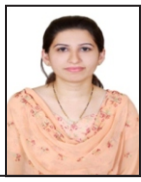
Volume No: 1(2014), Issue No: 10 (October) ISSN No: 2348-4845

Design & Development Of Arm7 Based Vehicle Monitoring System Using Controller Area Network (Can) Protocol

Nawab Afaque Mohammed Khan
M.Tech student
VIF College of Engineering and Technology.

Azra Fatima, M.Tech
Assistant Professor,
Electronics And Communications Engineering Department,
VIF College of Engineering and Technology.

Imthiazunnisa Begum, M.Tech
HOD, ECE,
Electronics And Communications Engineering Department,
VIF College of Engineering and Technology.

Korani Ravinder,M.Tech(Ph.D)
Assistant professor,
Electronics And Communications Engineering Department,
VIF College of Engineering and Technology.

ABSTRACT:

Controller Area Network (CAN) is an attractive alternative in the automotive and automation industries due to its ease in 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 ARM for vehicle monitoring system. The main feature of the system includes monitoring of various vehicle parameters such as Temperature, presence of CO level in the exhaust, Battery Voltage and Light due to spark or fire. The software part is done in MPLab IDE using Embedded C. Schematic is prepared using OrCAD. Hardware is implemented and software porting is done.

Index-terms:

Controller Area Network (CAN) protocol, CO level in the exhaust, Light due to spark or fire, PIC, ARM processor.

I.INTRODUCTION :

The Controller Area Network (CAN) is an attractive alternative in the automotive and automation industries due to its ease in use, low cost and provided reduction in wiring complexity. The priority based message scheduling used in CAN has a number of advantages, some of the most important being the efficient bandwidth utilization, flexibility, simple implementation and small overhead. CAN is a serial bus communications protocol developed by Bosch [3] (an electrical equipment manufacturer in Germany) in the early 1980s.

Thereafter, CAN was standardized as ISO-11898 and ISO-11519, establishing itself as the standard protocol for in vehicle networking in the auto industry. By networking the electronics in vehicles with CAN, however, they could be controlled from a central point, the Engine Control Unit, thus increasing functionality, adding modularity, and making diagnostic processes more efficient.

CAN offer an efficient communication protocol between sensors, actuators, controllers, and other nodes in real-time applications, and is known for its simplicity, reliability, and high performance [5].The CAN protocol is based on a bus topology [1], and only two wires are needed for communication over a CAN bus. The bus has a multi master structure where each device on the bus can send or receive data.

Only one device can send data at any time while all the others listen. If two or more devices attempt to send data at the same time, the one with the highest priority is allowed to send its data while the others return to receive mode. CAN distinguishes four message formats [2] viz. data, remote, error, and overload frames. A data frame begins with the Start-Of-Frame it. It is followed by an eleven-bit identifier and the Remote Transmission Request (RTR) bit. The identifier and the RTR bit form the arbitration field.

The control field consists of six bits and indicates how many bytes of data follow in the data field. The data field can be zero to eight bytes. The data field is followed by the Cyclic Redundancy Checksum (CRC) field, which enables the receiver to check if the received bit sequence was corrupted. The two-bit acknowledgment field is used by the transmitter to receive an acknowledgment of a valid frame from any receiver. The end of a message frame is signaled through a seven-bit End-Of Frame (EOF). There is also an extended data frame with a twenty-nine-bit identifier (instead of eleven bits). Error detection and error handling are important for the performance of CAN. Error detection is done in five different ways in Vehicle Applications of Controller Area Network: bit monitoring and bit stuffing, as well as frame check, ACK check, and CRC. This project targets in the development of a system where we can monitor various vehicle parameters such as Temperature, CO percentage in the exhaust, Battery Voltage and LDR through CAN protocol.

II.RELATED WORK:

1.ARM processor:

The ARM core uses RISC architecture. Is a design philosophy aimed at delivering simple but powerful instructions that execute within a single cycle at a high clock speed? The RISC philosophy concentrates on reducing the complexity of instructions performed by the hardware because it is easier to provide greater flexibility and intelligence in software rather than hardware. As, a result RISC design plays greater demands on the compiler. In contrast, the traditional complex instruction set computer (CISC) relies more on the hardware for instruction functionality, AND consequently the CISC instructions are more complicated.

The processing of instructions is broken down into smaller units that can be executed in parallel by pipelines. Ideally the pipeline advances by one step on each cycle for maximum throughput. Instructions can be decoded in one pipeline stage. The processor operates on data held in registers. Separate load and store instructions transfer data between the register bank and external memory. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor. Optimized for cost and power- sensitive applications, the ARM7TDMI solution provides the low power consumption, small size and high performance needed in portable, embedded applications.

2.CAN transceiver:

CAN, by itself, is not necessarily a complete network system. It consists of only the physical layer (the two wires), the priority scheme (highest priority message always gets through first) and some error detection and handling circuitry. This allows simple messages of from zero to eight bytes to be passed on the system. CAN, like most modern networks, is serial based. This means that the information travels along the network one bit at a time's CAN network needs from one to two linesdepending on the design.

Parallel networks usually require more than 8 wires plus several handshaking lines to facilitate the data transfer. Most network systems using CAN will employ a higher level Protocol such J1939, CAN open or a proprietary scheme to create and process messages over the basic CAN network.

The microcontroller receive the data CAN bus, convert the data in serial format and transfer the data to Personal computer(PC) or Laptop using RS232 serial port or virtual serial port. A CAN transceiver MCP2551 is a high-speed CAN, fault-tolerant device that serves as the interface between a CAN protocol controller and the physical bus.

The MCP2551provides differentials transmit and receive capability for the CAN protocol controller and is fully compatible with the ISO-11898 standard. The CAN BUS Analyzer is a simple to use low cost CAN bus monitor which can be used to develop and debug a high speed CAN network.

The device supports CAN 2.0b and ISO11898-2 and a broad range of functions which allow it to be used across various market segments including automotive, vehicle, medical and marine.

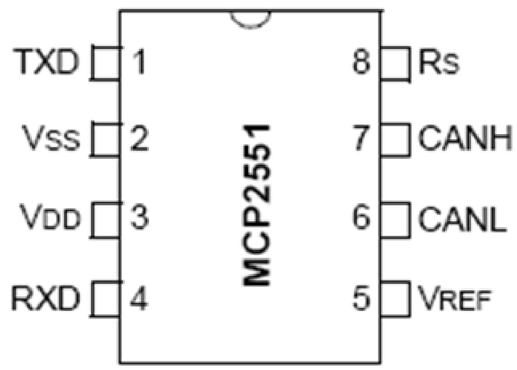


Figure-1: Transceiver PIN diagram

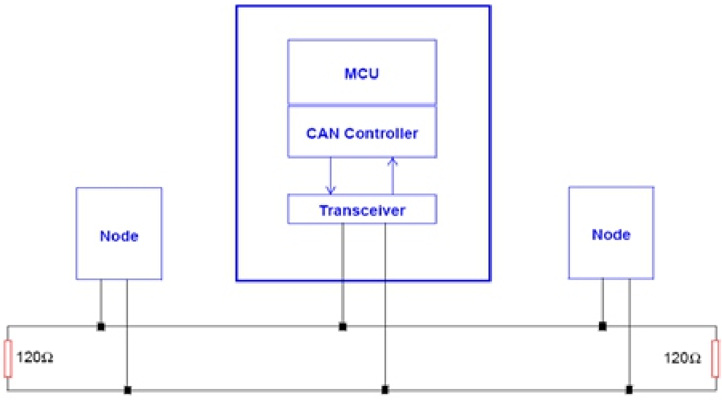


Figure-2: CAN Bus

The main features are it supports 1 Mb/s operation. It is suitable for 12V and 24V systems. It is a low current stand by 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.

III.MONITORING SYSTEM:

1.Temperature sensor LM35:

The LM35 is an integrated circuit sensor [11] shown in Fig.8 that can be used to measure temperature with an electrical output proportional to the temperature (in oC). It measures temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. It has an output voltage that is proportional to the Celsius temperature.

The scale factor is .01V/oC. The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4oC at room temperature and +/-0.8oC over a range of 0oC to +100oC. Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self heating capability. The sensor self-heating causes less than 40.1 oC temperature rise in still air. The sensor has a sensitivity of 10mV / oC.

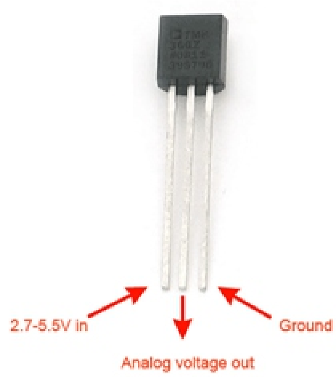


Figure-3: LM35

2.Light dependent resistor:

A light-dependent resistor, alternatively called an LDR, is a variable resistor whose value decreases with increasing incident light intensity. An LDR is made of a high-resistance semiconductor. If light falling on the device is of high enough frequency, photo ns absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band.

There sulting free electron (and its hole partner) conduct electricity, thereby lowering resistance. A photoelectric device can be either intrinsic or extrinsic. In intrinsic devices, the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap designed to decimate with a decimation factor R=8 and is implemented in 3 stages.

The input signal having a sampling rate of 10MHz is down sampled by filter to the signal having a sampling rate 1.25MHz for pass band of 78.150 KHz. The single stage implementation of purposed filter and complete 3-stage design is shown in Fig. 4.

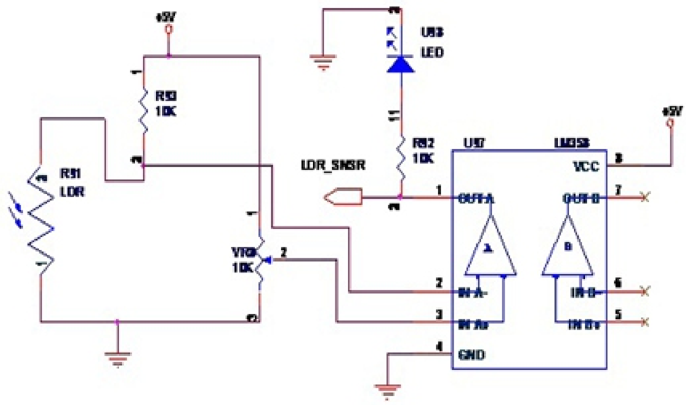


Figure-4: light dependent resistor.

IV. RESULTS:

The project is implemented using one LPC2129 development board and 4 PIC18F458 boards with all modules required to ignite this project. In these LPC2129 board has 2 CAN controllers, so from this board we can connect 2048 nodes to each controller. In this project we are using one controller and is connected to 3 PIC individual nodes which are interfaced with sensors. One more PIC is interfaced with Zigbee and it will communicate only with LPC2129.

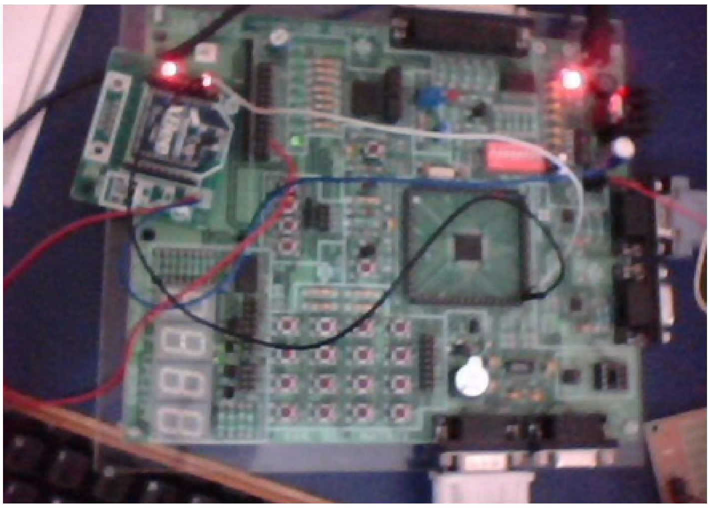


figure-5: lpc2129 CAN receiver.

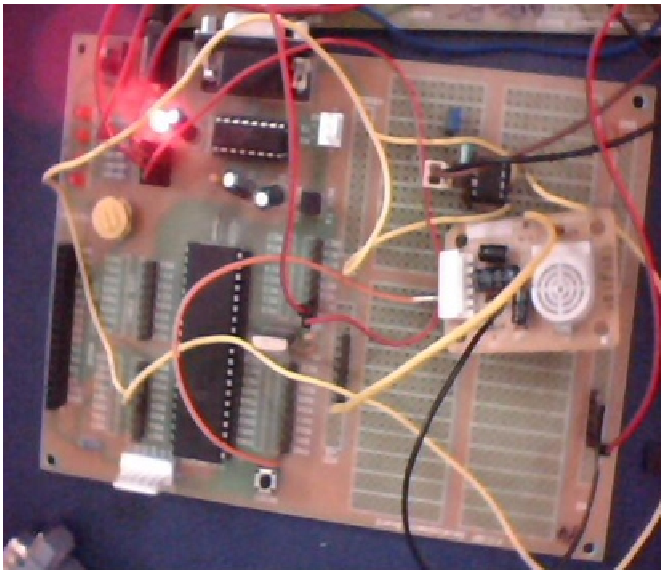


Figure-6: PIC18F458 individual nodes with sensors.

V.CONCLUSION:

The project "vehicle monitoring system using controller area network (can) protocol" has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

REFERENCES:

[1] Karl Henrik Johansson, Martin Törngren, and Lars Nielsen, "Vehicle Application of Controller Area Network".proc of The Handbook of Networked and Embedded Control Systems Control Engineering, 2005, VI, pp.741-76.

[2] Renjun Li, Chu Liu and Feng Luo, "A Design for Automotive CAN Bus Monitoring System", IEEE Vehicle Power and Propulsion Conference (VPPC), September 3-5, 2008, Harbin, China.

[3] CAN specification version 2.0. Robert Bosch GmbH, Stuttgart, Germany, 1991.

[4] Wilfried Voss, "A Comprehensible Guide to J1939", Published by Copperhill Technologies Corporation.

[5] Steve Corrigan, "Introduction to the Controller Area Network",Published by Texas Instruments Application Report,SLOA101A August 2002–Revised July 2008.

[6] O. González, M. Rodríguez, A. Ayala, J. Hernández and S. Rodríguez, "Application of PICs and microcontrollers in the measurement and control of parameters in industry", Proc of the International Journal of Electrical Engineering Education 41/3, pp.265-274, Feb 2001.

[7] Microchip Technology Inc. DS41159E: PIC18FXX8 Data SheetPat Richards, "A CAN physical layer discussion", Microchip Technology Inc. DS00228A [8] Dogan Ibrahim, "Microcontroller based temperature monitoring and control", ISBN: 0750655569, Elsevier Science & Technology Books.

[9] P.M. Knoll and B.B. Kosmowski, "Liquid crystal display unit for reconfigurable instrument for automotive applications", Opto- Electronics Review, 10(1), 75 (2002).

[10] MCP 2551 High speed CAN Transceiver Datasheet.
[11] National Semiconductor, "LM35 Precision Centigrade Temperature Sensors Data sheet", National Semiconductor Corporation, November 2000.

[12] MQ-6 Gas sensor Datasheet.

[13] J.Axelsson, J.Froberg, H.A.Hansson, C.Norstrom, K.Sandstorm and B.Villing, "Correlating Bussines Needs and Network Architectures in Automotive Applications – a Comparative Case Study",Proc of FET'03,pp.219-228, July 2003.

[14] BS IV regulations April 2010.

[15] Fairchild, Ray, M., Snyder, Rick B., Berlin, Carl W.,Sarma, D. H. R]"Emerging Substrate Technologies for Harsh-Environment Automotive Electronics Applications".