

Response time analysis of mixed messages in CAN

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Abstract

Controller Area Network (CAN) is a network protocol that allows multiple processors in a system to communicate efficiently with each other. Microprocessors became small enough and powerful enough to start appearing everywhere, not just inside personal computers. A CAN system sends messages using a serial bus network, with the individual nodes (processors) in the network linked together in a daisy chain. Every node in the system is equal to every other node. Any processor can send a message to any other processor, and if any processor fails, the other systems in the machine will continue to work properly and communicate with each other. In modern vehicle technology CAN is used to reduce point to point wiring harness for vehicle automation and for data communication. To overcome the drawbacks of analog vehicle driving interface, this paper presents the development and implementation of a digital driving system for a semi-autonomous vehicle to improve the driver-vehicle interface. This offers increased flexibility and expandability. This system uses sensors to measure temperature, distance from the other car, presence of alcohol in car, position monitoring, theft monitoring and etc., and sends a warning signal to the driver if any of the parameter goes out of range to avoid accidents. In addition to this if accident occurs in any remote area then using vibration sensor, accident is detected and SMS is send immediately using GSM and preventing him from potentially getting into a serious problems.

Keywords CAN, Monitoring, Controlling, analog vehicle driving, digital vehicle driving.

I. INTRODUCTION

Automotive Electronics has been witnessing a major change from the analog world to the digital world to accommodate the rapidly growing technology so that the driving experience is made better, safer and at the same time, the end-user is provided with a variety of features that he can utilize in the vehicle. This change in the automotive industry is driven by a driving mechanism called the digital driving behavior of the vehicle.

The CAN bus is a two-wire serial bus with Multi-Master Capability. This means that multiple devices sitting on a single two-wire bus can talk to one another. CAN include a CSMA/CD (Carrier Sense Multiple Access with Collision Detection). Each device can transmit a message and will retry if it loses the arbitration to another device. Each device listen to the bus and thus a device trying to transmit can determine easily if the message ongoing is the same than the one it tries to transmit. If it is different, it will release the bus immediately. This arbitration mechanism ensures that one master will always win, thus no messages will be lost to a collision. In CAN, errors are detected with a CRC check. Message are acknowledged at the end of the frame by a special acknowledge bit. Receivers assert the ACK bit acknowledge proper reception. With all the above, The CAN bus can offer a 100% data integrity in the harsh environment found in cars and manufacturing floors.

The CAN robustness has a cost. All nodes are synchronized on the same bit time period. The group delay cannot exceed a fraction of the bit time period which lead to the maximum bus throughput being a function of the bus length. The maximum throughput is 1Mb/s with up to 40m bus length and 50Kb/s with up to 1km bus length. With point-to-point Ethernet LAN connection between a device and a bridge with a UTP5 cable 10Mb/s could be achieved up to 100m.

II. HARDWARE STRUCTURE

The hardware structure mainly integrates the CAN bus controller, PIC as the main control module, LCD display to provide Digital interface, GSM for mobile communication and other accessories.

A. CAN bus

1. CAN Bus in an Automobile

CAN is a LAN (Local Area Network) controller CAN bus can transfer the serial data one by one. Fig 1 shows a typical architecture from an automotive. 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. 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.

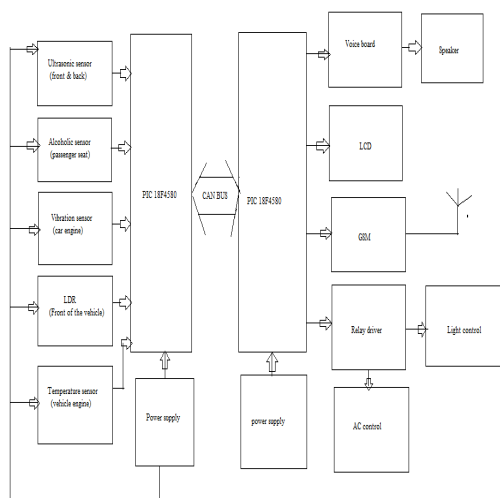


Figure 1 block diagram

The ultrasonic sensor which is used to measure the distance between vehicles and the information send to the microcontroller. If distance is too short both audio and text message will generate. Audio message generated by using voice board and text message will be displayed on LCD display. The alcoholic sensor sense whether the driver is drunk if he drunk the proper message send to the authority by using GSM and displayed in LCD for future reference

The vibration sensor detects accidents and sends location of information to required place. LDR detects whether day or night if it detects night time automatically headlight will be turned on by using relay drive .Temperature sensor sense the thermal information within the car if it detects over heat automatically AC will be turned on or else if AC is over cooling automatically cooling will be controlled by using relay drive and motor. Then the information will be collected by the microcontroller (PIC 18F4580) and this information is transmitted to the receiver microcontroller by using CAN bus.

B. Main control module

1. PIC Architecture

High computational performance at an economical price – with the addition of high-endurance, Enhanced Flash program memory. In addition to these features, the PIC18F4580 family introduces design enhancements that make these microcontrollers a logical choice for many high-performances, power sensitive applications.

40-Pin, Enhanced Flash Microcontrollers with ECAN™ Technology, 10-Bit A/D and nanoWatt Technology.

III. WORKING MODEL CIRCUITS AND RESULTS

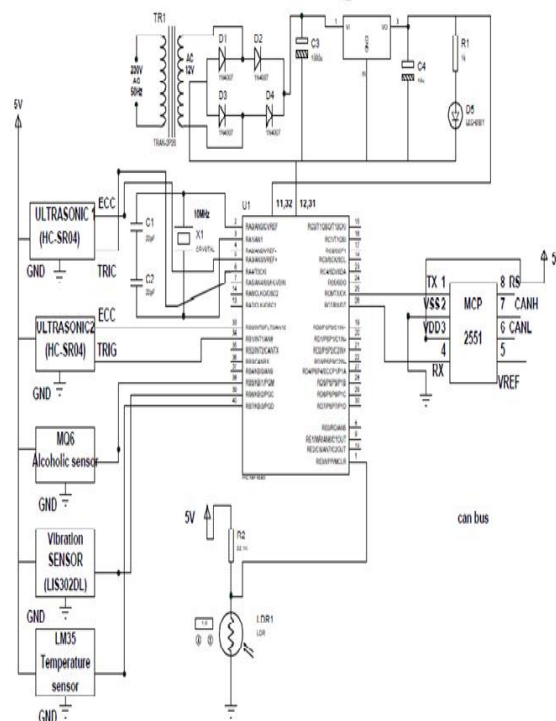


Figure 2 Circuit diagram for monitoring section

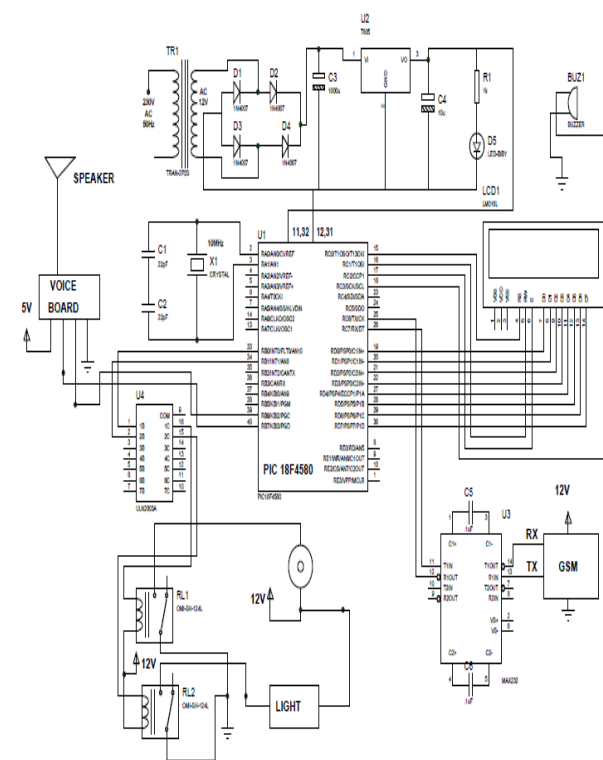


Figure 3 circuit diagram for controlling section

Step down transformer converts 230v ac to 12v dc supply. Voltage regulator (IC 7805) is used to convert 12v dc to 5v dc. Crystal oscillator is the heart of the microcontroller. This is used to generate clock pulse. External clock pulse is used to enable the hardware part and then only the microcontroller will be allowed to work. Coupling capacitor used to reduce noise and repulsion in the circuit. 5v dc supply is given to the input of the microcontroller. Then sensor process is carried out. Ultrasonic sensor threshold value 7cm is stored in microcontroller. If it exceeds this value, the signal sends to microcontroller. Then it transmit the value to other controller by using CAN bus.

Vibration sensor detects when it changes from its logic value will be intimated to the microcontroller and further controlling process carried out. Temperature sensor threshold value is -55°C to $+150^{\circ}\text{C}$ will be stored in microcontroller. If it exceeds controlling process will be carried. Alcoholic sensor detects above 100 ppm concentration message will send to the concerned authority. Hence this outputs are given to the microcontroller it transmit signals to other microcontroller by using CAN bus. The other end microcontroller receives signals and then controlling process carried out. Relay driver IC (ULN 2003A) like a NOT gate used for voltage conversion. MAX232 is a Wireless device driver circuits that converts logic level of the microcontroller to the GSM circuits. GSM uses SIM 900 because access all SIM and god antenna coverage.

RESULTS

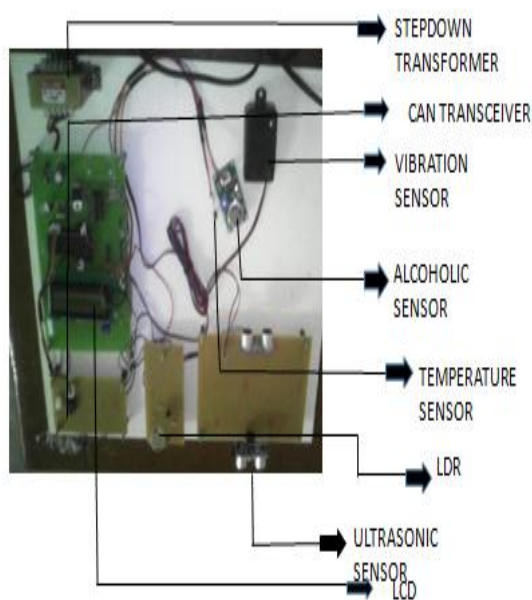


Figure 4 Hardware assembled parts

IV. Conclusion

This paper introduces an embedded system with a combination of CAN bus systems. Digital control of the vehicle is an important criterion of modern technology. With the rapid development of embedded technology, high-performance embedded processor is penetrated into the auto industry, which is low cost, high reliability and other features to meet the needs of the modern automobile industry. The proposed high-speed CAN bus system solves the problem of automotive system applications, also has a certain practical value and significance. With 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.

V. Acknowledge

S. Arthy would like to thank everyone, including: parents, teachers, family, friends, and in essence, all sentient beings for their help and support this paper would not have been possible. Especially, I dedicate my acknowledgment of gratitude toward my mentor and Co-author S. Asvini for his guidance and support.

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