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Arduino based vehicle control system using CAN Protocol

Shanmathi.S[1], Prof. C Kamalanathan [2],
Dr. S.M Ramesh[3], Dr.S.Valarmathy[4], B.Preethi[5]

[1,5]PG Scholar, [2]Professor , [3]Asst. Professor,[4]HOD
[1,2,3,4,5]Bannari Amman Institute of Technology
Sathyamangalam, India-638401
[1]lunashanmathi@gmail.com, [2]kamalanadhan@gmail.com,
[3]drsmramesh@gmail.com,[4]hodece@gmail.com,[5]bpreethiece@gmail.com

Abstract:- *The main purposes of Present Automobiles are being developed by more of electrical parts for efficient operation. Generally a vehicle was built with an analogue driver-vehicle interface for indicating various vehicle statuses like speed, fuel level, Engine temperature etc., This paper presents the development and implementation of a digital driving system for a semi-autonomous vehicle to improve the driver-vehicle interface and having Intelligent Braking system. The benefits of CAN bus based network over traditional point to point schemes will offer increased flexibility and expandability for future technology insertions. 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 CAN bus, LCD display, Ultrasonic sensor, controlling sensors, etc.*

1. INTRODUCTION

The protocol was developed aiming at automotive applications. Today CAN have gained wide spread use and is used in industrial automation as well as in automotives and mobile machines. The CAN protocol is implemented in silicon. This makes it possible to combine the error handling and fault confinement facilities of CAN with a high transmission speed. Examples of such devices include engine management systems, active suspension, ABS, gear control, lighting control, air conditioning, airbags and central locking. So, it is important that human drivers still have some control over the vehicle. Advanced in-vehicle information systems provide vehicles with different types and levels of intelligence to assist the driver.

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.

2. OVERVIEW OF CAN PROTOCOL

1. CAN Bus in an Automobile

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 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. For example, the rate of engine control system and ABS is high speed of real-time control fashion of 125Kbps to 1M bps. While the rate of movement adjustment is low-speed with transmission rate of 10 to 125K bps. Others like multimedia systems use medium-speed rate between the previous two. This approach differentiates various channels and increases the transmission efficiency.

2. CAN Bus for vehicle drive control System

A typical drive system with the control unit has electronic fuel injection system, automatic transmission systems, antilock braking system (ABS), airbag systems etc. These units are the core components in a modern car system. They are sensitive for time and closed to the reliability and security of the entire system. As each control unit for real-time requirement is based on the data update rate and the control period varies, in order to meet the real-time requirements of each

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subsystem, it is necessary to achieve the implementation of public data sharing, such as engine speed, wheel speed, and throttle pedal location. The contents include the completion of speed measurement, fuel measurement, A/D conversion, the calculation conditions, the control actuator and a series of processes. That means the sending and receiving data in 1ms must be completed within the electrical control in order to achieve real-time requirements [1]. Therefore, the data exchange network must be a priority-based competitive mode, and has a very high speed communication fashion [3].

3. CAN Bus for accessories control system

CAN bus for vehicle system is a leading control network that connects several objects. They are central controller, 4-gates controller, memory modules and other components. There are several items controlled by the CAN bus. They are locker, windows, luggage locker, mirrors and interior dome light[2]. In the case of remote control, it involves the remote control signal receiving and processing the anti-theft and warning systems.

4. 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 [4]. 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.

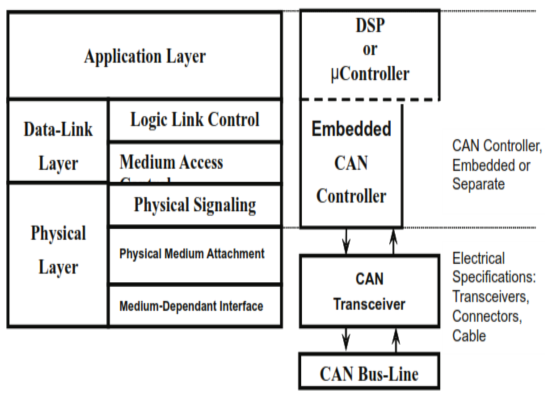

Figure 1: The Layered ISO 11898 Standard Architecture

3. 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.

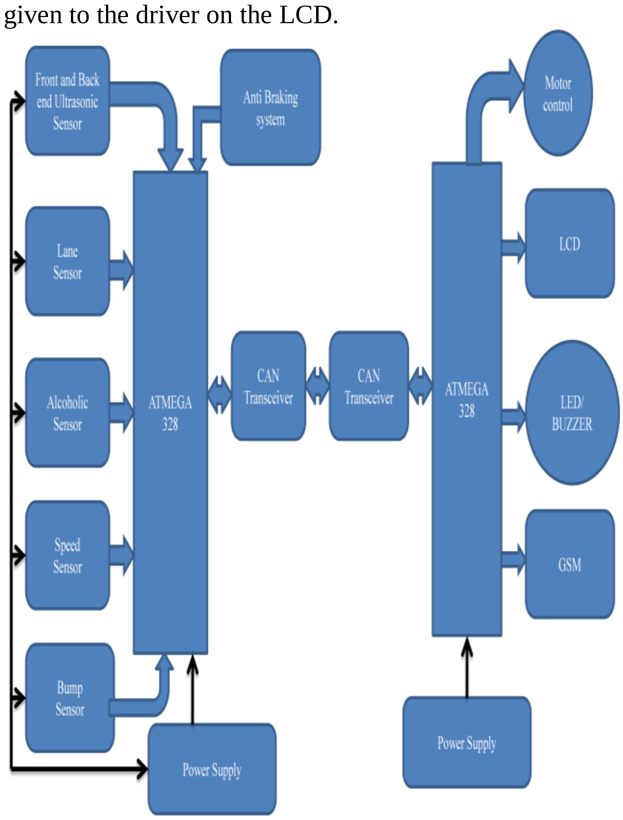

Figure 2: Block Diagram

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. Anti breaking system

ABS generally offers improved vehicle control and decreases stopping distances on dry and slippery surfaces for many drivers; however, on loose surfaces like gravel or snow-covered pavement, ABS can significantly increase braking distance, although still improving vehicle control. Since initial widespread use in production cars, anti-lock braking systems have been improved considerably. Recent versions not only prevent wheel lock under braking, but also electronically control the front-to-rear brake bias.

G. 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.

H. 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.

4. 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[5]. 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.

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.

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			

Figure 3: Identifier format

5. 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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