

# INDUSTRIAL PROCESS PARAMETER CONTROL USING ETHERNET

Renuka P.Gore 1, Prof S.A. Mobeen 2

Research Scholar, Department Of Electronics, SRES C.O.E.,S.P.P.U.Kopargaon, Maharashtra,India

Assistant Professor, Department Of Electronics, SRES C.O.E.,S.P.P.U.Kopargaon, Maharashtra,India

**Abstract-** In today's world networking is important part of industrial automation for monitoring and control of industrial process parameters. To provide this automation we implement a system which uses ARM Processor with Ethernet controller W5100. As most of industrial devices does not have network interface capability so W5100 will use to provide interface capability. This design basically consists of SPI communication module, processor module and Ethernet interface module. Due to which system has high performance and offers widest range of features such as flexibility, reliability, durability when compared with conventional and old solution to monitor and control. The main aim of our project is to implement a Industrial automation console that can be easily accessible from distant places through a simple web server running inside the industry. The basic functionalities in this proposed system includes automatic control of temperature, pressure and monitoring of humidity and gas parameters.

**Key Words:** -LPC2148, SPI, Ethernet, LAN etc

## I INTRODUCTION

Monitoring and control of industrial process parameter is complete system in which sensors are used to collect the data from the actual industrial environment. This actual environment may be the boiler, nuclear reactor or dairy plant etc whose temperature , pressure, humidity and gas we have to monitor over the Ethernet. 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“. With Ethernet file sharing and printer sharing among machines become possible. Again, installation of Ethernet is easier and less expensive than other network protocol. Thus this paper suggests LAN to SPI communication using Ethernet. To monitor industrial parameters like temperature, pressure, humidity and gas .Numbers of monitoring equipments are used. Here we proposed LAN to SPI interface to monitor these industrial parameters with the help of different sensors.

## II HARDWARE IMPLEMENTATION

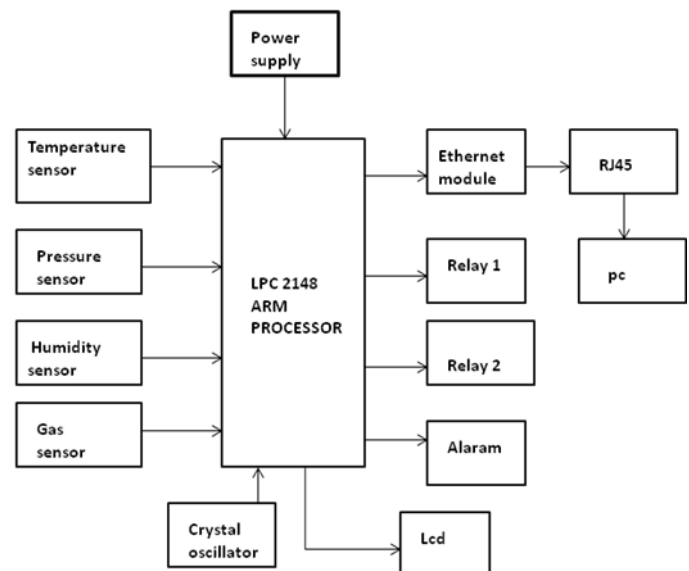


Fig. 1 System Block Diagram

The block diagram of the hardware system is shown in the fig.1. The system consists temperature sensor (LM 35), pressure sensor, humidity sensor and gas sensor, Ethernet, Relay Control device, LCD and PC.

In the system ARM processor is used to measure and control the parameter. Input port is used to sense the Temperature, pressure, humidity and gas, and output port is used to control the process. Ethernet provide communication capability to the system.

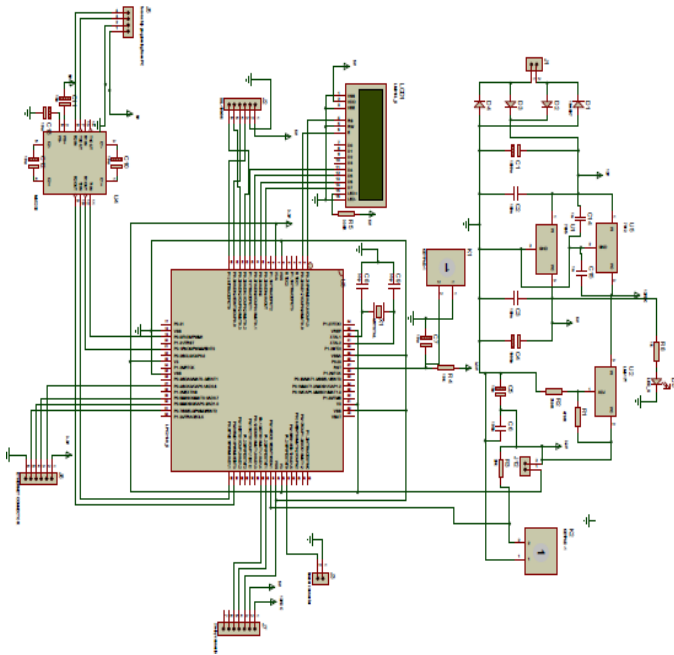


Fig. 2 Schematic diagram of system

Sensors are used to collect the data from actual industrial field. Sensor is the device which converts the one form of energy in to another form.[7] As a processor we are using LPC 2148 because of following features. It is 32 bit ARM 7 TDMI microcontroller with 40KB of on chip flash static RAM 512KB of on chip flash memory, It has In system programming Using on chip boot loader. For interfacing of sensor it has 10-bit ADC with 14 analog input and conversion time as low as 2.44us per channel. The conversion rate can be increase up to 400K samples per second by setting the ADC's serial registers. So most of the data processing is done by ADC so limited software is required for design other tasks. The LPC 2148 can communicate with serial communication through SPI and transmit the data to the host computer through Ethernet interface. The ARM is the heart of the system as it has high speed of execution and powerful information processing capability due to pipelined structure, Capability of multi-parameter execution [6]. The word NETWORK implies a linkage between two or more computing devices together for the purpose of sharing data. The network can be categorized as local area networks (LANs) and wide area networks (WAN). Ethernet is a family of frame based computer network technologies for local area networks (LANs) with the data transfer rate as high as 10 Mbps. The principle to access the Ethernet is carrier sense Multiple access with collision detection (CSMA/CD). The Ethernet is having two layers one is physical layer which converts the data into electrical signals. Second is data link layer it is further divided into two sub-layers. One is logic link control (LLC) which is esponsible for flow and error control. Next is media access control (MAC) which is

responsible for the operation of CSMA/CD access method. Now days, the most popular protocol is TCP/IP. TCP protocol is said to be connection oriented and provides a reliable service.

A typical Ethernet frame format is shown in fig 3. It consists of 7 bytes of preamble and this is used for bit synchronization. Start frame delimiter is of size 1 byte which is a frame flag that indicates the start of the frame. Source and destination addresses are of same size that is 2 to 6 bytes which is the 48-bit MAC address. Data size of 1500 bytes is allowed and frame checksum for checking errors is of 4 byte size that cyclic redundancy check[5].

Pre- amble	Start frame delimiter	Dest address	Source address	Type of length	Data	Pad	Check sum
7 bytes	1byte	2- 6bytes	2- 6bytes	2bytes	0- 1500 bytes	0-46 bytes	4 bytes

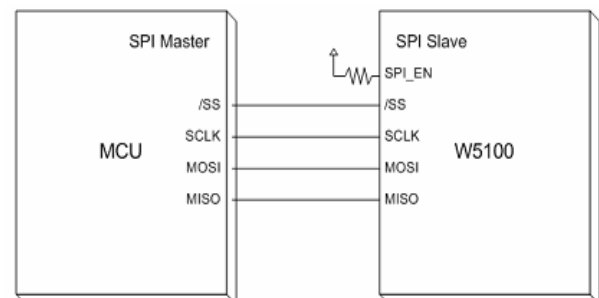
Fig.3 Ethernet frame format

**A.W5100**

The W5100 is a full-featured, single-chip Internet enabled 10/100 Ethernet controller designed for embedded applications where ease of integration, stability, performance, area and system cost control are required. The W5100 has been designed to facilitate easy implementation of Internet connectivity without OS. The W5100 is IEEE 802.3 10BASE-T and 802.3u 100BASE-TX compliant. The W5100 includes fully hardwired, market-proven TCP/IP stack and integrated Ethernet MAC & PHY.

**B. SPI (Serial Peripheral Interface) mode**

Serial Peripheral Interface Mode uses only four pins for data communication. Four pins are SCLK, /SS, MOSI, MISO. At the W5100, SPI\_EN pin is used for SPI operation.



### III SOFTWARE DESIGN

With the help of MikroC compiler the code for microcontroller can be written. MikroC 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 and functions provided by MikroC compiler.

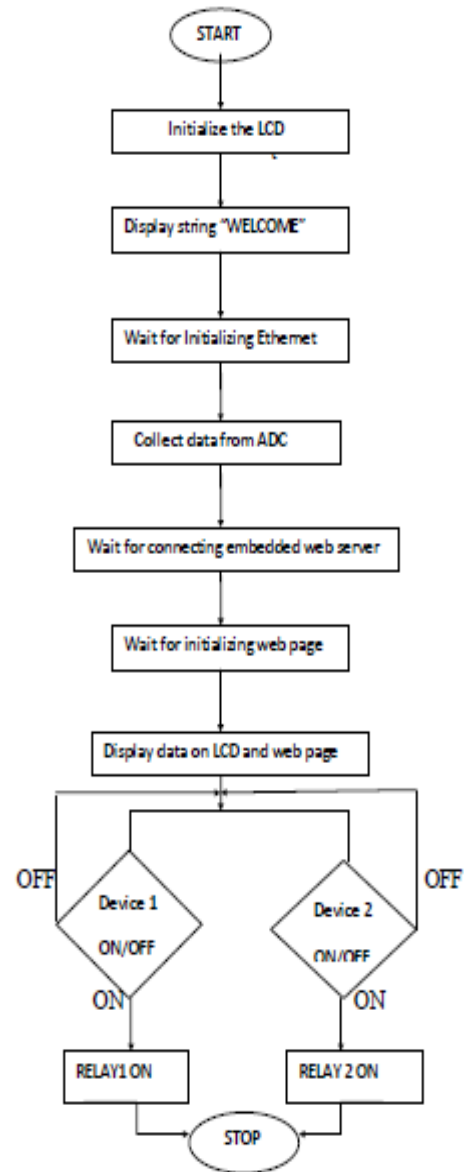


Fig. 4 Flowchart for system

The html code is written in the 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. HTML is a format that tells a computer how to display a web page. The documents themselves are plain text files with special "tags" or codes that a web browser uses to interpret and display information on your computer screen. HTML stands for Hyper Text Mark-up

Language; an HTML file is a text file containing small mark-up tags. The mark-up tags tell the Web browser how to display the page. An HTML files must have an htm or html file extension.

**IV RESULTS:**

Sensor senses the various parameters from environment in analog form. Analog to digital convert these data in to digital form .LPC2148 collect data from sensors and gives these data to display on LCD and web page.

In this system we are going to control temperature and pressure and gas and humidity only monitored. Relay 1 and relay 2 considered as a device 1 and device 2 respectively.

Device 1 is used to control temperature. When device 1 get ON it means relay 1 will turn ON to turn ON fan to control the temperature. In this system 50°C temperature set as a reference value ,when temperature rise above this reference value device 1 will get turn ON automatically to control the temperature in room.

Device 2 is used to control pressure. When device 2 get ON it means relay 2 will turn ON to turn ON valve to control the pressure. In this system 150Pa pressure set as a reference value ,when pressure rise above this reference value device 2 will get turn ON automatically to control the pressure in industry.

**A) Display of parameter on web page:**

Thus after implementing the system we can observe the parameter on the web page as shown in diagram below:-

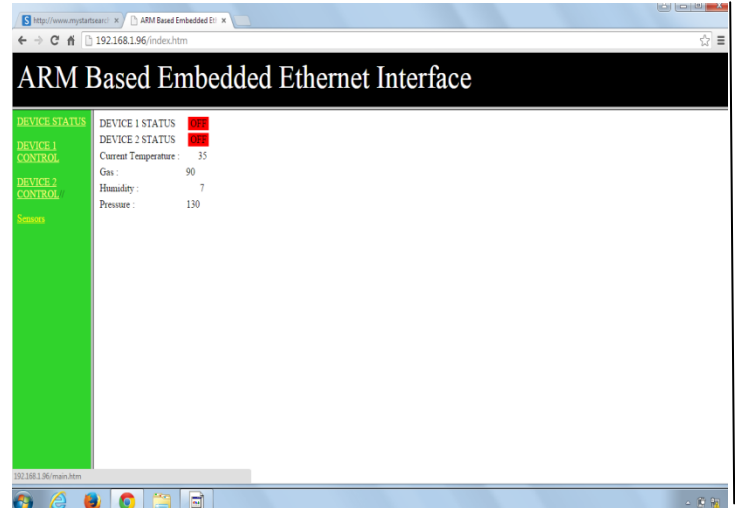


Figure 6.1 Display of parameter on web page

Once the parameter get displayed on web page we can control the temperature and pressure by turning ON or OFF the device 1 and 2 through relay 1 and relay 2 respectively. Above diagram gives the monitoring of all parameters. Here device 1 and device 2 is off because temperature is below 50°C and pressure is below 150Pa.

**B) Device 1 is in ON state:**

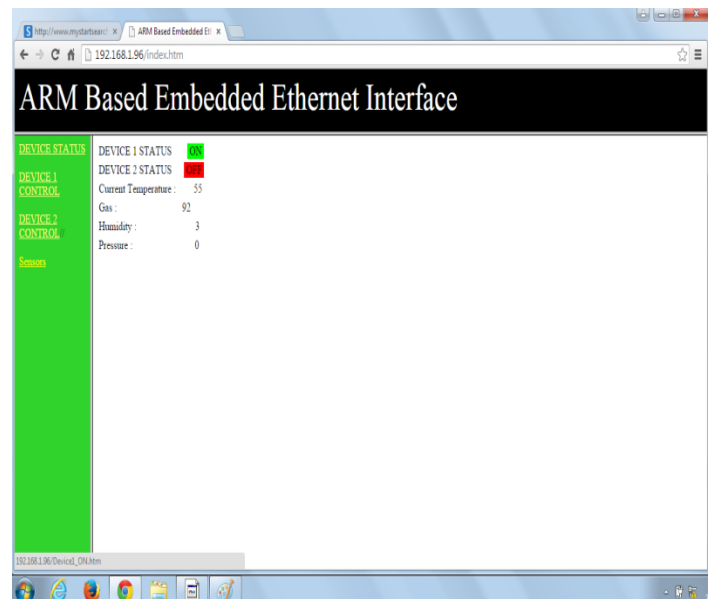


Figure 6.2 Device 1 is in ON state

In this case temperature rise above 50°C hence the device 1 is turn ON through relay 1 and device 2 is in OFF state because pressure is below 150Pa.

**C) Device 2 is in ON state:**

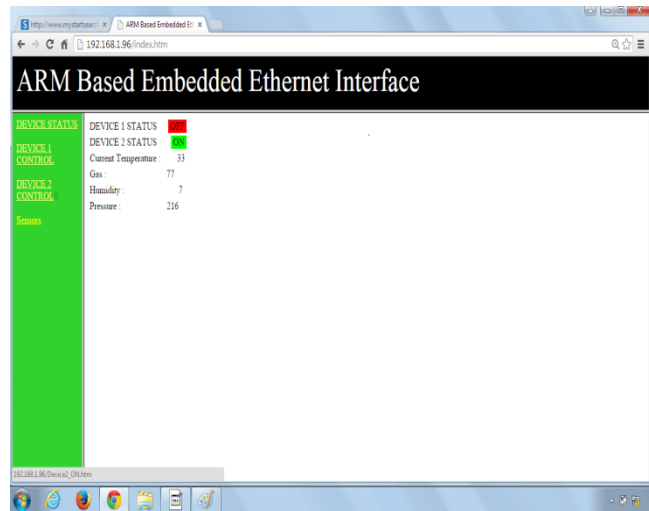


Figure 6.3 Device 2 is in ON state

In this case temperature is below 50°C hence the device 1 is in OFF state and pressure rise above 150Pa hence device 2 is in ON state. Thus in this way all parameter get monitored and temperature and pressure get controlled in this system.

**V CONCLUSION**

This system is implemented to provide concepts and a prototype system for industrial automation using Ethernet. It is implemented to monitor industrial parameters like temperature, pressure, gas and humidity, 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. Internet-enabled hardware products are slowly becoming common place. Ethernet’s potential as a network for distributed measurement and control is virtually unlimited. Ethernet provides inexpensive, relatively high speed network access to individual users and low delay that can support many applications. Ethernet continues to be enhanced with greater performance, higher determinism, and lower cost implementations and even consolidate control network

applications. A real web server is implemented in a device in industry, which is connected to pc via a local area network. If we compared Ethernet Technology with other technologies like Bluetooth, Zigbee, IR, RF-ID and GSM, it is having low response time, but Ethernet having very high speed, secured and also reliable.

**VI FUTURE SCOPE**

In future we can use this system in several applications by adding additional components to this project. This project can be extended by using GPRS technology, which helps in sending the monitored and controlled data to any place in the world. In future the separate embedded web server can be designed with Wi-Fi and Ethernet, which is co-existence technology on a single-chip. So the industrial can also control from Wi-Fi enabled smart device such as smart phones with high graphical interface. In future we can focused on industrial automation through internet. So that, it is possible to access that web page through internet and can able monitor and control the temperature with a PC or Laptop.

**REFERENCES**

[1] Zhao Ruimei; Wang Mei; “Design of ARM-based embedded Ethernet interface” *Computer Engineering and Technology (ICCET), 2010 2nd International Conference*.

[2] Szekacs, A.; Szakall, T.; Hegykozi, .; “Realising the SPI communication in a multiprocessor system” *Intelligent Systems and Informatics, 2007. SISY 2007. 5th International Symposium*.

[3] Chen Xiao-long Zhou Wen-hua, “ENC28J60 Ethernet controller applied in the network’s three-phase Electric Energy meter” *Networked Computing (INC), 2010 6th International Conference*.

[4] Microchip, “W5100 Datasheet”

[5] Bin Tan, Bo Yuan and Bing Zhu, " The Design of ethernet controller interface circuit based on ENC28J60" *Proceeding of second International Symposium on networking and network security(ISNNS'10) 2-4 April 2010.*

[6] Florin ravigan, Nicolae boteanu, Adrian mircea drighiciu, "Ethernet interface for a system of automation with microcontroller", *Annals of the university of Craiova Electrical Engineering series No 35, 2011.*

[7] AXELSON, J. (2003). Embedded Ethernet and Internet Complete. *Lakeview Research LLC, Madison, 2003. ISBN 1-931448-00-0.*

[8] Kumbhar trupti sambhaji, Prof S.B. Patil, " Design of PIC based Ethernet interface to control the industrial parameter", *International journal of engineering reasurch and application (IJERA), ISSN: 2248-9622 Vol. 2 Issue 4, July-n Aug 2012 PP 977-979 .*

[9] U. suneetha, K. tanveer alam, N. Anuja latha,B.V. S. goud,B. ramamurthi, " Ethernet based remote monitoring and control of temperature by uning Rabbit processor", *International journal of advanced computer science and applications(IJACSA),Vol.3, No 9, 2012*

[10] Mr M.R. Gaikar, Prof S.G.Galande, Prof. D.B.Rane "Ethernet Controller ARM Processor" *International journal of Electronics communication and soft computing science and engineering volume 2issue 1.*

[11] Suyog A. Wani, "Ethernet Enabled Digital I/O Control in Embedded Systems," *International Conference on*

*Computing, Electronics and Electrical Technologies (ICCEET)2012.*

[12]Rajan and Aby K. Thomas, "ARM Based Embedded Web server for industrial Application," *International conference on computing and control Engineering (ICCE) 2012.*

[13] Mr. Narendra U. Chipde ; Prof. V. R. Raut; " Industrial Process Parameter Monitor using Ethernet" *International Journal Of Computer Science And Applications Vol. 6, No.2, Apr 2013.*

### **BIOGRAPHIES**



University, Pune.

#### **RENUKA P. GORE**

She has completed B.E.(Electronics) Engg and pursuing Master of Engineering in Digital System at SRES College of Engineering, Kopargaon (M.S) from Savitribai Phule Pune



#### **PROF.S.A.MOBEEN**

He has completed his B.E. in E&TC Engg, M. E. in Electronics and Telecomm Engg and Currently he is working as Assistant Professor in E&TC Engg department at SRES College of Engineering, Kopargaon (MS) (India). He has participated and published many research papers in International Conferences and Journals.