Design of PIC Based Ethernet Interface to Control the Industrial Parameters

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ABSTRACT

Currently device with microcontroller has been widely used in industrial field. However a large number of devices don't have the network interface and data from them can not be transmitted in network. A design of PIC –microcontroller interfaced with the Ethernet is presented. In the design, existing SPI serial devices can be converted into a network interface peripheral to obtain compatibility with the network. The design mainly consists of SPI communication module, controller module and Ethernet interface module. This paper will implement LAN to SPI communication using Ethernet module.

Keywords--**PIC-microcontroller, SPI, Ethernet, LAN**

I. INTRODUCTION

Data collection is a complete system, which the sensor and other measure equipment and the digital measure cell are contact with each other. It is the board used in weather, electric power, chemical engineering etc. However, many applications bring forward many rigorous demands. How to found a useful, extensively, agility, high efficiency data collection system is a important and difficult problem. Data collection technique is a significant fact of a modern science research and technology development.

Traditional data collection systems use the single-chip as the kernel of the system. The precision and the operation ability of the system is finite, the interface is not easy. Again, the distance of data transferring, capability of the data storage is also finite. With the embedded new technology development, data collection system import multitask operation system. This have many characteristics, such as rapidness of the collection velocity, easy interface etc. The technology will bring into play important effect on industry development.

LAN supplies networking capability to group of computers in close proximity to each other such as in an office, school or a home. Most LANs are built with relatively inexpensive hardware.

Ethernet is a physical and data link layer technology for LANs. Ethernet means 'network of everywhere'. No computer should be island. With Ethernet file sharing and printer sharing among machines become possible. Again, installation of Ethernet is easier and less expensive than other network protocol. It offers efficient ways to connect across MAC.PC, Linux, UNIX workstations.

Thus this paper suggests LAN to SPI communication using Ethernet. To monitor industrial parameters like temperature, speed etc numbers of monitoring equipments are used. Here we proposed LAN to SPI interface to monitor these industrial parameters with the help of different sensors.

The other target application can be industrial automation, building automation, home control etc.

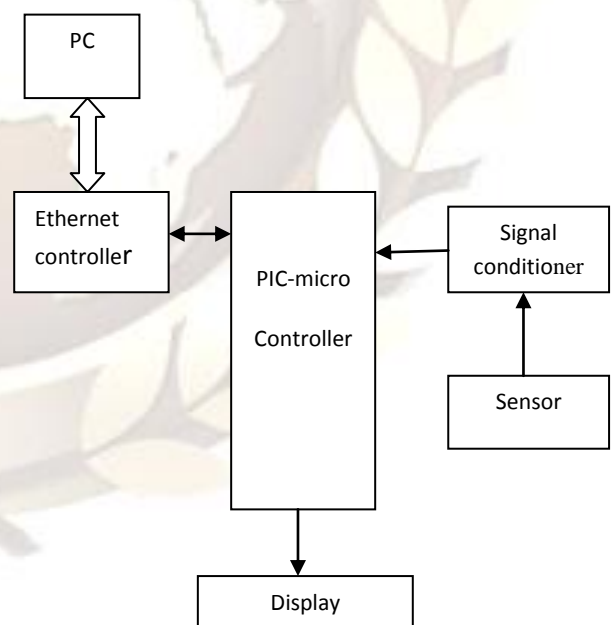## II.STRUCTURE OF HARDWARE SYSTEM

Figure 1. Structure of hardware system

As shown in above diagram the sensor output will be given to the signal conditioner. Again the output of the signal conditioner is given to the PIC-microcontroller, where PIC-microcontroller will convert hexadecimal data to

BCD & BCD to ASCII. After converting the data to the ASCII format, it will be displayed on the LCD. The data transfer between PC & PIC-microcontroller will be done through the Ethernet. For this purpose the necessary initialization for the Ethernet will be done through the PIC-microcontroller.

PIC-microcontroller is commonly used in robotics and control applications. Its potential use is in data acquisition and measurements.

PIC family is logical choice for many performance applications where cost is preliminary considerations.
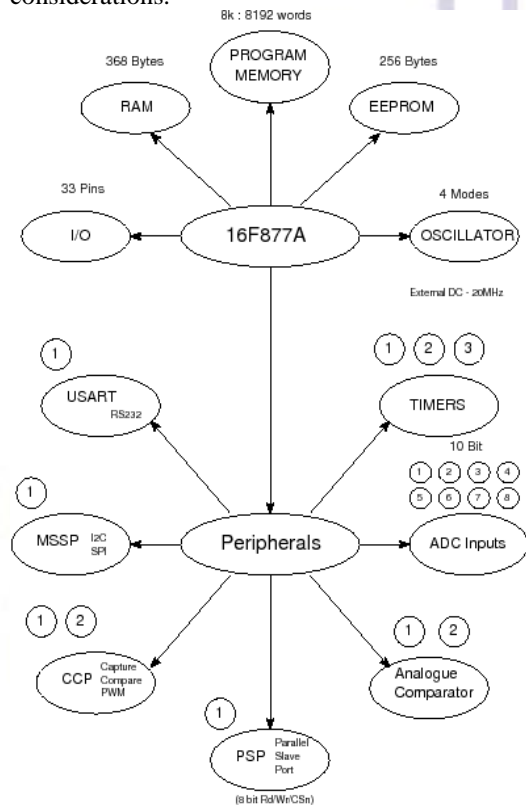

Figure 2. Various features of 16F877A PIC

PIC-microcontroller   mentioned in this paper is 18F877A having features like, high performance RISC (Reduced Instruction Set CPU) architecture, operating frequency is 20MHz, only 35 single word instructions, two 8-bit and one 16-bit Timers, fifteen Interrupts, built in support for SPI, USART, A/D etc., 8K programmable memory & 368 data bytes, five I/O Ports as A, B, C, D, E etc.

Serial Peripheral Interface (SPI) will be used to interface the sensor to PIC. With SPI we can connect as many devices as many as pins we have on the PIC-microcontroller. The speed of the communication between ICs is much faster as SPI can be used in full duplex mode. SPI is synchronous serial interface useful for communicating with the other peripheral or microcontroller devices. These peripheral devices may be microcontrollers, serial EEPROMs, shift registers, display drivers, A/D converters etc. SPI module has flexible operating modes as 8-bit data transmission/reception., Master and slave mode, Framed SPI mode. The purposed mode in this paper is Master and Slave mode.

In master/slave mode, master device initiates the data frame. Multiple slave devices are allowed with individual salve select (chip select). The SPI bus can operate with a single master device with one or more salve devices.
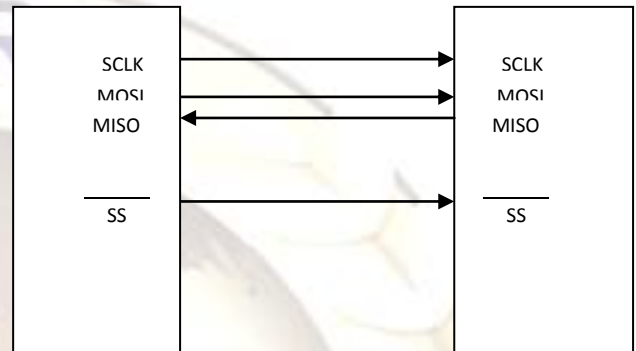
Master   Slave
Figure 3. Single master and single slave

Above figure shows single master & single slave. At start of the communication, master first configures the clock, where the frequencies range from 1-70 MHz. Master sends a bit on MOSI line and slave reads it from that same line. Again, slave sends a bit on MISO line and master reads it from that same line.

Ethernet controller is designed to serve as an Ethernet network interface for any controller equipped with SPI.

Here we suggest Ethernet controller ENC28J60 which meets all of the IEEE 802.3 specifications. It incorporates a number of packet filtering schemes to limit incoming packets. It also provides an internal DMA module for fast data throughput and hardware assisted IP checksum calculations. Communication with the host controller is implemented via two interrupt pins and the SPI, with data rates of up to 10 Mb/s. Two dedicated pins are used for LED link and network activity indication.

The ENC28J60 consists of seven major functional
blocks:

1. An SPI interface that serves as a communication channel between the host controller and the ENC28J60.
2. Control Registers which are used to control and monitor the ENC28J60.
3. A dual port RAM buffer for received and transmitted data packets.

4. An arbiter to control the access to the RAM buffer when requests are made from DMA, transmit and receive blocks.

5. The bus interface that interprets data and commands received via the SPI interface.

6. The MAC (Medium Access Control) module that
     implements IEEE 802.3 compliant MAC logic.

7. The PHY (Physical Layer) module that encodes and decodes the analog data that is present on the twisted pair interfaces.

The device also contains other support blocks, such as the oscillator, on-chip voltage regulator, level translators to provide 5V tolerant I/Os and system control logic.

The controller communicates with the Ethernet controller via its data and address lines to initialize the chip, poll it for packet status and send/receive data.

The primary use of a signal conditioner is to convert a signal that may be difficult to read by conventional instrumentation into a more easily read format. Many applications require environment or structural measurements such as temperature and vibration from sensors. These sensors, in turn require signal conditioning before a data acquisition device can effectively and accurately measure the signal. Signal conditioning provides more accurate sensor measurements. The other functions that may take place such as, amplification, electrical isolation that breaks the galvanic path between the input and output signal, linearization, cold junction compensation, excitation, filtering etc.

A sensor is a device that measures a physical quantity and converts it into a signal which can be read by an observer or by an instrument. It responds to an input quantity by generating a functionally related output usually in the form of an electrical or optical signal. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, sound intensity etc. The various applications include cars, machines, aerospace, medicine, manufacturing and robotics etc.

II.   SOFTWARE DESIGN

With the help of MikroC compiler the code for PIC16F877A can be written. MikorC is designed to provide the programmer with the easiest possible solution for developing application for the embedded systems. It allows user to quickly develop and deploy complex application. We can write C source code using the built I code editor. Here MikroC libraries can be use to speed up the development. In this code we used the syntaxes ad functions provided by MikroC compiler.

The html code is written in the PIC-microcontroller memory as per the requirement and it is transferred to the PC through Ethernet controller with the help of the SPI communication. Thus we can see the web page which includes the necessary title and the run time real temperature.

IV.RESULTS

Thus after implementing the system we can observe the temperature on the LCD as shown in diagram below:-
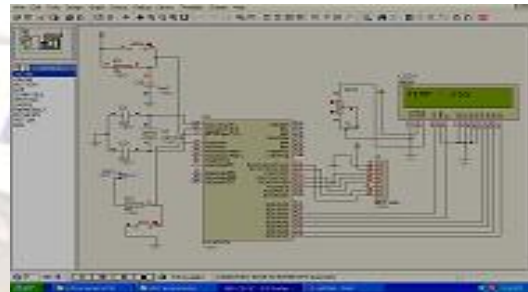
V. CONCLUSION

In this paper, the system is implemented to monitor industrial parameters like temperature, speed etc. with the help of the different sensors which can act as a network node using LAN to SPI communication. LAN provides higher data transfer rates and lack of leased telecommunication lines. Workstations can share peripheral devices thus cheaper. Again installation of Ethernet is easier and less expensive than the other network protocols, also provides connectivity to backbone.SPI provides full duplex communication, higher throughput, simple hardware interfacing and typically requires lower power. The system designed in this paper provides the characteristics of low cost and strong processing ability while the electronic unit is simple and reliable.

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