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Embedded Web Server for Wireless Sensor Network in Industrial Applications

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Abstract: The Embedded Web Server design primarily aims at incorporating intelligent electronics systems in Industrial field control. There are numerous parameters that are required to be monitored and controlled in an industrial setup and in the current scenario data transmission systems are thoroughly dependent upon wired transmissions. In this paper a cost effective model of embedded server is proposed which can replace wired transmission of information, in various industrial set ups such are cement industry, material handling industry etc which are heavily suffering from the dependability problems.

In this work Wireless Sensor Network model is established which serves as the 'Sensor node'. This sensor node acquires data wirelessly and transmits to the Low cost Server that acts as the data host for the intercepted information. Designed Server adopts the concept of data hosting on web, and therefore has the capability of carrying out the various functionalities of a server.

Keywords: Embedded Web Server, Wireless sensor network, LAN, Industrial field control.

I. INTRODUCTION

Nowadays, controlling a system via PC is very common. A web base control and monitoring system can make a control system more effective and efficient. So developing a cost effective, programmable and high efficient web based control is necessary for the world competition [3]. The purpose of this project is to build a remote control system through a webpage which is controlled through local area network by using an embedded TCP/IP ENC28J60 module. The ENC28J60 is chosen because of having ease in Program download utility and ideal for Ethernet interface [2].

A. *Wireless Sensor Network*

Wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, humidity, pressure, etc. and to cooperatively pass their data through the network to a main location or server. Now most modern networks are bi-directional and also have enabling control of sensor activity. The WSN is built of "nodes" from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors [4]. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source usually a battery or an embedded form of energy harvesting

B. *Embedded Web server*

An embedded web server is a hardware component of a system that implements the HTTP protocol interfaced with an application .It can be used to provide a application or to design application for the distribution and acquisition of information to be displayed in the regular interface, it has an advantage of easily being interfaced with a Network through Ethernet[1].

The aim of this model is to monitor/control the physical parameter values or devices from the remote areas. A wireless communication is required to fulfill the application. Out of different wirelesses communications existing XBee

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module is used here as RF communication system

Objective of work here is to observe and control sensor network wirelessly using an embedded web server in an industrial setup. The embedded web server designed here performs two tasks continuously displays the output of WSN node to all the systems connected through LAN/Ethernet and control one AC & one DC device from the web through R.F Module.

II.MODEL DESCRIPTION

The Embedded web server model used here consists of ATMEGA32 microcontroller and XBee module (transceiver) and Ethernet module. The server has its own IP address & gets the sensor data from the client and this data can be accessed through local LAN or WAN . In this model a node of three sensors is developed i.e. temperature, humidity, LDR and a DC &AC device is controlled in the form of a 12V Motor& a50 watts Bulb respectively.

The Industrial Ethernet Module is based on an Alter Cyclone III FPGA. An integrated CPU is responsible for processing the Industrial Ethernet protocol and data exchange via the host interface. It has 8 MB RAM to run the protocol software and 2 MB FLASH from which the software and the FPGA design are loaded. ENC28j60 Ethernet module is used which allows the operator to control the operation of AC/DC device and monitor the parameters like Humidity, Temperature, and Light etc. Fig 1 below shows the overall Block Diagram of a sensor & server node

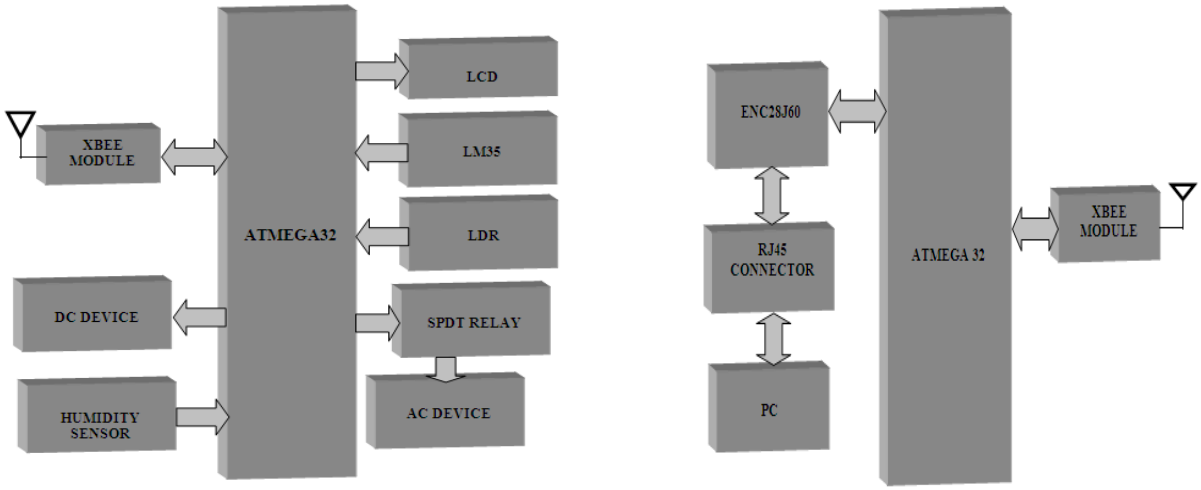

Fig.1 Block diagram of sensor node and server node

III. DESIGN DETAILS

Objective of this work is to Control and monitor a industrial system through LAN/Internet. A personal computer will become a client and the atmega32 microcontroller will be a server. A TCP/IP ENC28J60 Ethernet module develops an interface for extended device connection. Http Webpage application software will run at the PC platform. This is developed by using Embedded C for local area network (LAN). Through Webpage base embedded software, Controlling and monitoring the sensors & I/O devices like DC motor, and AC 230V bulb is done

This work is divided into two phases' i.e. hardware and software. The hardware phase deals with building up a server that can connect to the ENC28J60 and a sensor node on which the sensors as well as AC/DC devices are connected from which data is acquired. For the software phase, webpage base embedded software is build for enabling personal computer to communicate with web server. The changing of the I/O devices i.e. on/off and the three sensor

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data readings are displayed in the personal computer by accessing the webpage. Fig 2 below shows the proposed model.

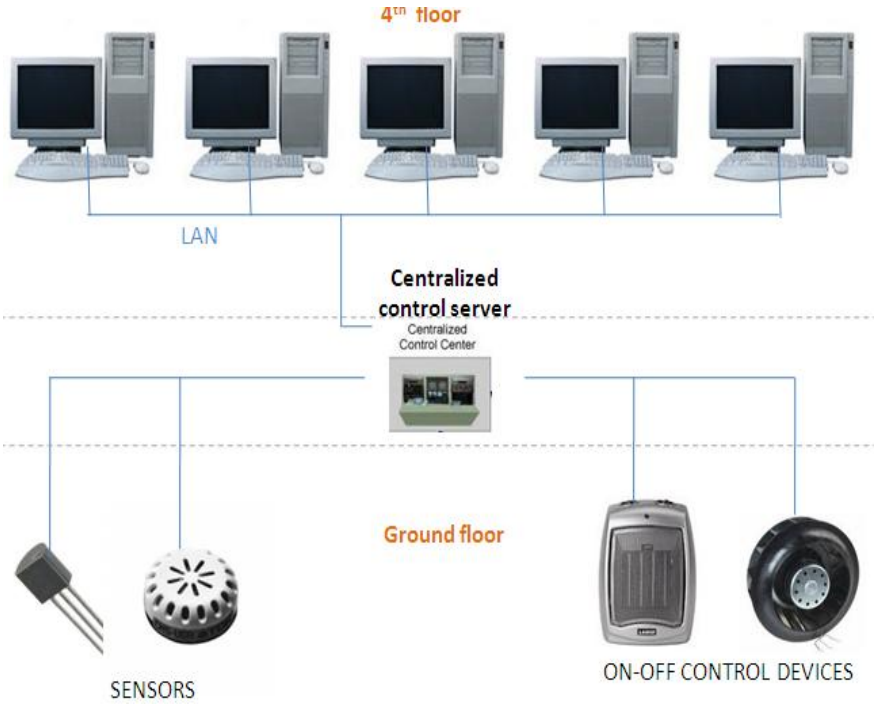

Fig 2 Proposed Model

A basic RF communication module works on 434MHz frequency but on this frequency we are not able to transmit the data from transmitter to receiver with proper synchronization. To overcome this problem an XBee module as a RF communicator is used which works at 2.4GHz frequency transmitting data for long distances as compared to basic RF modules. The Model developed here can transmit data for maximum distance of 100 metres and works as a transceiver.

IV.EXPERIMENTAL SET UP

. **4.1 HARDWARE:** The following Fig 3 & Fig 4 represents the actual hardware model developed for a server and sensor

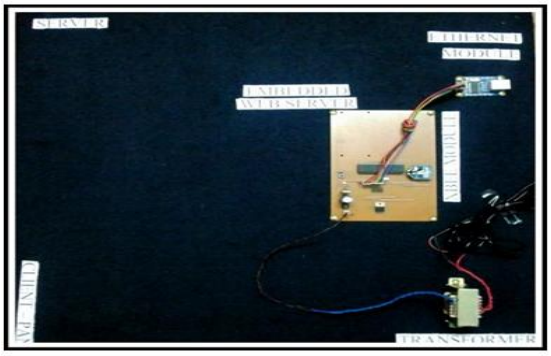

Fig 3 Embedded web server model

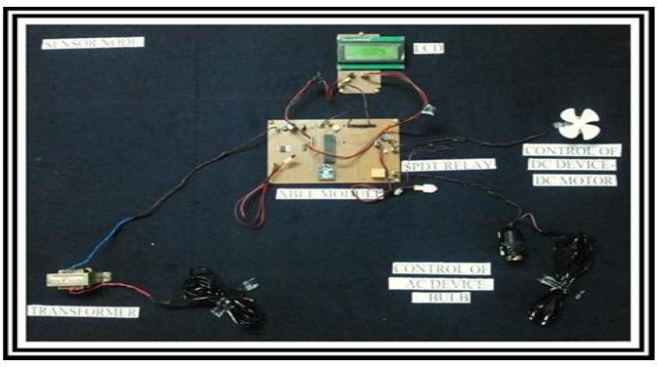

Fig 4 Sensor node model

Fig 5 & 6 shows results obtained on the computer screen when hardware model is interfaced through Ethernet LAN,

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it's a html webpage showing sensor side Data and server side data respectively

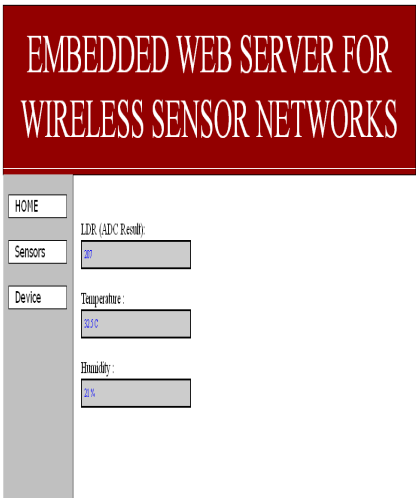

Fig.5 Screen Shot showing various sensor readings at embedded server

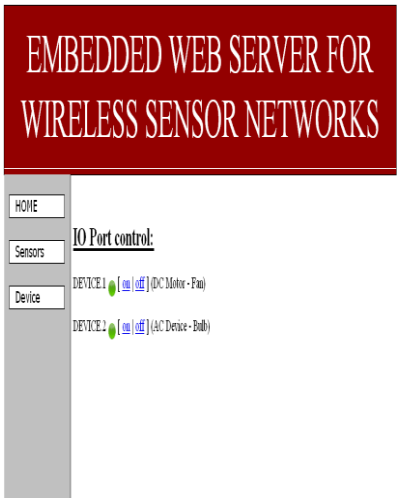

Fig.6 Screen Shot showing a AC & DC Devices control

V. EXPERIMENTAL RESULTS:

Following Experimental Results shows that on an average maximum of 0.05% error exits between the sensor node side and the server side data transmitted which is due delay in signal transfer which can be overcome by using higher model of XBEE. Once the data is transmitted to server it can be logged through a web page

Table 1 Temperature Readings:

	Time (in sec)	Server side Temperature Reading display	Actual Temperature (Sensor data in C)
1.	5	25	25.6
2.	10	30	29.1
3.	15	35	34.5
4.	20	40	41.2
5.	25	45	45.7
6.	30	50	50.1
7.	35	55	55.32
8.	40	60	61.15

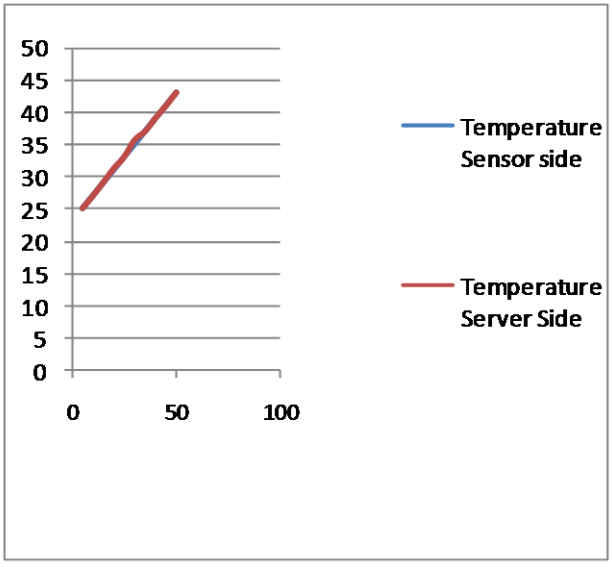

Fig 7.Graph showing temperature readings of sensor side & server side

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Table 2 Humidity Readings:

S.No	Time (in sec)	Server Humidity Reading display	Actual Humidity (Sensor data)
1.	5	21%	21%
2.	10	26%	26.5%
3.	15	35%	35%
4.	20	37.5%	37%
5.	25	42%	42%

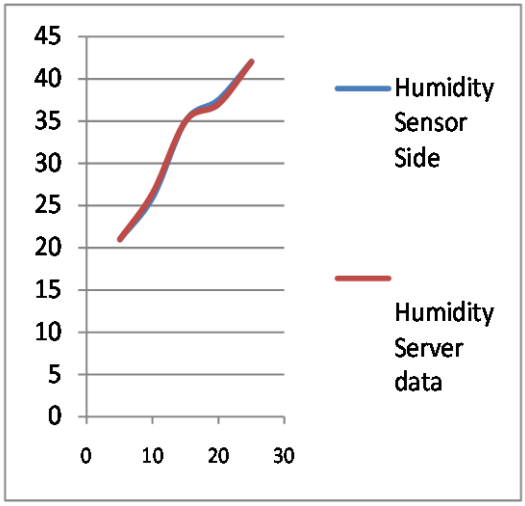

Fig 8.Graph showing Humidity readings of sensor & server

VI. CONCLUSION

Embedded Web Server for Wireless Sensor Network model developed here can continuously display the real time sensor data of Temperature and Humidity on a WSN to the system connected through LAN/Ethernet. And this real time data of Temperature and humidity is wirelessly transferred from sensor node to the embedded web server which can be monitored and further processed.

The developed model can be used for Industrial Applications which has tremendous scope for growth in industrial sector especially in a Small and middle scale industries. This work can further be extended with usage of high end embedded servers along with wireless sensor networks with increase in parameters and increase in sensor nodes.

VII. ACKNOWLEDGMENT

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