International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 09 | Sep 2018 www.irjet.net p-ISSN: 2395-0072

Interfacing CAN Protocol With PIC Microcontroller

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Abstract:- *The Controller Area Network (CAN) is a serial bus communications protocol developed by Bosch in the early 1980s. It defines a standard for efficient and reliable communication between sensor, actuator, controller, and other nodes in real-time applications. CAN is the de facto standard in a large variety of networked embedded control systems. The early CAN development was mainly supported by the vehicle industry: CAN is found in a variety of passenger cars, trucks, boats, spacecraft, and other types of vehicles. The protocol is also widely used today in industrial automation and other areas of networked embedded control, with applications in diverse products such as production machinery, medical equipment, building automation, weaving machines, and wheelchairs. In the automotive industry, embedded control has grown from stand-alone systems to highly integrated and networked control systems*

The various advantages of CAN bus are discussed over other serial buses like MOD bus. The various designing components used in interfacing CAN bus with PIC32 bit micro-controller is described with the final design schematic of CAN bus with PIC18F458 and CAN Transceiver (MCP 2551)

Keywords- CAN bus ,PIC micro-controller, CAN Transceiver Automotive electronics, MCP 2551

1. INTRODUCTION

Controller area network (CAN) is a new type of serial bus, which is developed by Bosch Corporation to solve the problem of data interchange among many electronic devices of future automobile in 1980s. CAN bus has the merits of high intelligence, fault-tolerant and reliability [1], which can support distributing real-time control [2], so the instance it comes into being it is popular in industry field. In the general control system, some modules exchange amount of data, such as position and speed signals and some physiological parameters. Therefore, It is extremely important to exchange data between modules accurate and real-time. Most control systems use RS-232 or RS-485 bus in communication, and communication means is the command and response mode, that is the host send a inquiry to sub-controllers, and then sub-controllers upload their own status. The shortcomings of this approach are low data transmission efficiency; host controller with poor

Flexibility and in busyness; the data can't immediately upload when sub-controller is abnormal, it must wait for an order from the host. In view of the above shortcomings, the present control system combines input and display module and MDM through single-chip AT90CAN128 and CAN bus communications technology, making it as a multi-host Distributed control system.

1.1 COMMUNICATION PRINCIPLE OF CAN BUS

CAN bus is not a communication protocol based on station but message [3]. There are two ISO criterions based on CAN technique in automobile electron field: one is ISO11898 which is suitable to high-speed application, the other is JI 1519 which is suitable to low-speed application. CAN bus can operate in single transmit multi-receive mode and the mode make it have outstanding advantage in automobile application [4]. The standard format and expanding format of data frame are shown as Fig. 1

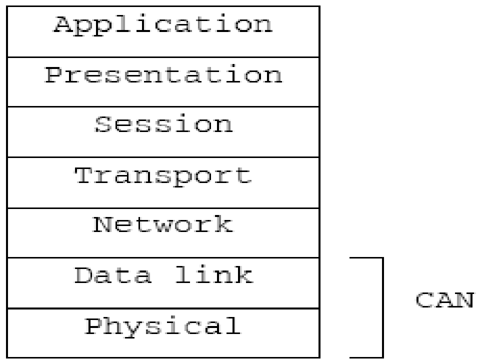

Fig.1CAN protocol defines the two layers of the OSI model.

2. HARDWARE

A. *Peripheral Interface Controller (PIC)*

PIC [6] is a family of Harvard architecture microcontrollers made by Microchip Technology to control peripheral devices, alleviating the load from the main CPU. Compared to a human being, the brain is the main CPU and the PIC is equivalent to the autonomic nervous system. PIC is very cost effective, that is the different model PIC's are available with proportional cost. There is chance to choose the PIC suitable for the application. When operated at its maximum clock rate a PIC executes most of its instructions in 0.2 microseconds or 5 instructions / microsecond. [6] A watchdog timer resets the PIC if the chip ever malfunctions and deviates from its normal operations. Three versatile timers can be characterizing inputs, control outputs and provide internal timings for program execution. Up to 12 independent interrupt sources [4], which can provide useful interrupting as and when needed. Ultraviolet erasable, programmable parts support development. Lower cost on time programmable parts support both small and large productions runs. The PIC micro controller has a number of inbuilt modules like ADC, CAN that increase versatility of micro controller.

B. CAN Transceiver

The MCP2551 [7] shown in fig.3. 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 Mb/s. 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).

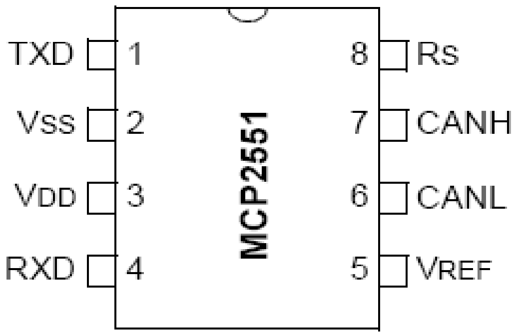

Fig2, Pin diagram of MCP2551

C. Power supply unit

Junction (J1) is connected two step down t transformer which convert 240V to 120V. Then it go throw the SINGLE-PHASE SILICON BRIDGE having Reverse Voltage - 50 to 1000 Volts and Forward Current - 1.5 Amperes then current goes to capacitance filter to remove unwanted noise then 3-Terminal 1A Positive Voltage Regulator The KA78XX/KA78XXA series of three-terminal positive regulator are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed Primarily as fixed voltage

regulators, these devices can be used with external components to obtain adjustable voltages and currents. Voltage regulator give the 5V DC supply to microcontroller and transceiver.

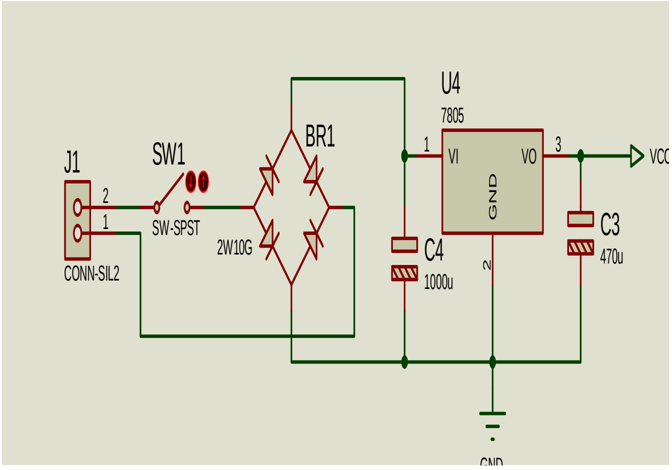

Fig3. Circuit diagram of power supply

3. CONNECTING CAN BUS WITH PIC 18F458 MICROCONTROLLER THROUGH TRANSCEIVER

In the project, communication between three nodes are designed, every node has CAN transceiver and receiver, for transceiver IC MCP 2551 and CAN receive IC PIC18f458 is used shown in fig.4. PIC18f458 which is manufactured by Microchip Corporation. The connection circuit between the single chip and MCP2551and PIC18f458 is shown as Fig.6. MCP2510 is a control chip for CAN bus interface exclusively produced by Microchip Corporation, and it accords with 2. OB technique criterion of CAN bus. Moreover the chip has SPI TM serial interface according with industry standard so that it is possible for any single chip to connect to CAN bus [5].MCP2551 is a high-speed transmission receive controller matching for MCP2551 and it is charged with voltage level switch of receive and transmit between node and bus. The circuit can implement CAN communication between different single-chip microprocessor and it strengths the application flexibility of chips.

CAN protocol is a message-based protocol, not an address based protocol. This means that messages are not transmitted from one node to another node based on addresses. All nodes in the system receive every message transmitted on the bus (and will acknowledge if the message was properly received). It is up to each node in the system to decide whether the message received should be immediately discarded or kept to be processed

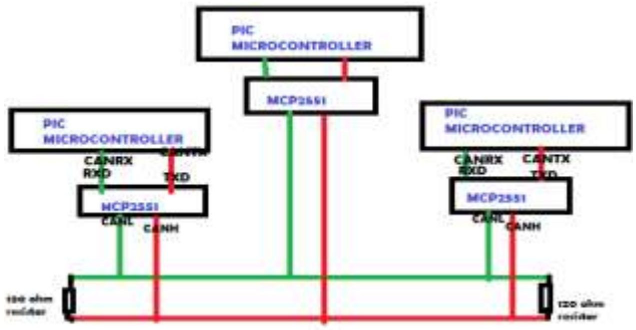

Fig4.CAN bus control area network

Another useful feature of CAN protocol is the ability for a node to request information from other nodes. This is called a Remote Transmit Request (RTR). In this a node is not transmitting the data by itself instead asking for the data from other node. For example, a safety system in a car

gets frequent updates from critical sensors like the airbags, but it may not receive frequent updates from other sensors like the oil pressure sensor or the low battery sensor to make sure they are functioning properly. Periodically, the safety system can request data from these other sensors and perform a thorough safety system check. The system designer can utilize this feature to minimize network traffic while still maintaining the integrity of the network

4. CAN MESSAGE TRANSMISSION

A CAN bus with three nodes is depicted in Fig. 4. The CAN specification [4] defines the protocols for the physical and the data link layers, which enable the communication between the network nodes. The application process of a node, e.g., a temperature sensor, decides when it should request the transmission of a message frame. The frame consists of a data field and overhead, such as identifier and control fields. Since the application processes in general are asynchronous, the bus has a mechanism for resolving conflicts. For CAN, it is based on a non-destructive arbitration process. The CAN protocol therefore belongs to the class of protocols denoted as carrier sense multiple access/collision avoidance (CSMA/CA), which means that the protocol listens to the network in order to avoid collisions. CSMA/CD protocols like Ethernet have instead a mechanism to deal with collisions once they are detected. CAN also includes various methods for error detection and error handling. The communication rate of a network based on CAN depends on the physical distances between the nodes. If the distance is less than 40 m, the rate can be up to 1 Mbps. CAN distinguishes four message formats: data, remote, error, and overload frames. Here we limit the discussion to the data frame, shown in Fig. 3. A data frame begins with the start-of-frame (SOF) bit. 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. CAN controller Receiving : the CAN controller stores received bits serially from the bus until an entire message is available, which can then be fetched by the host processor (usually after the CAN controller has triggered an interrupt). Sending: the host processor stores its transmit messages to a CAN controller, which transmits the bits serially onto the bus. Transceiver Receiving: it adapts signal levels from the bus to levels that the CAN controller expects and has protective circuitry that protects the CAN controller. Transmitting: it converts the transmit-bit signal received from the CAN controller into a signal that is sent onto the bus

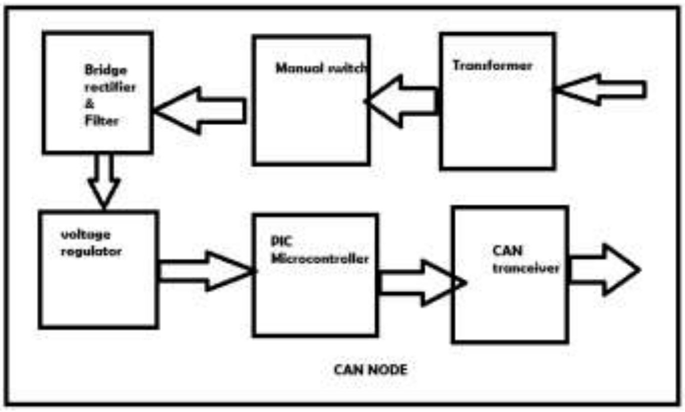

Fig5.Block Diagram of CAN node

,The PIC18F458 implements three transmit buffers. Each of these buffers occupies 14 bytes of SRAM and are mapped into the device memory map. CAN bus is a "multi-slave" bus where any connected dispositive can send a message. Frames are composed of an id which is set by user that is 0x01 for node 1, 0xO2 for node 2, 0x03 for node 3 and 1 to 8 data bytes. Device waiting for a specific data will filter og incoming frames based on their id. Thus both emitter and receiver exchanging data must have in common the frame id that will be used. Each CAN frame are acknowledged by the receiver All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified. To initiate message transmission, the TXREQ bit must be set for each buffer to be transmitted. When TXREQ is set, the TXABT, TXLARB and TXERR bits will be cleared. When the transmission has completed successfully, the TXREQ bit will be cleared, the TXBnIF bit will be set and an interrupt will be generated if the TXBnIE bit is set.

SOF	Identifier	RTR	Control	Data	CRC	ACK	EOF

Fig.6. Message frame structure of CAN

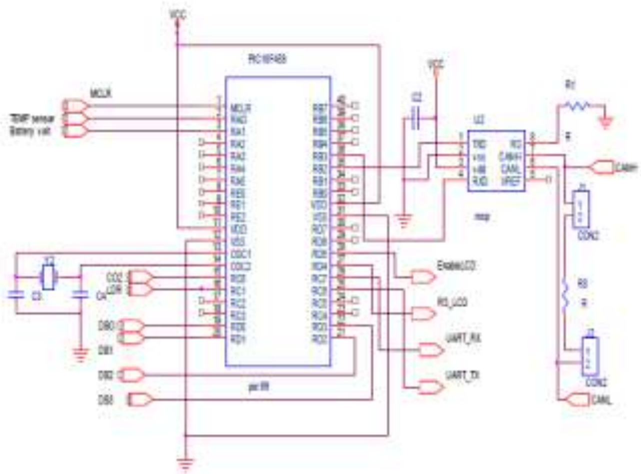

Fig7.Interfacing of PIC microcontroller with MCP 2551

5. CONCLUSIONS

In this paper, we develop a full-speed CAN bus communication system based on CAN2.OB protocol and man-machine interface devices. The system has many

Advantages, such as low cost, flexible construction, and high reliability . It can connect to CAN control network easily through complementing a chip of MCP25 10 and MCP255 1 to exiting circuit according to the demand of actual situation or user. The system has been applied to the TCU of experiment sample car successfully and it realizes the communication between the ECU(engine electric control unit) and TCU. The actual operation indicates that the CAN bus control network developed in this paper is stable and reliable and it has good communication and control ability.

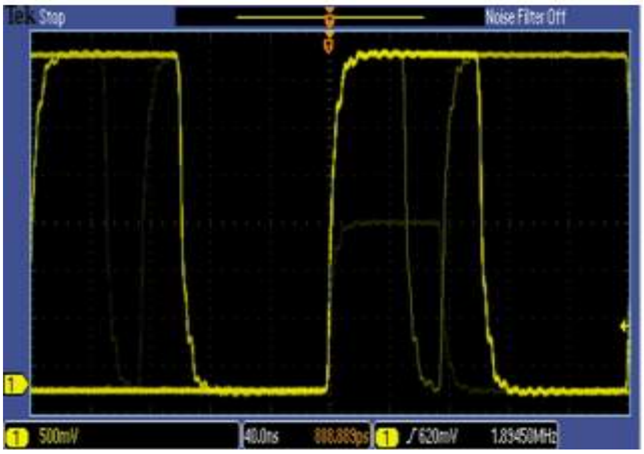

Fig7.CAN bus signal on Tektronix Oscilloscope

6. SCOPE FOR FUTURE WORK

1. Controller area network having many advantages they can used as single CAN controller and many types of traffic light controller, In the future CAN would be used in every type of embedded systems and machines. CAN is widely used for Automotive Applications to replace the complex wiring problems.

2 .This theses is limited to a three node network. This can

be extended to four nodes, eight nodes, 16 nodes etc. for vehicle monitoring applications , MCP 2551can support 112 nodes .

3. Response time analysis can be done. Response time

analysis for CAN aims to provide a method of calculating the worst-case response time of each message. These values can then be compared to the message deadlines to determine if the system is schedulable. Initially we provide analysis assuming no errors on the CAN bus. This analysis is then extended, to account for errors on the bus.

4. Cost analysis can be done.

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