Design and Development of PIC Microcontroller Based Vehicle Monitoring System using Controller Area Network (CAN) Protocol

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Abstract— Controller Area Network (CAN) is an attractive alternative in the Vehicle Monitoring System because it is easy to use, low cost and provided reduction in wiring complexity. It was developed by Robert Bosch for communication between various digital devices inside an automobile where heavy electrical interferences and mechanical vibrations are present. This project is aimed at the implementation of CAN protocol using PIC for vehicle monitoring system. The main feature of the system includes monitoring of various parameters like temperature, pressure, speed, Obstacle Detection. The software part is done using Embedded C. Schematic is prepared using DipTrace. Hardware is implemented and software porting is done.

Key words: CAN MCP2551, PIC18F458, LM35, Buzzer, Fan, IR Sensor

I. INTRODUCTION

For Efficient Operation Vehicles are been developed by using electrical devices. Microcontrollers act as a central processing unit and all devices are connected to central processing unit. Multiple Connections such as electrical lines and data connected to microcontrollers make it very complex to understand and troubleshoot it. This project presents the development and implementation of a digital driving system for the vehicle to improve driver vehicle interface .The communication module has efficient data transfer because of embedded networking by CAN. CAN Messages can be time stamped with 10 microsecond's resolution. CAN Protocol can detect collision and messages can also be prioritized .Multiple no. of Microcontroller and other devices can be connected to a common CAN Bus using Controller Area Network (CAN) Protocol. To connect the devices to CAN bus we require a CAN transceiver in between bus and devices which enables the communication between all with great speed and priority. CAN Transreceiver can transmit and receive messages as Frames. Standard CAN is 11 bit identifier .This project also detects obstacles using IR sensors which can prevent the vehicle from Accidents. It is important that human drivers still have some control over the vehicle.

It utilizes PIC for procuring information that utilizes ADC to bring all control information or data to digital format and visualized by GLCD. The communication module used for the achievement is embedded networking CAN by which we can have effective data exchange. GSM is also used for immediately sending messages in case of any emergency.

This project is aimed at the implementation of CAN protocol using PIC18F458 for vehicle monitoring system. The main feature of the system is that it can be used as a real time vehicle where in the above parameters can be monitored and necessary corrective action can be initiated like

- When the temperature is too high, FAN will be turned ON.
- When the obstacle is detected it sends message to owner with the help of GSM,
- When the tilt is measured with the help of Accelerometer, Buzzer gets started.

The software part is done in MPLAB using embedded C.

II. PROJECT SCOPE

SPI and I2C were used in Vehicle Monitoring System before CAN was developed but SPI requires more no.of signal lines (wires) than other communications methods. The communications must be well-defined in advance (you can't send random amounts of data whenever you want). I2C was used later but the speed of communication was not enough. The hardware complexity also increases when number of master/slave devices is more in the circuit. Half duplex mode of communication was used. The protocol is managed by software stack.

To overcome above issues CAN Protocol was introduced by BOSCH. CAN allows 1Mbps data rate and also has Large on-board RAM Buffer for CAN messages. CAN reduces wiring complexity in various automotive applications. It has less complex interface, so it is widely used across various industries. It saves overall cost and time due to less and simple wiring as well as use of flash programming. It works in various electrical environments without any issues. The protocol supports different error detection capabilities such as bit error, acknowledgement error, form error, CRC error and stuff error.

III. SYSTEM ARCHITECTURE

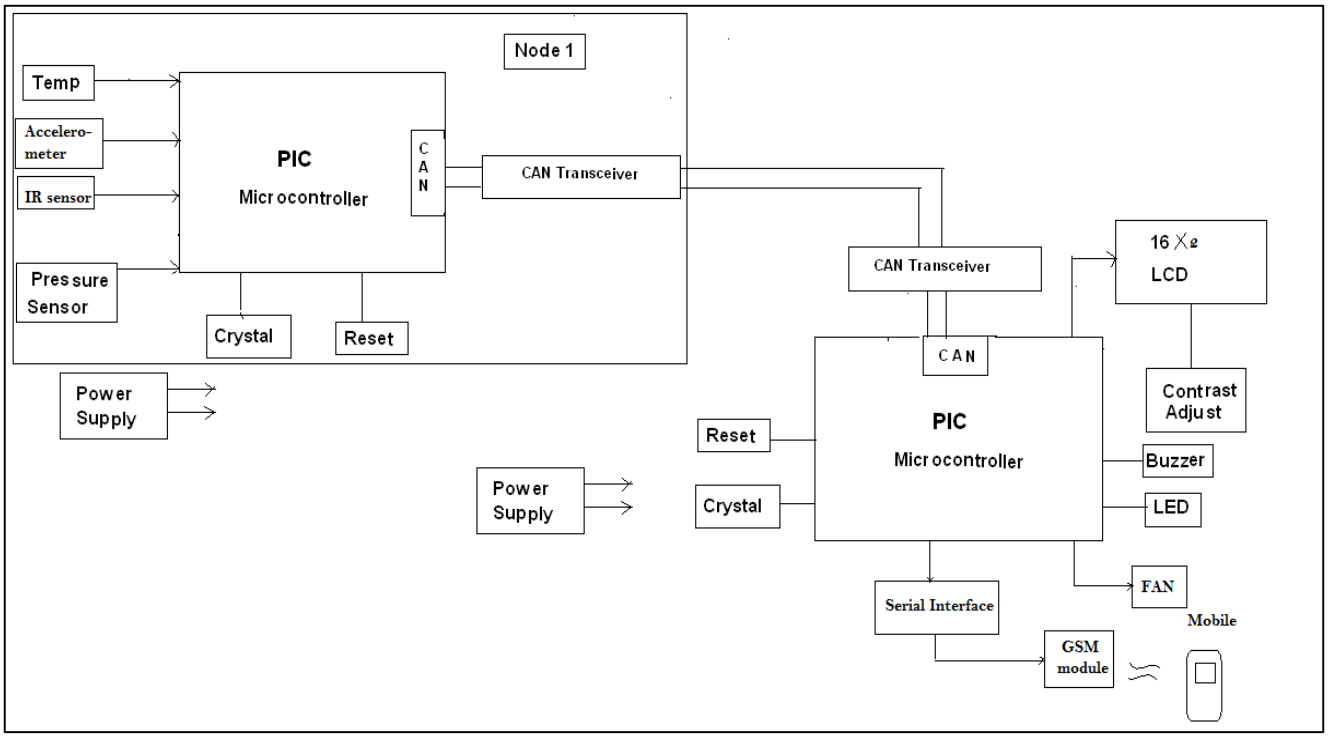

Fig. 1: System Architecture

IV. WORKING

The proposed system here is used to monitor different parameters in vehicle and give notifications at dashboard using CAN protocol. In this proposed system we are monitoring parameters like temperature in vehicle, tyre pressure, accident etc. we are using LM35 temperature sensor, ADXL 335 acceleration sensor, IR sensor and Pressure sensor. Two units will be there for justifying CAN protocol. Temperature sensor will be used to monitor temperature in vehicle and FAN will be turned ON if temperature increases beyond a predefined limit.

ADXL335 sensor will be used to monitor accidental condition and notification will be sent to dashboard unit. Dashboard unit will generate a alert message. SMS will be sent using GSM module connected to dashboard unit. IR sensor is used to detect if any other vehicle is closer to this vehicle and buzzer will be turned on at dashboard unit.

Pressure sensor is used to monitor tyre pressure and LED will be turned ON at dashboard unit for indication. LCD of 16 by 4 will be used at dashboard unit for monitoring all the parameters. GSM module is interfaced using serial communication with microcontroller. Microcontroller used here will be PIC18F458 which is from Microchip Company. It supports CAN protocol and MCP 2551 CAN transceiver will be for implementing CAN protocol.

V. TECHNIQUES USED

A. CAN Transceiver

The MCP2551 is a high-speed CAN, fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus. The MCP2551 provides differential transmit and receive capability for the CAN protocol controller and is fully compatible with the ISO- 11898 standard, including 24V requirements. It will operate at speeds of up to 1 Mbps. Typically, each node in a CAN system must have a device to convert the digital signals generated by a CAN controller to signals suitable for transmission over the bus cabling (differential output). It also provides a buffer between the CAN controller and the high-voltage spikes that can be generated on the CAN bus by outside sources. The main features are it supports 1 Mbps operation. It is suitable for 12V and 24V systems. It is a low current standby operation. There is protection against damage due to short circuit conditions (positive or negative battery voltage). Also there is protection against high-voltage transients. Up to 112 nodes can be connected. PIC18F458 is connected to CAN Transceiver at the engine side.

B. MCLR

PIC18F458 devices have a noise filter in the Master Clear (MCLR) Reset path. The filter will detect and ignore small pulses. This pin is an active low Reset to the device It should be noted that a WDT Reset does not drive MCLR pin low. The behavior of the ESD protection on the MCLR pin differs from previous devices of this family. Voltages applied to the pin that exceed its specification can result in both Resets and current draws outside of device specification during the Reset event. For this reason, Microchip recommends that the MCLR pin no longer be tied directly to VDD. The use of an RC network is suggested.

C. LM7805

The operating voltage range of PIC18F458 is 2.0V to 5.5V. So LM7805 which is a +5.0V 1A voltage regulator, is used. It is a linear voltage regulator that produces a relatively constant output voltage of +5VDC. There is an input pin, which must generally be greater than +7VDC, a ground pin, and an output pin.

D. Temperature Sensor (LM-35)

LM-35 was Calibrated Directly in ° Celsius (Centigrade).It is Linear + 10 mV/°C Scale Factor0.5°C Ensured Accuracy (at +25°C) .Rated for Full −55°C to +150°C Range. LM-35 is Suitable for Remote Applications. It is Low Cost Due to Wafer-Level Trimming. It Operates from 4 to 30 V and Less than 60-µA Current Drain .It has Low Self-Heating 0.08°C in Still Air. And Low Impedance Output, 0.1 Ω for 1mA Load. It indicates the low level and high level temperature measurement and automotive ignition level gas exhausting, over heat when vehicle engine/motor speed was increased gradually.

E. Conclusion

For the first stage project presentation the required research work has been completed and the validation of project has been proved. Hence it can be said that the aim of the project "Design and Development of PIC Microcontroller Based Vehicle Monitoring System Using Controller Area Network (CAN) Protocol" can be achieved successfully.

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