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SAJID. K. SHAIKH
Department of ETRX, PIIT, Panvel, Mumbai, Maharashtra, India., sajidshaikh143@yahoo.co.in

R. H. KHADE
Department of ETRX, PIIT, Panvel, Mumbai, Maharashtra, India., rhkhade@yahoo.com

PADMAJA BANGDE
Department of ETRX, PIIT, Panvel, Mumbai, Maharashtra, India., pdb2007@gmail.com

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WIRELESS SENSOR NETWORK WITH CENTRALIZED EMBEDDED WEB SERVER USING ARM 7

SAJID.K.SHAIKH[1], R.H.KHADE[2], PADMAJA BANGDE[3]

[1,2,3]Department of ETRX,
PIIT, Panvel, Mumbai, Maharashtra, India.
Email:sajidshaikh143@yahoo.co.in[1,] rhkhade@yahoo.com[2,] pdb2007@gmail.com[3]

Abstract: A plat form independent embedded web server and its integration into a network of wireless sensor nodes is implemented here. The embedded web server is designed and built as an expansion module for one of the nodes in the Wireless Sensor Network (WSN). It allows authorized Internet users to establish two-way communication with the sensor network. The server uses limited available hardware resources to implement an interface to the WSN node. This allows the user to monitor the operation of the WSN remotely, to periodically download the sensed data and to change the operation mode of the network. In this project, by typing the IP-address of LAN on the web browser, the user gets a web page on screen; this page contains all the information about the status of the devices. The user can also control the devices interfaced to the web server by pressing a button provided in the web page.

***Keywords**: Sensors, Embedded Web Server, Zigbee, Ethernet Controller*

I. INTRODUCTION

The Embedded Web Server Technology is most evolving technology for Internet devices. As well as many application areas such as telecommunication devices, measuring instruments and lots of consumer electronics. With the development of network technology and communication technology, the need that industrial control can be completed via network has become a trend. In traditional industrial control system, the structure that one host connects multiple serial devices through multiport serial cards is adopted. The task of host is to communicate with each serial device, process data and interact between the operator and computer. This structure is feasible in the case of fewer devices, lower transmission rate. But when a host needs to connect more serial devices at the same time with higher transmission rate and the data processing is more complex, the system performance is poor. In addition, these serial devices connect the same host may be geographically far and this will increase the length of wiring and drop communication quality. So a solution need be found to realize the communication between industrial control devices and Ethernet.

As the embedded system itself has the performance of network and human-computer interaction, it is possible that the embedded system replaces the previous control method based on microcontroller. So an ARM processor- based embedded Ethernet interface system is designed.Web access functionality is embedded in a device to enable low cost widely accessible and enhanced user interface functions for the device. A web server in the device provides access to the user interface functions for the device through a device web page. A web server can be embedded into any appliance and connected to the Internet so the appliance can be monitored and controlled from remote places through the browser in a desktop.

The aim of the project is to monitor and control the devices or equipment's which are at remote place through a web page. It means that the devices or becomes complex. Also multiple IP addresses has to be memorized based on number of plant i.e. as each plant will have its own IP address as different Ethernet Controller are used. So to overcome this we proposed a new system. In this, we made use of Remote node. This node includes ARM processor and Zigbee.To this Remote Node plant is connected that sense or a measure quantities and then using wireless technology Zigbee transmitted to one Centralized Node. Centralized Node consists of ARM processor; Ethernet Controller and Zigbee.To this node, all the Remote Nodes send data. This data is then displayed on PC by typing IP address. So even if number of plant increases only we have to attach Remote Node to that plant. So no multiple IP addresses require to be memorized. appliances that are connected to a network can be monitored or controlled from other place. Here all the devices, which are to be controlled, are connected to the relays (acts as switches) on the web server circuit board. The web-server circuit is connected to LAN or Internet. The client or a person on the PC is also connected to same LAN or Internet. By typing the IP-address of LAN on the web browser, the user gets a web page on screen; this page contains all the information about the status of the devices. The user can also control the devices interfaced to the web server by pressing a button provided in the web page.

II. PROBLEM STATEMENT

In the existing project, the plant was sensing or measuring certain quantities using ARM and via Ethernet Controller(NIC Card) displaying it on PC which was accessible by typing IP address ,also via

LAN possible to see on other PC so that the quantities can be monitored. There were certain drawbacks existing in this .i.e. if more than one plant is to be monitored then based on number of plant that many number of ARM and Ethernet Controller would be required which increases cost and system design too

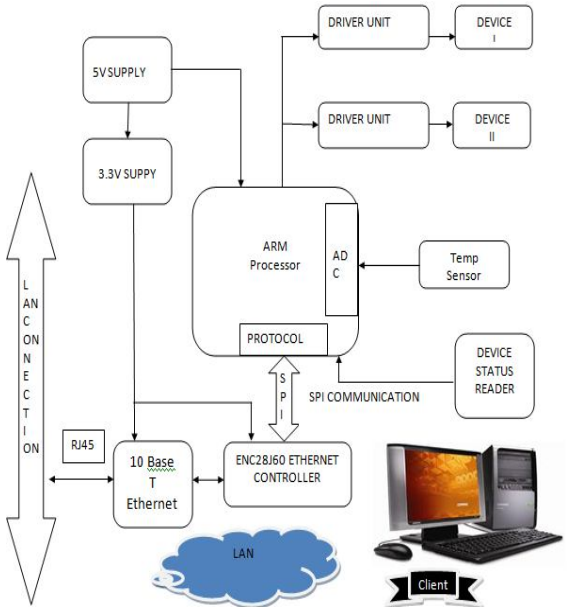

Fig.1.

III. PROPOSED SYSTEM

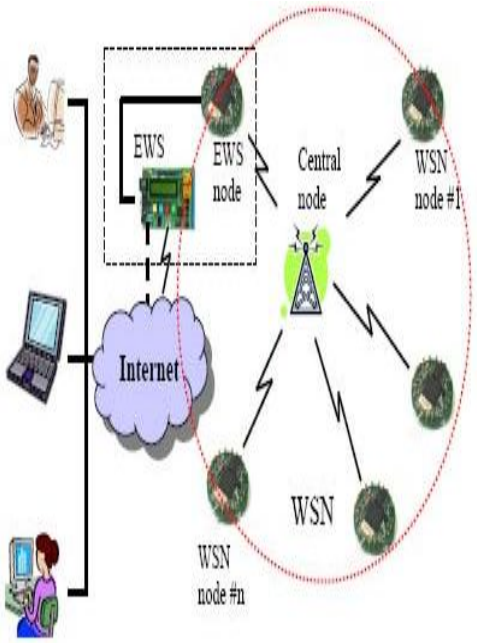

Fig. 2.

The system which we proposed would not only monitor the plant at remote place but also control the plant. There are three modules of this system. First module call Remote Node which consist of ARM 7 processor and Zigbee to this plant is directly connected. Second module call Centralized node which consists of ARM processor, Ethernet Controller and Zigbee. Thirdly, GUI (graphical user interface) on PC where is parameter of plant is monitor and plant is controlled.

To Remote Node, plant is connected which will sense or a measure physical quantities using temperature sensor, LPG sensor and relay which will control the plant. By using wireless technology, it will transmit data to one Centralized Node. Centralized Node consists of ARM processor, Ethernet Controller and Zigbee module. To this node, all the Remote Nodes send data. This data is then displayed on PC by typing IP address on the GUI design using Visual Basic. Once logged in, all devices and their current status are displayed .For security proposes two login's are provided. One for employer who will only monitor the plant and second for administrator who will not only monitor but also control the plant. The database is also designed where all the details of measured quantities of plant are stored automatically as reception of data start. Thus via internet the plant can be monitor and controlled from any wherein the world.

IV.DESIGNING

The designing part includes basically two sections as follows:

- Hardware design
- Software design

1. HARDWARE DESIGN

It includes Power supply design, Temperature sensor, LPG sensor, ARM processor and Zigbee connector circuit

A. POWER SUPPLY CIRCUIT:-

The hardware requires different power supplies.

- **+5 v:** for temperature sensor circuit.
- **+3.3 v:** for ARM 7 processor.

I have designed 5 v power supply using bridge rectifier, regulator IC 7805 and a filter. This 5 v supply I have given to the IC 1117. It is a 3.3 v regulator IC .This IC takes 5 v as a input and gives 3.3 v as its output which is then given to the ARM7 microprocessor.

B. ARM 7 PROCESSOR:-

The ARM7TDMI-S is a general purpose 32-bit microprocessor, offers high performance and very low power consumption. ARM architecture is based on RISC principles, instruction set and related decode mechanism are simpler than CISC Pipeline techniques employed ARM Processor supports both 32-bit and 16-bit instructions via the ARM and Thumb instruction sets. The 3 parameters to be monitored are sensed using respective sensor and data is feed to ARM7 .Traditionally, embedded devices include two types of processors: a Microcontroller and a DSP to process signals. However, with the development of ARM processors, last two can be replaced by one single processor. This unit is the heart of the complete system.

It is actually responsible for all the process being executed. It will monitor & control all the peripheral devices or components connected in the system. In short we can say that the complete intelligence of the project resides in the software code embedded in the ARM 7. The code will be written in Embedded C and will be burned or programmed into the code memory using a programmer.

C. LPG SENSOR:-

It's ideal sensor for use to detect the presence of a dangerous LPG leak in your home, car or in a service station, storage tank environment. This unit can be easily incorporated into an alarm unit, to sound an alarm or give a visual indication of the Combustible Gas/LPG concentration. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense iso-butane, propane, CNG and cigarette smoke. This LPG Gas Sensor can be used to make wireless Gas leak detector in home security system.

D. TEMPERATURE SENSOR:-

LM35 series are precision integration-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies. This is 3 legs IC that directly gives analog output. This unit requires +5VDC for it proper operation.

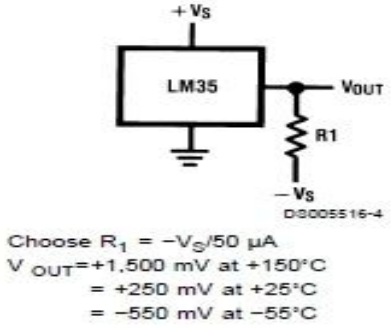

Fig.3

E. ZIGBEE:-

ZigBee is 'Wireless Networking Technology' and is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices. This kind of network eliminates use of physical data buses like USB and Ethernet cables. We are using ZNet 2.5 (Series 2) modules. The XBee ZNet 2.5 modules from Digi are more advanced than the popular XBee Series-1 modules, but they require a little additional work to set up.

F. ETHERNET CONTROLLER:-

ENC28J60 is a 28-pin, 10BASE-T stand alone Ethernet Controller with on board MAC & PHY layer, 8 Kbytes of Buffer RAM and an SPI serial interface. With a small foot print package size the ENC28J60 minimizes complexity, board space and cost.

2. SOFTWARE DESIGN

This includes the coding of ARM 7 processor and coding for downloading of data and for GUI (Graphical User Interface) on server side.

For ARM 7: Embedded c using Keil software.
For GUI: VB.Net, SQL 2005
For Zigbee: XCTU software for configuring Zigbee

V.CONCLUSION

We can conclude that our high- performance mobile sensor platform proves the feasibility of our technology choices for both wireless data communication and wireless power transfer and control the devices using the web server. By centralizing monitoring of these systems, it enables business decisions to be made more efficiently and ultimately reducing complexity and cost. The communication between the monitoring computer and the number of serial Equipments is made very simple. For traditional serial devices, the design provides an effective implementation to connect Ethernet and the remote devices with and can be changed into the shared resources in network. This design can be used widely in remote data acquisition and control system in industry.

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