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Automotive control system using CAN protocol

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ABSTRACT

In the latest years, various developments are done in Automobiles Industries. This automobile is being developed by more of electrical parts for efficient operation and development of CAN based automobile control system CAN is a standard protocol for efficient and reliable communication between the sensor, actuator, controller and other nodes in real-time applications. CAN enable us to connect all the devices together using only two wires. The efficient data transfer rate up to 1Mbps. The CAN Protocol is used to exchange information between ECU. To provide an accurate result to the driver different sensors are used like Temperature sensor, Fuel level sensor, RPM sensor Ultrasonic Sensors, etc. CAN bus to implement the system to alert the driver. This paper provides the development and implementation of various previously presented systems, which are useful to improve the driver vehicle interface.

Keywords— *CAN (Controller Area Network), ECU (Engine Control Unit), Temperature sensor, Fuel level sensor, RPM sensor, Ultrasonic Sensors*

1. INTRODUCTION

To make driving easier, safety and reduce the human efforts various developments are done in the Automobiles Industries which will provides the different parameter directly to the driver, which will reduce the vehicle accident [1] In the past, devices and sensors in automotive industries are connected in a point to point wiring system which in turn causes the overall network system to be complicated, bulky, heavy and expensive [2]. In the early 1980s, Robert Bosch GmbH company has developed a new network controller in the automotive industries with the intention of replacing and simplifying the wiring system [3]. This development gave rise to a new network system, called the controller area network (CAN) [3]. The CAN system was developed as a serial bus with high speed, high reliability, and low cost for distributed real-time control applications, a multi-master, message broadcast system [4] Using CAN we get effective communication between transmitter and receiver CAN is easy in use, low cost and provided reduction in wiring complexity[5] The protocol was developed aiming at automotive applications with multiple sensors to monitor the various parameters and visualize them to the vehicle driver through an LCD display and alarm [6] Large numbers of sensors to provide driver assistance applications and the associated high-bandwidth requirements of these sensors have accelerated the demand for faster and more flexible network communication technologies within the vehicle [7] This paper discusses the development of existing car system which consists of a joint mechanism between the driver and vehicle for perception, decision making and control

2. CONTROLLER AREA NETWORK (CAN)

CAN bus is an inexpensive, robust vehicle bus standard designed for multiple CAN device communications with one another without a host computer. CAN is also called a multi-master serial bus and the CAN devices on the bus are referred to as nodes. Two or more nodes are required on the CAN network to communicate. All nodes are connected to each other via a two-wire bus (CAN H and CAN L) and the wires are 120ohms nominal twisted pairs. Termination resistor commonly 120 ohms is must in each node in order to suppress the reflections as well as return the bus to its recessive or idle state. Fig.1 is the block diagram of the CAN bus architecture, CAN bus contains only two wires for communication and has a multi-master structure where each device on the bus can send or receive data, here only one device can send data at any time while all the others listen [5] controller area network (CAN) protocol is used which is ease in use, low cost and provided reduction in wiring complexity. CAN is applied in the function of communication controllers that can transmit electric signals to different controllers in a vehicle system such as a signal lamp, audio, air conditioner, communication, electronic ignition, engine fuel injection, etc. Not only that CAN have been proven to reduce and simplify the number of signal lines and additionally solve many complex and difficult control problems of modern vehicles such as Automatic Stability Control (ASC) and Automatic Braking System (ABS) [8], [9].

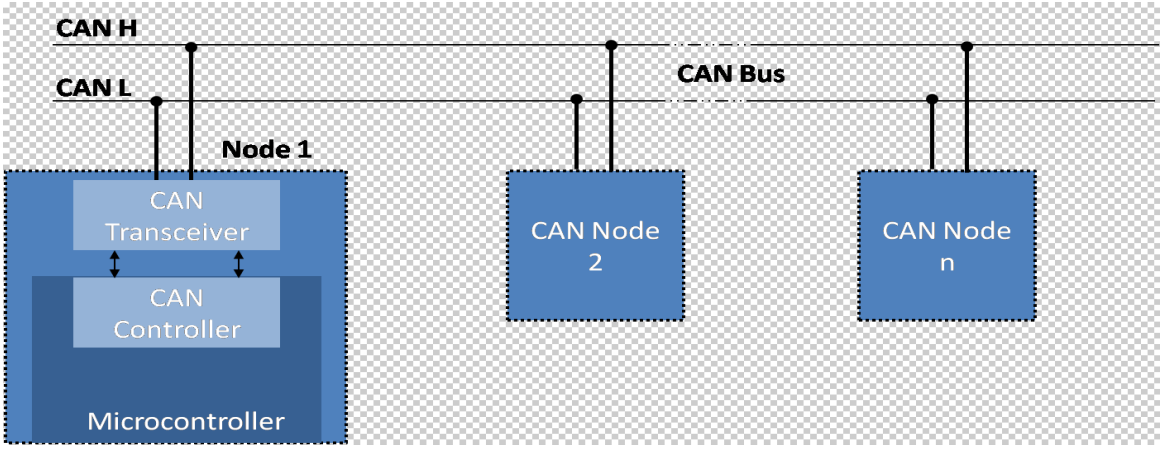

Fig. 1: Architecture of CAN bus

Each node in the CAN bus requires the following:

- Transceiver: It converts the data from the CAN controller to CAN bus levels and also converts the data from CAN bus levels to a suitable level that the CAN controller uses.
- CAN controller: They are often an integral part of the microcontroller that handles framing, CRC etc.
- Microcontroller: It decides what the received messages mean and what messages it wants to transmit.

The transceiver drives or detects the dominant and recessive bits by the voltage difference between the CAN H and CAN L lines. The nominal dominant differential voltage is between 1.5V to 3V and the recessive differential voltage is always 0V. CAN transceiver actively drives to the logical 0 (dominant bits) voltage level and the logical 1 (recessive bits) are passively returned to 0V by the termination resistor. The idle state will always be in the recessive level (logical 1).

Individually, CAN H will always be driven towards supply voltage (VCC) and the CAN L towards 0V when transmitting a dominant (0). But in a practical case, supply voltage (VCC) or 0V cannot be reached due to transceiver's internal diode drop. CAN H/L will not be driven when transmitting a recessive (1) where the voltage will be maintained at VCC/2.
The following figure depicts the block diagram and real-time capture of the CAN signals.

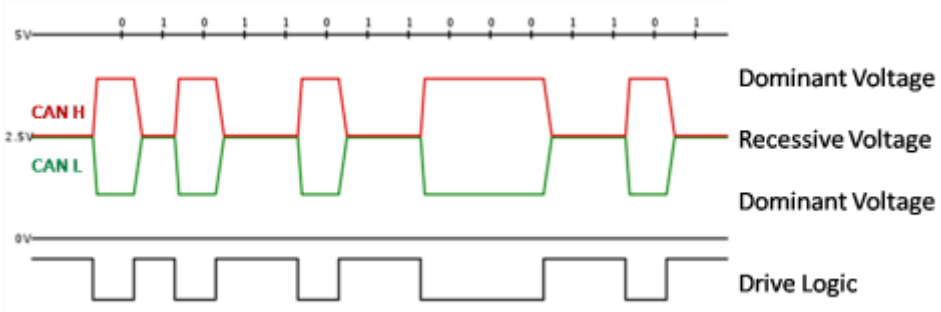

Fig. 2: CAN Bus – Voltage Levels

2.1 Need of CAN

- Numerous CAN products and tools on the object
- Hardware implementation of the protocol
- CAN Bus used for the combination of error handling and fault confinement with high transmission speed (up to 1Mbps)
- Simple transmission medium
- Twisted pair of is the standard, but also just one wire will work
- Other links work, too: Opto – or radio links
- Excellent error handling
- Fault confinement
- High speed, real-time communication
- Provide noise immunity in an electrically noisy environment

3. APPLICATION OF CAN

Presi. T. P. [1] design and development of a PIC microcontroller based vehicle monitoring system. This system provides monitoring of various vehicle parameters such as Temperature, the presence of CO level in the exhaust, Battery Voltage and Light due to spark or fire. Fig. 2 shows a block diagram of a system. The MCP2551 is used as CAN Controller, which is a high-speed CAN and fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. R. Manoj Prasanth [2] presents the intelligent braking system (IBS) using CAN protocol this project introduces an embedded system with a combination of CAN bus systems PIC as the main controller and it makes full use of the high-performance of PIC18f458 Fig. 3 shows a block diagram of a system.

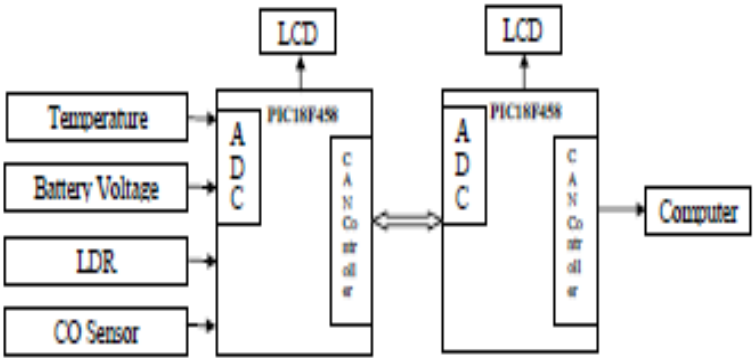

Fig. 3: Block diagram of system [1]

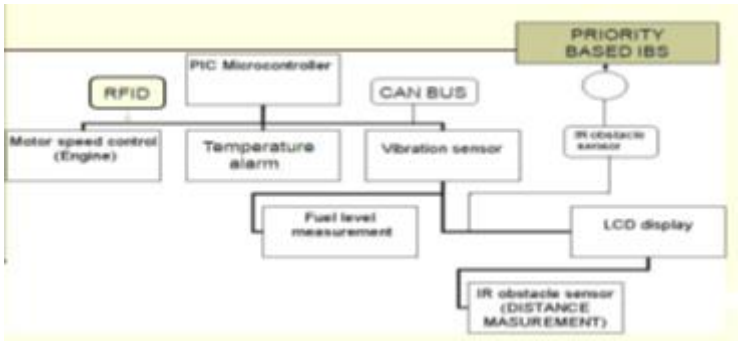

Fig. 4: Block diagram of the system [2]

It uses a PIC based data acquisition system that uses ADC to bring all control data from analogue to digital format and visualize through LCD. The PIC18f458 has message bit rates up to 1 Mbps and 29-bit identifier fields. This paper presents the development of distance measurement using Ultrasonic sensors which denotes that vehicle's position from obstacles. The vehicle detects the speed breaker& some critical zones before the certain limitation by tags using RFID module for introducing the new technology of priority based Intelligent Braking System (IBS).

Jadhav Snehal Dnyandeo [3] presents a digital driving system using CAN protocol. The system contains ARM-based data acquisition system that uses ADC to bring all control data from analog to digital format and communication module used in this proposed system was embedded networking by CAN which has efficient data transfer. This system keeps focusing on different parameter like temperature, speed, fuel level. For the temperature, Pt100 sensor was used and if the temperature increase above the 600 c the automatically cooling system applies due to this temperature is not exceeded. Speed measurement was done by using RPM sensor if revolution increases up to 70 per minute controller act and to avoid the maximum revolution and to check the fuel level continuously and display in the percentage if fuel level below 20 percent the controller gives buzzer to the driver and fuel level and temperature continuously display on the LCD. The hardware of the proposed system mainly contains CAN-bus controller, ARM LPC1768 as the main control module, Speed sensor, temperature sensor, ultrasonic sensor for obstacle detecting sensor, level sensor, LCD display to provide Digital interface etc. Figure 4 shows the general block diagram of the system [3],[10]

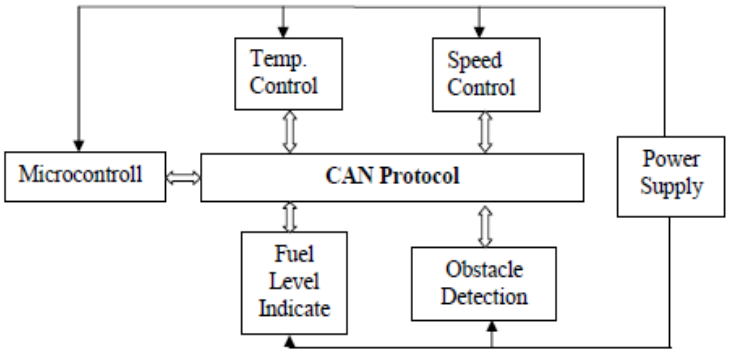

Fig. 5: General Block Diagram of System [3].

Pratiksha Nawale, Anjali Vekhande, Priyanka Waje [4] presents vehicle parameter monitoring system using CAN protocol this system presents the development and implementation of a digital driving system for a semi-autonomous vehicle to improve driver vehicle interface. The system presents the development of distance measurement using ultrasonic sensors which denotes the vehicle's position from obstacles. This paper consist the implementation of CAN protocol using PIC for vehicle monitoring system as well as monitoring of various vehicle parameters such as temperature, presence of CO level in the exhaust, Battery Voltage and Light due to spark or fire, Ultrasonic sensors generate high-frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Venkatesh H. and Rajashri Y Manakwad [5] developed a driver alerting system using CAN protocol. The vehicle itself known the danger parameter and this intelligent vehicle warns the driver regarding the danger ahead which will cause damage to the vehicle as well as his life also. Fig. 5 shows the Block diagram of the alerting system.

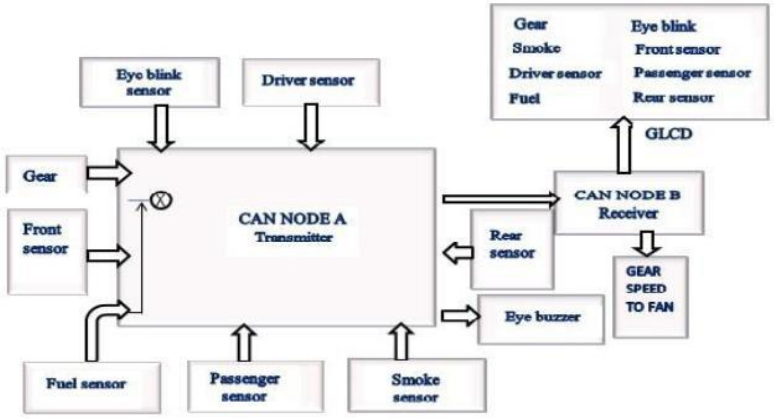

Fig. 6: Block diagram of the alerting system [5]

The architecture of the proposed system contains different hardware like GLCD; it is a Graphical LCD has a format for displaying of 128x64 dots, Joystick; which is used to control the gear system, ARM Processor; The ARM7 (LPC2129) is a general purpose 32-bit microprocessor which will provide performance and low power consumption, Eye blink sensor; to monitor driver whether he felt asleep while driving the vehicle, Fuel indication sensor, Smoke Sensor; to detects the presence of smoke at engine, Basic IR sensor, Relay, Buzzer, and CAN bus to implement the system to alert the driver.

3. CONCLUSION

The complexity of the existing controls systems and the need to exchange data between them means that more and more hardwired, dedicated signal lines have to be provided. In addition to the cost, the increased number of connections poses serious reliability, fault diagnosis, and repair problems during both manufactures and in service. The main goal of this paper is to provide details of the development of existing car system. This paper describes the design and development of the automobile control system using CAN protocol which will not only make driving simpler but also increase vehicle safety and security.

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