By using this feature, communication protocol can be made. Different identifiers are set for every data type or control command in this system, then distinguish the received messages conveniently, and choose corresponding processing mode[10]. The standard format of identifier is used in this system as shown in Figure 4[9]. It has 11 bits. Use of standard identifier can reduce the data length and improve data transmission efficiency. In this system, the 11 bit identifier is designed for the “address code + type code” format. Bits D7 to D4 of identifier is the address field, providing at most 16 address codes, and every address code corresponds to a individual node. Bits D3 to D0 is the type field, which can also provide 16 type codes. And the bits D10 to D8 is the backup filed which is used for system expansion. By configuring the value of the filter ID, each node would only receive the messages with the matched address code [10].

D10 D9 D8	D7	D6	D5	D4	D3	D2	D1	D0
000	0	0	0	1	0	0	1	0
backup	address code				type code			

FIG 4. Identifier format

VI. CONCLUSION

In this paper, the CAN-bus based communication system for accident avoidance system is designed. System can be upgraded easily and use of CAN reduces wiring to a great extent. Real-time, reliability and flexibility, all these characteristics make CAN BUS an indispensable network communication technology applied in automobile network communication field. With ATMEGA 328 as the main controller and it makes full use of the high-performance of ATMEGA 328, high-speed reduction of CAN bus communication control networks and instrument control so as to achieve full sharing of data between nodes and enhance their collaborative work. This system features efficient data transfer among different nodes in the practical applications.

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