Controller Area Network for Monitoring and Controlling the Industrial Parameters Using Bluetooth Communication

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Abstract: ***Various parameters in the industries can be monitored and controlled using CAN bus network integrated with Bluetooth Communication. Monitoring and controlling the industrial parameters involve a large amount of man power and time consumption. To overcome the need of huge man power and time consumption this technology was developed which makes use of single person for monitoring and controlling the entire network. This method has been implemented in order to reduce the usage of wires used for communication purpose and also to reduce the errors relating to the data transfer. In this project sensors are used to sense the variable industrial parameters and the CAN protocols are used for error free data transmission and data reception purpose along with Bluetooth, pic microcontrollers are used for programming the CAN controller. The data transmission rate will be higher than other wireless systems. This application is user friendly and it can be achieved at a very low cost.***

Keywords: CAN (Controller Area Network), PIC16F877A, Bluetooth.

1. Introduction

Consider an industry of large area where the monitoring and controlling of each section involves a big task. In previous days for every individual task a person is employed, as in an industry we have many tasks so to monitor and control them the industry has to invest huge amount for man power and apart from the above case human errors can lead to a huge lose to the industry. It involves a large amount of man power and time consumption. To overcome these above factors we developed this technology which makes use of single person for monitoring and controlling the entire network. This can be achieved with the combination of both wired and wireless technologies CAN bus network with the Bluetooth technology.

CAN bus have been widely used in sensors, data acquisition, industrial control systems, and instrument device with high reliability, reality, and flexibility. How to integrate the CAN bus wired technology with the Bluetooth wireless technology is a hot research task now. This paper gives a kind of design of CAN bus for monitoring and controlling the various parameters, which includes CAN bus intelligent nodes, sensors network, Bluetooth and the whole network architecture. This technology is a cost effective one and it can be used in various applications like industries, medical field, automobiles, and home.

2. Experimental Setup

In our experimental setup, various sensors are connected to the PIC16F877A which acts as a slave node. These sensors sense the various industrial parameters like temperature, fire, light and gas.

2.1 Transmitting Section

In the transmitting section, there are various sensors connected to the PIC microcontroller which acts as a slave node as shown in the below figure1. These sensors sense the various parameters like temperature, fire, light, gas. Those variable parameters which are sensed by the slave nodes are sent to the master controller through can bus and can controller using the can protocol. The master controller pic is programmed in such a way that the parameters are sensed periodically and transmitted.

The CAN protocol are effectively used for achieving higher data rate. The loads can also be operated by the master controller. If the value of any sensor is above the cutoff point then the master controller controls that sensor to come below the cutoff point. The master controller receives the data from the slaves and processes that data to the PC through Bluetooth.

In the receiving section constituting of a Bluetooth module as shown in the figure2 which is used for collecting the data which is sent by the master controller. The various nodes on the transmitting section can be monitored on the receiver side by

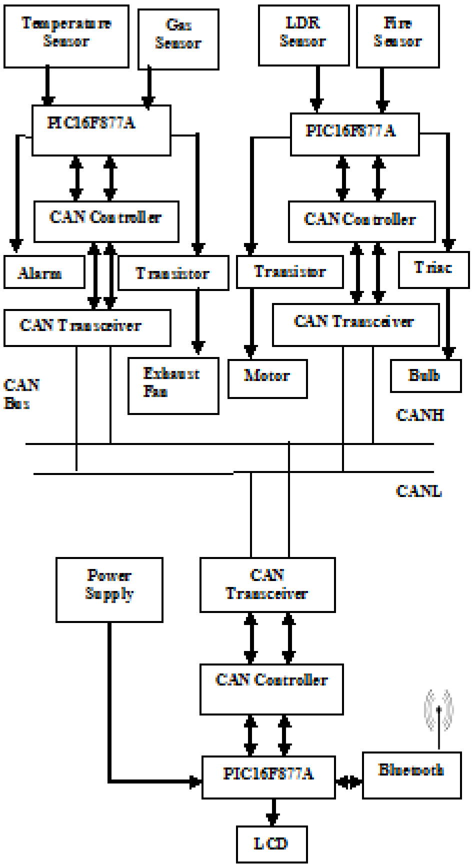

Figure 1: Block Diagram of Transmitter Section

2.2 Receiving Section

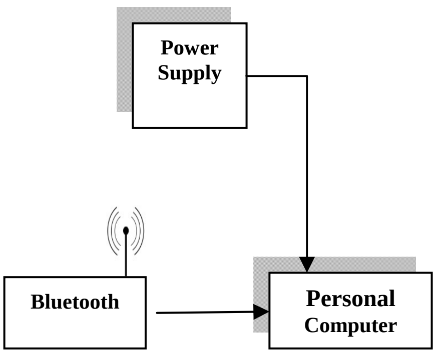

Figure 2: Block Diagram of Receiving Section

If anything is going abnormal, the user can control the devices at the other end. These values get updated in the personal computer for later verification.

3. Protocol and Hardware

3.1 CAN-controller area network

CAN is one of the field bus control system type used in networking. It is a message based protocol device. The communication can be achieved between various devices using CAN protocol. The CAN bus can be used to connect the control unit, transmitting and receiving unit. In this paper CAN bus is used in automation environment, which is primarily due to low cost. The multi-master node CAN is able to send and receive messages but not simultaneously.

The message consists primarily of an id which represents the priority of the message. The data's are transmitted serially on to the bus. This signal pattern is encoded in NRZ form and sensed by the nodes. Whenever the bus is free the most dominating message will be executed first and the lower priority will sense these and will back-off. Bit rate is up to 1MB/S are possible at network length below 40m and decreases with increase in network distance. Since the CAN shifts the voltage level the differential signal CANH and CANL are used. Carrier senses multiple access protocol with collision detection and arbitration on message priority are two types of protocols used in CAN. Error control mechanism such as CRC is used to ensure sensor data integrity. Both the remote frames and the overload frames are used for flow control mechanism.

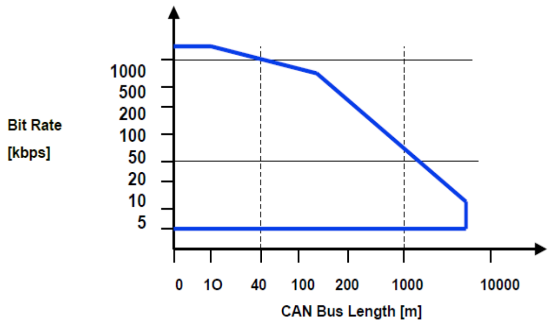

Figure 3: CAN bus length versus bit rate

The communication speed and bus length need to be set according to the system by the user. The CAN bus normally consists of two wires (CAN_High and CAN_Low), and the CAN controller is connected to those two wires via a transceiver. The bus level is determined by a potential difference between the CAN_High and CAN_Low wires. There are two bus levels, dominant and recessive, and the bus assumes either level at any given point of time. For logically wire-AND'd buses, the dominant and the recessive levels are recognized as a logic 0 and logic 1, respectively. A transmit unit can send a message to receive units by changing these bus levels. CAN nodes have the ability to determine fault conditions and transition to different modes based on the severity of problems.

3.2 PIC- Programmable Intelligent Computer

PIC is Harvard architecture. Data bus and address bus are separate in Harvard architecture. Thus a greater flow of data is possible through the central processing unit, and of course, a greater speed of work. Separating a program from data memory makes it further possible for instructions not to have to be 8-bit words. It is also typical for Harvard architecture to have fewer instructions than von-Neumann's, and to have instructions usually executed in one cycle. Microcontrollers with Harvard architecture are also called "RISC microcontrollers".

PIC16F873A/876A devices are available only in 28-pin packages, while PIC16F874A/877A devices are available in 40-pin and 44-pin packages. The PIC16F873A/74A have one-half of the total on-chip memory of the

PIC16F876A/77A. The 28-pin devices have three I/O ports, while the 40/44-pin devices have five. The 28-pin devices have fourteen interrupts, while the 40/44-pin devices have fifteen. The 28-pin devices have five A/D input channels, while the 40/44-pin devices have eight. The Parallel Slave Port is implemented only on the 40/44-pin devices.

The PIC16F87XA devices have a 13-bit program counter capable of addressing an 8K word x 14 bit program memory space. The PIC16F876A/877A devices have 8K words x 14 bits of Flash program memory, while PIC16F873A/874A devices have 4K words x 14 bits. Accessing a location above the physically implemented address will cause wraparound. The Reset vector is at 0000h and the interrupt vector is at 0004h.

4. Results

Below is the figure4 showing the values of different nodes on the lcd at the master node.node-2 gives the information of ldr and fire sensors node-3 gives the information regarding temperature and gas sensors.

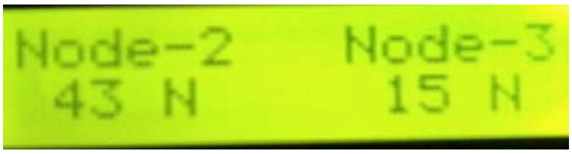

Figure 4: sensor values on lcd

The control information which is present at the CAN master controller is sent to the personal computer using the Bluetooth. Below is the figure5 showing the outcome of Bluetooth on the hyperterminal. This can be stored in the personal computer and can be used later for verification.

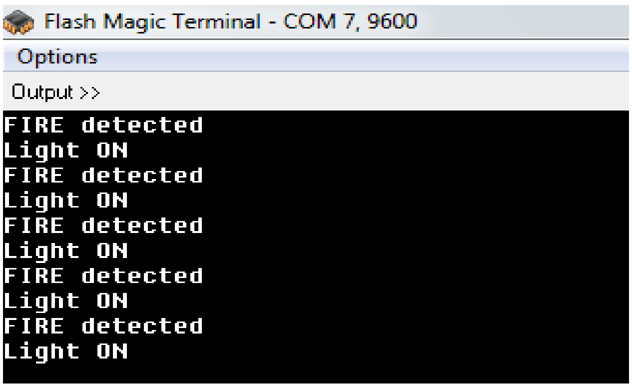

Figure 5: Displaying control information on hyperterminal.

5. Conclusion

In this method the integration of wired and wireless technology is achieved by using CAN and Bluetooth. In previous days manual monitoring and controlling was used. The wireless technology applied also has higher data rates. In this paper the above disadvantage has been overcome using Controller Area Network which makes us useful in the designing of number of CAN nodes. This paper gives the method of accurate and reliable transmission of data without data loss. The data from the slave nodes are transmitted to master PIC microcontroller. The transmitting section will send the data and receiver can check the data in the personal computer. The efficiency of this system is much higher than any other systems in use. This tends to be an accurate one since the intelligent device uses both encoding and decoding method for communication.

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