Vol 05, Article 10488, December 2014
http://ijves.com
International Journal of VLSI and Embedded Systems-IJVES
ISSN: 2249 – 6556

NETWORKING IN AUTOMOBILE USING CAN PROTOCOL

R.SIVA BABU[1], V.NARASIMHA RAO[2]
[1]R.Siva Babu, M.TECH, Embedded systems, Gudlavalleru engineering college,
[2]Sri.V.Narasimha Rao, Assistant Professor, Gudlavalleru engineering college,
[1]Sivababu23gec@gmail.com,[2]narasimharao_valluru@yahoo.co.in

ABSTRACT

Controller Area Network (CAN) bus is a vehicle bus is communication in a vehicle between microcontrollers and electronic devices without a host computer. CAN bus is a serial data bus which message-based protocol. CAN based protocol mainly used for automotive applications but it is also used in other fields like aviation and maritime, space, industrial and medical fields. CAN is a standard protocol for efficient and reliable communication between sensor, actuator, controller and other nodes in real-time applications. This project is aimed at the implementation of CAN protocol using ARM Microcontroller for vehicle monitoring and controlling system.This project tells about the design and development of a digital driving interfacing system for automated vehicles. To give real time data and accuracy of the data to the driver for better decision making. This projects uses an ARM based processor for data processing and speed. It contains the analog to digital converter's, these ADC'S takes data from the different sensors and converts analog data to digital data. The processed digital data is visualized through LCD. The communication system used in this project is the CAN protocol for efficient data transferring between multiple nodes. The main feature is to monitor various parameters such as presence of CO level, Battery voltage, Light Dependent Resistor (LDR), Temperature. In this each sensed parameter is prioritized and gives the appropriate output to do the specified task. The program is compiled in KEIL µvision3 using Embedded C. Hardware is implemented and software porting is done. The benefits of CAN bus based network over traditional point to point schemes will offer increased flexibility and expandability for future technology insertions.

KEYWORDS— *Controller Area Network (CAN) protocol, CO level, LDR, KEIL compiler, ARM Microcontroller*

1. INTRODUCTION

The continuous and sudden changes in the embedded systems make most of the technology into the vehicles. The changes in the technology cause the difference in the accuracy, capabilities and interaction with vehicle operator. Most of the vehicles in the ambiguous state whether to give the warning signals to the human vehicle operator or make the decision automatically to control the vehicle, but most of the vehicles acted upon the incomplete information. SO it is necessary to leave the decision to the human vehicle operators still have the control of the vehicle. In modern vehicles the intelligence networking system gives the advanced information to the vehicle operator and assist in the decision making process. The introduction of new embedded technologies allowed into the vehicle design has gives mutual beneficial relationship between the vehicle operator and vehicle by providing a sophisticated & intelligent driver-vehicle interface through an intelligent information network. This paper discusses the development of such a control framework for the vehicle which is called the digital-driving behaviour, which consists of a joint mechanism between the driver and vehicle for perception, decision making and control. To warn vehicle operator about any dangers ahead of the road is detected by sensors using collision avoidance system. The sensors do the work of objects around the cars like trees, rocks, poles and how close to the some other cars around the operating vehicle. These cars also give warnings about the parking slots about two cars trying to occupying the same slot by estimating their distance between the cars about the possible collision, while going around a curve, and how close the car is to going off the road. It tells about the how much speed needed around schools is also given by devices in the car.

The intelligent networking system in a semi automated vehicles uses sensors to communicate between the other cars. Some vehicles maintain database to estimate the data weather patterns and traffic patterns by connecting to the internet. For example a car is travelling in a predefined GPS based route positioning system. In this first it checks the current and destination positions using GPS co-ordinates. Then it checks the traffic patterns to reach from source to destination. Then it checks different route distance and their times taken to reach the destination. It verifies the speed limits on the road with distance taken to reach the destination obviously the intelligent system informs the driver which route takes the less time and less distance and more time and distance. Finally it is driver's decision which route wants to travel. For suppose an accident occurs or more traffic in the travelling route, cars communicate with other about the incident and intelligent vehicle can avoid this route and change to another route. To avoid collision ultrasonic sensors used to measure the distance between vehicles. If the measured distance is more then it digital networking system warns the driver about the possible collision. In this way different sensors used for different purposes in the vehicle automation.

2010-2014 – IJVES

Vol 05, Article 10488, December 2014
http://ijves.com
International Journal of VLSI and Embedded Systems-IJVES
ISSN: 2249 – 6556

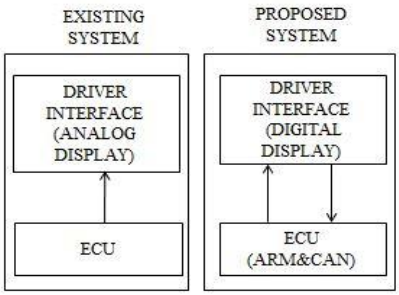

Fig1. Existing and Proposed vehicle control system

The remote frame is requested by the receiving section to get the message from the transmitting section. It consists of six fields: start of frame, arbitration field, control field, CRC field, ACK field, and end of frame field. Except lack of a data field in the remote frame, the data frame and remote frame are same. Generally the CAN hardware causes the Error frame generation and transmission. These error frames are used to indicate the error occurred during the transmission. An error frame consists of an error flag and an error delimiter. In these error flags are subdivided into two types, active and passive. The overload frame in the receiving unit tells it is not ready to receive frames form the transmitting section. The overload frame consists of the overload delimiter and flag. Generally vehicle are designed with analog interfaces for a driver to observe status of the parameters like speed, engine temperature, tire pressure and the distance travelled by the vehicle. In modern vehicles a new digital interface system was introduced to the driver instead of the analog interface. It improves the interface and accuracy of the vehicle to the driver. In modern vehicles the latest microcontrollers based data processing systems introduced. These microcontrollers contain the ADC's, which converts the data of the analog format to digital format. The CAN bus is spread throughout the vehicle to communicate the different devices.

2. IMPLEMENTATION AND WORKING CAN BASED MONITORING SYSTEM

In this system, the different parameters such as CO level, temperature, battery voltage, LDR is monitoring. These parameters are implemented using CAN Bus. This monitoring system consist of two nodes and are connect by CAN Bus. The two nodes are engine and display nodes which are having ARM controller LPC2148.

2.1 hardware design

In the hardware design different sensors and their inputs is processed by the engine side processor board. The data coming from the processor is send through the CAN bus. The connection between processor and the CAN controller is done through the SPI bus. CAN controller converts the data coming from the processor into CAN frame format. The CAN controller connected to the CAN transceiver. Between the engine side and display the data transformation is going with CAN transceiver. The two CAN transceivers are connected by CAN bus which contains the two wires and data is passed through these twisted pair. The data coming from the CAN transceiver is send to the CAN controller. The CAN converts data and send to the display side of the processor. The LCD is connected to the display processor and connected to the personal computer through the serial port. In both engine side and display side the processor is ARM7 processor.

2.11 A. Gas monitoring system

If the air conditioner is not serviced or maintained properly and if the filter is not cleaned regularly, definitely there will be a leakage from air conditioner. This leakage may be of CO. Normally Carbon Monoxide is colourless, odourless and tasteless gas that is slightly less than air. It is toxic to humans and animals when encountered in high concentration. In some cars the fuel is LPG. It is a combustible gas. Sometimes the leakage causes the fires in the automobiles. To detect these gases Gas sensor is used. The problem in a vehicle, CO sensor is fixed inside the vehicle and the concentration of CO or other gases apart from oxygen is continuously monitored and displayed in LCD. Gas sensor MQ2 used for to find out the gas activity in the vehicle and it is displayed in LCD.

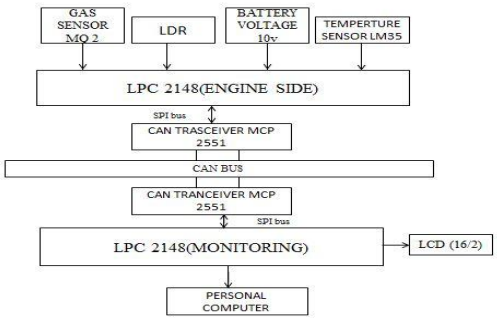

Fig2. Hardware diagram

2010-2014 – IJVES

Vol 05, Article 10488, December 2014
http://ijves.com
International Journal of VLSI and Embedded Systems-IJVES
ISSN: 2249 – 6556

2.1.1 Temperature sensor

The temperature is used to measure the temperature in the vehicle. The measurement of the temperature is done by using thermistor. The gas sensor is used to find the temperature is LM35. In this sensor the temperature is proportional to the electrical output. LM35 does not require any amplifier because it can generate the required output. The output voltage is measured in terms of the Celsius temperature.

2.1.2 LDR

The light sensors are generally used for converting light energy into electrical signal output. In these sensors the resistance changed according to the light. If the resistance of the sensor is decreases then the conductivity of the light increased. LDR sensor is connected to the LM358 series consists of two independent, high gain, internally frequency compensated operational amplifiers. The two operational amplifiers are working on the same power supply.

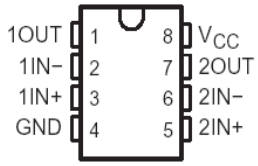

Fig3. Pin diagram of LM358

2.1.3 Battery voltage

This is used to find the battery voltage in the vehicles. The output of the battery voltage is applied to engine side of LPC2148. It processes the battery output and displays on the LCD on the monitoring side.

2.1.4 Transceiver

CAN transceiver MCP2551 takes the data from the CAN physical wires and transforms it to the level CAN controller understand the data with protective circuitry that protects the CAN controller. It do the same operation to the CAN bus, the data coming from the CAN controller to the process able data to the CAN bus. The 1st and 4th pins TxD and RxD are connected to the CAN controller and CANH and CANL is connected to the CAN bus.

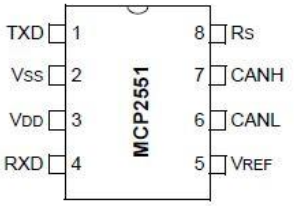

Fig4. Pin diagram of MCP2551

2.1.5. CAN Controller

It is a controller in the CAN communication network. It is used to convert the data coming from the processor or CAN transceiver to CAN frame format. There are two types of frame formats one is standard frame format and another one is extended frame format. CAN controller is used transmission and reception in both formats. The communication is done between the processor and CAN controller is done by SPI bus. In SPI bus CS, SO, SI and SCK are connection pins to the processor. 1st and 2nd pins are connected to the CAN transceiver 4th and 1st pins. The unwanted messages are rejected by filters and masks in the CAN controller.

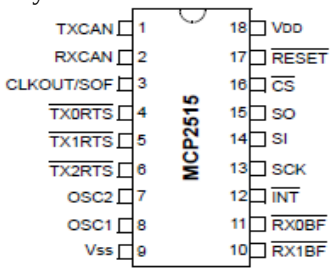

Fig5. Pin diagram of MCP2515

2.1.6 Output Devices

The given data from the different sensors are given to the LPC2148 board it contains the ARM7 processor which processes the data and sensor output displays on the LCD display. The results can also displayed on computer by using DB9 connector which connected monitoring side to the serial port.

3. DESIGN SCHEME OF COMMUNICATION PROTOCOL

The different fields in the CAN frame format are explained in this section. The nodes are identifies their messages through the message Identifier not through the address of the node. The CAN bus is connected to the different nodes in the system, when a node identifies through its message identifier and checks message is

2010-2014 – IJVES

Vol 05, Article 10488, December 2014
http://ijves.com
International Journal of VLSI and Embedded Systems-IJVES
ISSN: 2249 – 6556

correct message or not. If it is correct then the filters in the CAN controller saves the messages with it matched identifier in the saved box like receiving box. There are two types of CAN frame formats, those are standard and extended CAN frame format. The standard frame format contains the 11 message identifier and extended fame format contains the 29 bit identifier field.

3.1 Bus in an Automobile

The data transfer done in an automobile using CAN protocol. The data transfer is the serial data and it is bit by bit. All the nodes present in the system can access the CAN bus via CAN bus interface. The nodes can send data or receives the data through this CAN bus interface. CAN bus use the bus arbitration technique in these if there is a collision occurs the highest priority node is transfer the data and lowest priority node wait for some time to send the data. By using bus arbitration technique data transfer stopping can't be possible in CAN bus. In CAN bus any node in the system fails it is doesn't affect the other nodes. The data transmission speed is high in the CAN bus. For example, the rate of engine control system and ABS is high speed of real-time control fashion of 125Kbps to 1M bps.

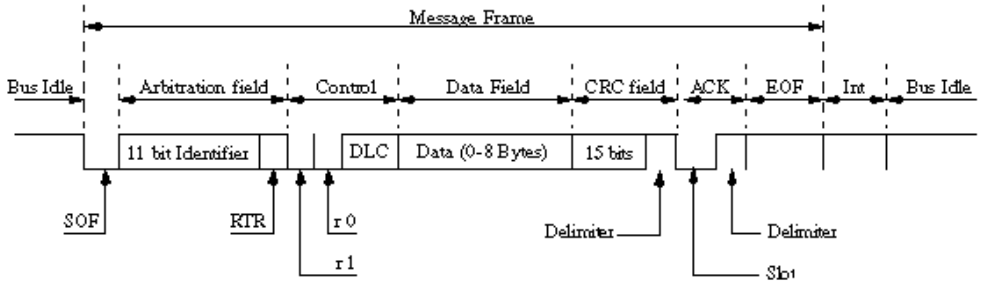

Fig6.CAN standard frame format

4. RESULTS

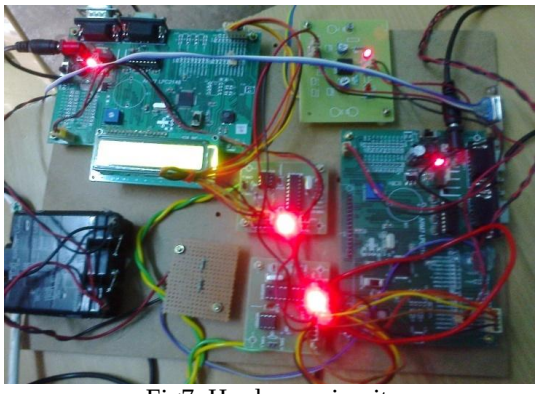

Fig7. Hardware circuit

Figure 7 shows the hardware circuit for can controller based vehicle monitoring system using arm processor. This contains the two LPC2148 boards and CAN modules and different sensors.

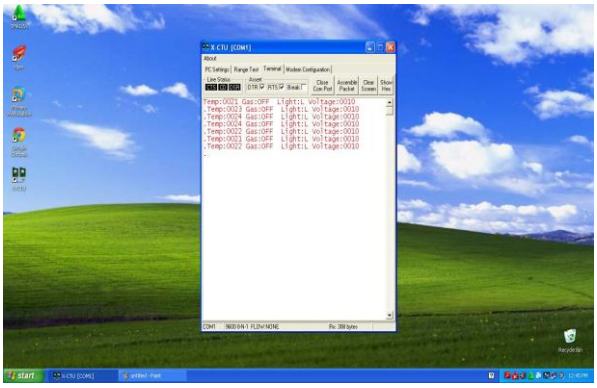

Fig8. Software output display

Fig9.LCD display

The results of various sensors outputs can be displayed on personal computer by using X-CTU version 5.1.4.1 software. There are four parameters mainly Battery voltage, Gas, Temperature and Light. Their corresponding values displayed on the personal computer. The same parameters are displayed on the LCD.

2010-2014 – IJVES

Vol 05, Article 10488, December 2014
http://ijves.com
International Journal of VLSI and Embedded Systems-IJVES
ISSN: 2249 – 6556

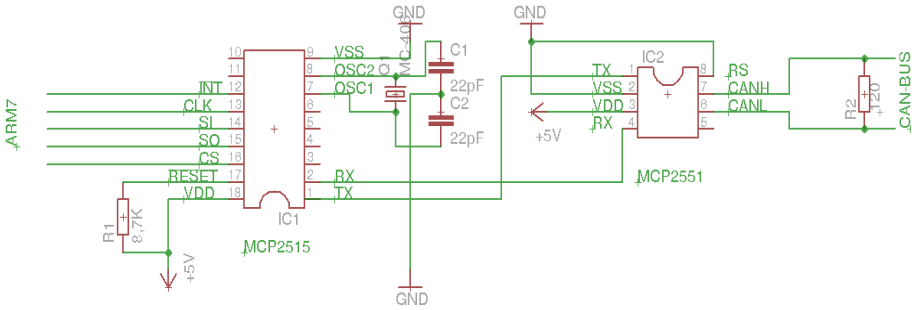

Fig10. CAN module schematic diagram

From the figure 10 schematic diagram the CAN controller and CAN transceiver are connected to the Tx and Rx pins on the both IC's. The above diagram shows the pin connections of these IC's. CAN controller and ARM7 processor board is connected to the SPI bus of their control and data pins. The CAN transceiver 7 and 8 pins are connected to the CAN physical wire bus. The CAN bus is connected to another node of the CAN transceiver. In these way pin connections and data is transmission done in automobiles using CAN protocol.

CONCLUSION

The parameters in a vehicle are monitored and necessary control has been made for each parameter by using CAN protocol. The concentration of Carbon Monoxide (CO) is maintained below 300 ppm, to avoid breathing problem while inside the vehicle. The different parameters are monitored using these sensor and are displayed in LCD. A closed loop control has been made for these parameters and each parameter is prioritized. CAN bus can reduce the complex wiring and fast data transferring in the real time with greater flexibility, by including of all these features made CAN bus is very essential networking bus in automobile vehicles for communication Also, use of ARM 7 processor ensures fast operation, high efficiency, low cost, low power and higher performance.

REFERENCES

[1] Kumar, M. A.Verma, and A. Srividya, Response-Time "Modeling of Controller Area Network (CAN). Distributed Computing and Networking, Lecture Notes in Computer Science Volume 5408, p 163-174, 2009.
[2] Tindell, K., A. Burns, and A.J. Wellings, Calculating controller area network (CAN) message response times. Control Engineering Practice, 3(8): p. 1163-1169, 2005.
[3] Li, M., Design of Embedded Remote Temperature Monitoring System based on Advanced RISC Machine. Electrotechnics Electric, 06, p. 273, 2009.
[4] Prodanov, W., M. Valle, and R. Buzas, A controller area network bus transceiver behavioral model for network design and simulation. IEEE Transactions on Industrial Electronics, 56(9): p. 3762-377, 2009.
[5] ISO (1993). Road Vehicles: Interchange of Digital Information: Controller Area Network (CAN) for High Speed Communication. ISO 11898:1993.
[6] B.Gmbh, "CAN specification" vol 1 Version 2.0, 1991.
[7] Pazul, "Controller Area Network (CAN) Basics", Microchip technology Inc., AN713, May 1999.
[8] Wilfried Voss, A comprehensive guide to controller area network, Copperhill Media Corporation, 2005-2008.
[9] Benjamin C Kuo, M. FaridGolnaraghi, Automatic Control systems, Eight edition, John wiley& sons., Inc 2003.
[10] MazranEsro, Amat Amir Basari, Siva Kumar S, A. Sadhiqin M I, ZulkifliSyariff, "Controller Area Network (CAN) Application in Security System" World Academy of Science, Engineering and Technology 35 2009.

[1]**R.SIVA BABU**, has completed B.Tech (ECE) fromSri Vasavi Engineering College and he is pursuing his M.Tech in Embedded System at Gudlavalleru Engineering College, AP.

[2]**V.Narasimha Rao**, is working as Assistant Professor in Gudlavalleru Engineering College, AP. He completed his P.G. in computers and communication systems. So far he has 10 years of teaching experience.

2010-2014 – IJVES