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Study and Analysis of Controller Area Network for The Implementation of Temperature Sensor

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Abstract— **The Controller Area Network (CAN) is a serial, asynchronous, multi-master communication protocol for connecting electronic control modules in automotive and industrial applications. CAN was designed for automotive applications needing high levels of data integrity and data rates of up to 1 Mbit/s. In this project Controller Area Network protocol is implemented using on chip Motorola Scalable Controller Area Network (MSCAN) of MC9S12DP256B 16-bit Microcontroller. The application we have taken up is "Monitoring of Temperature using LM35 based on Controller Area Network architecture" .The system is constituted of two CAN nodes, each CAN node is formed by a transceiver MC33388 and 16-bit microcontroller MC9S12DP256B.**

The first stage consist of the conventional sensor of temperature (LM35) that converts the room temperature into voltage signal, and then this signal is conditioned and then the signal is transmitted to the input of the A/D converter of the microcontroller. The A/D converted data is transmitted to the CAN node 2 using the CAN architecture. At node 2 the received temperature readings are displayed using an alphanumeric LCD display of size 16X2. Node 2 consists of a keypad through which user can enter the maximum operating temperature of the device. According to the maximum temperature value entered the node 2 can take decisions and controls temperature source which is at node1 by sending control signals via the CAN network as per the user requirements.

In this thesis we have concerned with design techniques for implementation of CAN nodes for data monitoring and taking appropriate decision based on data in the control system. Implementation of CAN for temperature monitoring and controlling the device is successful and the same idea can be applicable to monitor tire pressure monitoring system, Adaptive Cruise control, power window and Engine management systems in Automotive. This leads to decentralization of control system in vehicles. This can be extended to industrial control applications

Index Terms—**CAN, LCD, LM35, Transceiver.**

I. Introduction

An embedded system rooted on microprocess which is monitoring a function or range of functions and the end user is not designed to be programmed as a PC. This is precisely what a user can do with a computer; computer is word processor and After this, it is a game machine, which is realizing software. An embedded system is designed for explicit responsibilities and several selections. An embedded system is group of hardware and software. The microprocessor or microcontroller rummage-sale in the hardware circuit of the embedded system is programmed to perform specific tasks by following the set of instructions.

II. The Controller Area Network (CAN)

The controller area network bus has been evolved for self-propelled electronics. It handle a large number of tools and gives megabit rate. The Echelon LON network has been establish for home and industrial automation. DSP processors assign personal appertain structures for multiprocessing. Other then this, for the common purpose computing, many structural networks have been put in use for embedded execution.

The new microcontroller existing in the market, which supply TCPIP connectivity because the peripheral and IP core have applied in chip, which can be used in web-based control systems. Myrinet was used in many advance-execution signal processing systems.

We can quest various protocols by investigation. We must be vigilant while choosing these protocols to design embedded systems. We have to patterned to the availability of equipment based on system specifications, design requirements, related protocols and system cost.

Based on the beyond terms, we can make some solid rules while selecting communication protocols:

1. Data deviation of communication protocol or highest or lowest velocity of baud rate.
2. The protocol should be immune to electromagnetic interference (EMI) because the data security or corruption caused by PCB or electromagnetic interference (EMI) in the system.
3. Data Size: The data chunk, which can be transferred on the protocol for each frame. It allows 8-bit, 16-bit and 32-bit data transfers.
4. Performance can be achieved by the efficiently defined distance between the nodes. For example, I2C will perform best if we distance between nodes is 10 to 12 feet.
5. In very complex systems such as automobile and space craft, the number of nodes or devices in network cases. The protocol must support many equipment required by the designer.
6. Communication protocols should have good error handling conditions.

Automotive real time systems requires a code of behavior that ropes unrestricted no of nodes(some thousands of nodes),to highest baud rate and good error handling systems or more than 100 ft distance between the nodes. Internal communication in IC and SPI not satisfies above requirements. So under BOSCH leadership, Society of Automotive Engineers (SAE) was founded in 1994, to define protocol standard for Automotive. SAE first represented SAEJ11850 BLDC – byte data link communication protocol in 1995. This protocol matches upstairs necessities. Later,

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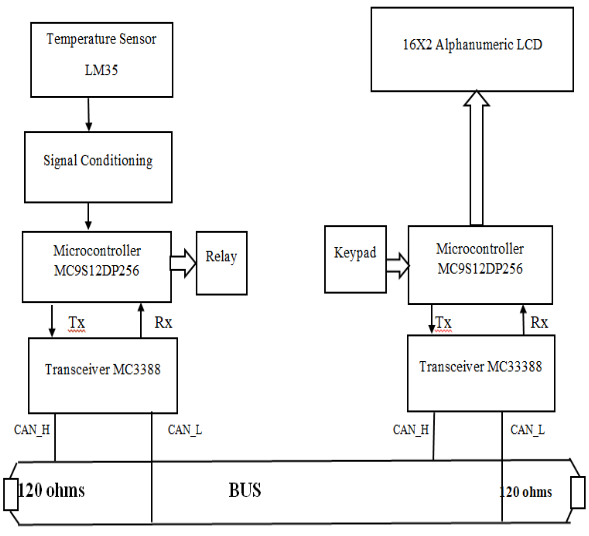
SAE came up to Controller Area Network protocols, which become very famous and upgraded version of J1850.
In spite of success to transfer data through CAN, we use to CAN protocol with Twentynine bit identifiers, that primes to connection of the devices on the network, extra than eleven bit identifiers mode. Controller Area Network uses discrete CAN controller and CAN transceiver related to microcontroller. In this project we used CAN IP of Freescale HCS12 microcontroller, that gives high cost of production but PCB size reduction. HCS12 also have on

chip Analog and digital converter, that gives more reduction in hardware on board and cost.
Our work in this project is execution of sensors for analysing the temperature and communication in the network using CAN protocol. The effective execution of CAN gives to decentralization of control systems in Automotive and Industrial control systems. Devices which are connected in the network are capable to take decision based on temperature data. These results can contain actuator controller, the gives required data of the controller in communication with other connected devices that can provide requested function. CAN gives the control of system in a distributed network in real time and with higher safety levels

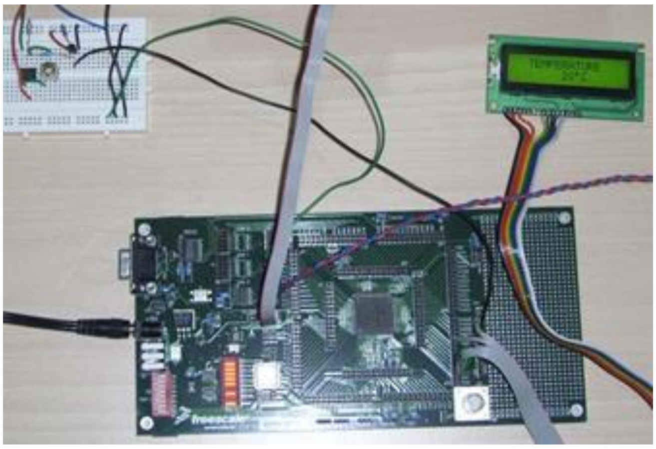
III. Proposed Work & Methodology

The temperature controller system is as publicized overhead. It is similar to the temperature monitoring system with minor adjustments. In alterations, node 1 is involved with an electromagnetic convey and node 2 is on condition that with keypad. The node one and the node two performances by way of the receiver along with the transmitter. Node two allows the programmer to cross the threshold the device's maximum operating temperature using the keypad. Keypad has three keys that two keys are rummagesale to cross the threshold the temperature worth and the third key is castoff as the Enter key. The recorded extreme temperature worth is diffused to controller area network Nodeone and deposited in a shield. Node 1 monitors that value to temperature and decides to turn the device on or off. Relay operates in accordance with the decision taken by node 1. That's why the device is controlled using controller area networking.

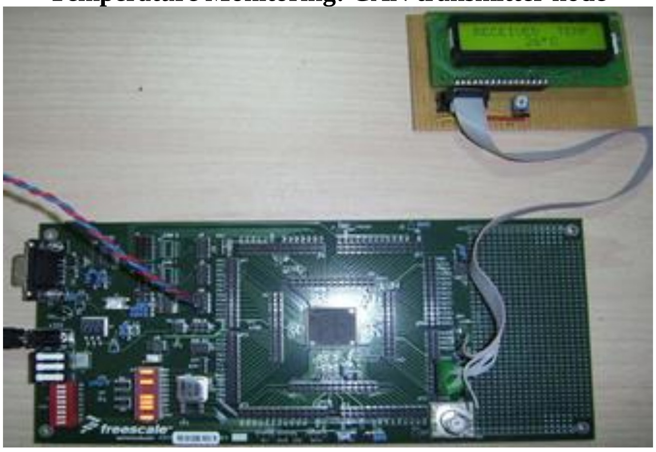


Block diagram of the Temperature Controller

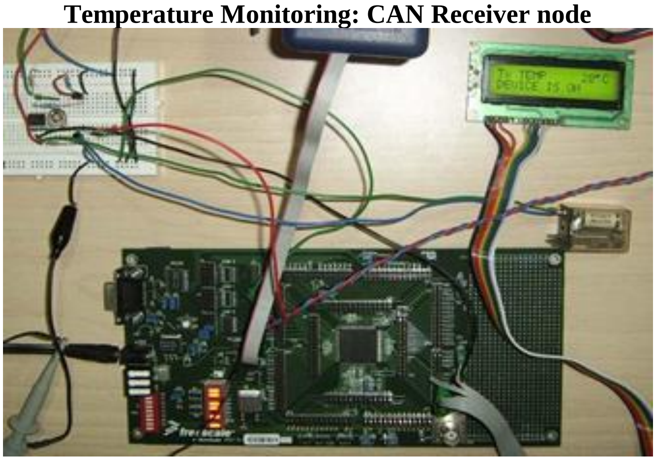
IV. Simulation Results of Proposed Work



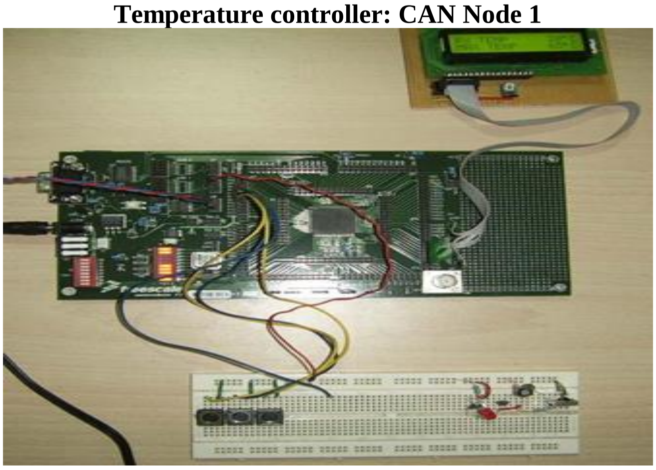
Temperature Monitoring: CAN transmitter node



Temperature Monitoring: CAN Receiver node



Temperature controller: CAN Node 1



Temperature Controller: CAN Node 2

V. CONCLUSION

The above report is all about how to design and implement CAN nodes such that it gives best results for data monitoring and from the data in the control system we can take suitable decisions. CAN implementation to monitor temperature is effective and similar way it can also be applied various other automotive applications such as to monitor tire pressure system, cruise control, and power window and engine management. This can be
decentralizing entire control system of the vehicle. It might be stretched to vehicles that are used for industrial purpose, largely to decentralize PLC control mechanisms.

We have used Freescale 68HCS12DP256 microcontroller for implementing CAN nodes, that is having built in CAN IP core. We have also discussed it's provision for peripherals in brief, hardware designs for circuit board and it's background debug mode. we have discussed how temperature monitoring can be implemented and how CAN architecture can be used for to control temperature. Also discussed about MC33388D which is CAN transceiver.

If you want to easily integrate and can handle inaccuracy by extra range of few degrees, TMP36 will be useful. But if you want to connect temperature sensor to an Arduino that can't handle temperature in minus, than you should consider LM35. This gives you higher accuracy and also voltage supply and negative output will be no more problem.

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