

STUDY ANALYSIS OF EMBEDDED WEB SERVER FOR BOILER PARAMETERS

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Abstract – This paper presents a design of new industrial automation system that uses embedded web server technology which can be used to communicate with the system remotely. It introduces design of Embedded Web server based on ARM 7 processor and Ethernet controller. It is better to use embedded web server rather than PC as a server due to small size, low cost and less power consumption. This Embedded Web server can be used in various applications like industrial, agriculture and home automation. This paper proposes a review on remote monitoring and control of boiler plant parameters. Users and admin can locally (LAN) or remotely (internet) manage and control system by entering correct ip address in the browser with correct password.

Key Words– Embedded Webserver, ARM 7, Ethernet controller.

I. INTRODUCTION

Our daily life has become so much dependent on automation that it is difficult to imagine life without automation. Environmental protection engineering, agriculture, industrial and medical engineering are some of the areas where automation is playing important role. In the past, automation engineering was mainly thought as control engineering with a number of electrical and electronic components. This phenomenon has been changed since computers and software have made their way into each component and element of communication and automation. Data acquisition systems with remote access are much in need in industrial sector and consumer applications. With the ability to access the application remotely, one can avoid the need to send a person to the application and thus save money and labor time. A web server provides access to the end devices for the client by uploading web pages as per the requests of the client. When the configured IP address is entered in the web browser, the designed HTML web pages gets displayed through which the client can remotely monitor the sensor status and control the parameters. ARM7 processor is the main controller of the system, ARM Processor is chosen because ARM has high data processing capability. Boiler parameters such as temperature, pressure, water level and gas leakage are used in this system which can be monitored through the predesigned web pages.

II. LITERATURE REVIEW STAGE

A deep and profound literature survey is backbone of any successful project. Extensively search has been carried out for past and related work in this field. Internet tool is used as source of information for carrying out this literature survey.

(1) “Embedded Web Server for Home Appliances”, IJERA, Mar’12 by Mr. Abhishek Vichare and Ms. Shilpa Verma:

Main aim of this paper is to describe how to connect a micro- controller to LAN or Internet and use it as a web server. This paper offers a new approach to control home appliances from a remote terminal, with an option from a local server, using the Internet. The system is designed to control home appliances' on/off, to regulate their output power, and to set their usage timing. The microcontroller which is used in this project is the Philips P89C51RD2BN microcontroller.

(2) “ARM Embedded Web Server Based on DAC System”, 2011 IEEE by M Poongothai:

This paper describes the principles to design a system for Internet-based data-acquisition system and control by using Advanced RISC Machine (ARM7/9) processor and in-build web server application with General Packet Radio Service (GPRS) technology. The main core of the system is an embedded hardware running on a NUT OS, an industrial grade RTOS for hard time applications.

(3) “Design and Implementation of an Embedded Webserver Based on ARM”, 2010 IEEE by Mo Guan and Minghai Gu:

In this paper, the embedded web server, which take Samsung Corporation's ARM9-S3C2440AL processor as core is designed, its operating system is Linux, and the system hardware architecture is presented.

(4) "ARM microcontroller based Wireless Industrial Automation System", IJAREEIE, Vol. 3, Special Issue 4, April 2014 by Nagisetty Sasidhar and Monica P. Suresh: Design and implementation of ARM Micro controller based wireless industrial automation system is discussed in this paper. It collects the information from all sensor modules and provides that information to the end user through TCP/IP network. The sensor module is an ARM microcontroller for monitoring and controlling the various parameters of a plant.

III. PROPOSED SYSTEM

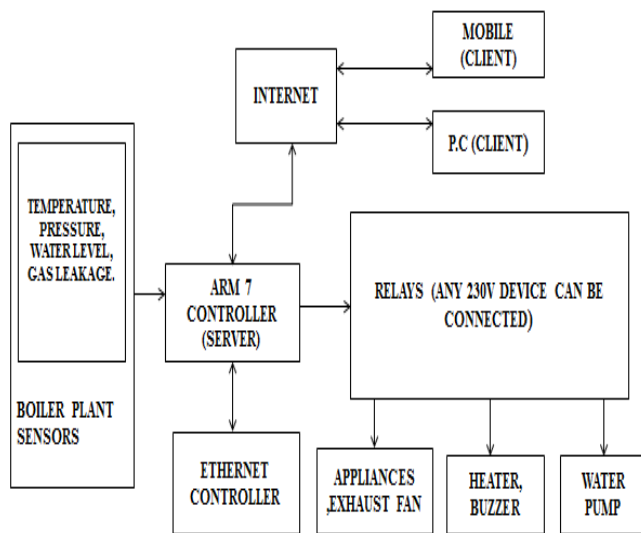


Figure 1: Block Diagram of proposed system.

Block diagram of embedded webserver based industrial automation for boiler system is shown in Fig 1. ARM7 is the main micro-controller of the system. The sensory network is to the ARM7. ARM 7 acts as the server of the system. The admin can monitor and control the devices by sending commands to controller through the server by opening the web page, and the controller will send and receive the signals from the sensors and relays. The sensors are pressure sensor, temperature sensor, water level sensor, gas leakage sensor which is used to monitor various parameters of the boiler plant. The server can be accessed from anywhere if internet connection is available. All the real time data from the various sensors and modules will be updated in the server continuously. Thus the user can monitor his industry from anywhere and can control the plant and various machines remotely. The system consists of Ethernet controller chip which handles all the requests of various clients.

IV. HARDWARE DESCRIPTION

1) ARM 7:

The ARM7 is a low-power, general purpose 32-bit RISC microprocessor macro cell for use in application or Customer-specific integrated circuits (ASICs or CSICs). It's simple, elegant and fully static design is particularly suitable for cost and power-sensitive applications. The ARM7's small die size makes it ideal for integrating into a larger custom chip that could also contain RAM, ROM, logic, DSP and other cells.

The various specifications of ARM 7 are:

- a) 32-bit RISC processor (32-bit data & address bus)
- b) High performance RISC
- c) 17 MIPS sustained @ 25 MHz (25 MIPS peak) @ 3V
- d) Low power consumption
- e) 0.6mA/MHz @ 3V fabricated in .8µm CMOS
- f) Fully static operation
- g) ideal for power-sensitive applications
- h) Fast interrupt response
- i) For real-time applications
- j) Virtual Memory System Support
- k) Excellent high-level language support

2) Ethernet controller:

Ethernet controller ENC28J60 is composed of seven main functional modules:

- a) SPI interface: to serve as the primary controller and the communication channel between ENC28J60.
- b) Control register: used to control and monitor ENC28J60.
- c) Dual-port RAM buffer: for receiving and sending data packet.
- d) Preferred device: When the DMA request transmits and receive modules, the right to control access to buffer RAM.
- e) Bus Interface: SPI receive through the data and command parsing.
- f) MAC (Medium Access Control) modules: implementation in line with IEEE802.3 standard MAC logic.
- g) PHY (physical layer) modules: the simulation of the twisted-pair data on the encoding and decoding.

3) Sensory network:

The various sensors used in the proposed system are:

A) Temperature sensor :

For temperature measurement PT100 sensor is used. This sensor can detect temperature of range from -200 °C to +850°C. The temperature coefficient of the sensor is 0.0039 Ω/ °C. PT100 uses platinum as a metal, whose resistance changes depending on the temperature to which it is exposed. The change in resistance for every 1 °C is 0.384 Ω.

B) Pressure sensor:

The pressure transmitter is used as a pressure sensor to measure the pressure of steam of the boiler. The pressure sensor used is SPD 005G. It can detect pressure range from 0-35000 Pa.

C) Water level sensor:

For detection of water level 3 probes are used. The probes are used to detect 3 levels namely low, medium and high level of water. If the water level is empty then the water pump is switched on automatically. When the water is full the 3 probes are shorted and it triggers to switch of the water pump.

D) Gas leakage sensor:

MQ2 sensor is used to detect the gas leakage of boiler rooms. MQ-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application. In this system if gas leakage is detected then the exhaust fan and buzzer are switched on to prevent from hazardous condition.

4) General hardware structure:

The general hardware structure is shown below. Each I/O channel can select various signals like voltage, resistance, current coming from the sensors. These signals from the sensors is given to ARM 7 LPC2148 and then to built-in ADC for A/D conversion. The digital data is stored in the memory. This data is accessed through web server by entering the correct IP address given to the system. ARM 7 has inbuilt SPI module which directly support the Ethernet communication.

The system has Ethernet controller chip which handles most of the network protocol requests. The Ethernet controller communicates directly to the LPC2148 (ARM 7) controller using a standard SPI interface. The system hardware consists of Ethernet controller ENC28J60, RJ45 socket, LPC2148 controller and input/output devices like sensors and appliances connected to relays.

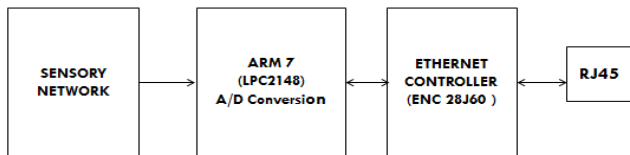


Figure 2: General hardware structure

V. BOILER

A boiler or steam generator is a device used to create steam by applying heat energy to the fluid. A boiler is a closed vessel in which water or other fluid is heated. A steam boiler produces steam for many applications such as power generation, chemical pulping process, domestic purposes etc. The process uses various fluids and includes the water storage tank, boiler, and pipelines. The feed water temperature is approximately 25°C and after the boiler, the steam temperature is approximately 250 °C. Figure 3 shows general steam boiler in which 3 temperature sensors and 1 pressure sensor is used.

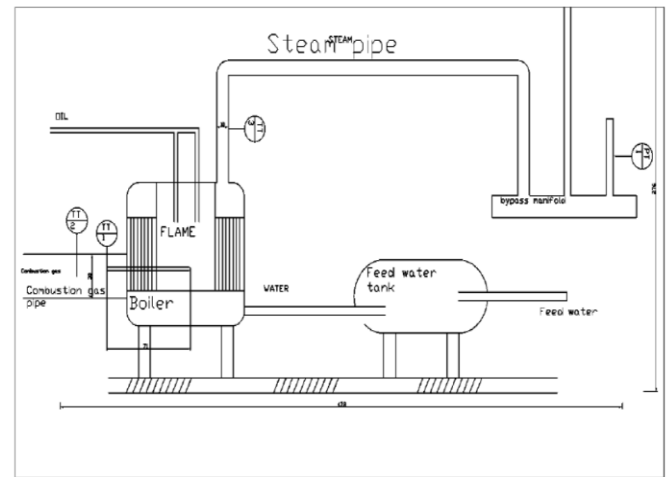


Figure 3: A general steam boiler

There are four measurements implemented in this figure: three for the temperature and one for the steam pressure. Figure shows the measurement locations.

- 1) The temperature is measured from the flame in chamber (the required measuring range is approximately 1800 °C)
- 2) The temperature of the combustion gas pipe (from the room temperature to over 350 °C)
- 3) The temperature from the steam pipe (from the room temperature to approximately 250°C).
- 4) The pressure approximately 15 bars, is measured from the bypass manifold.

During maintenance operations, however, the pressure may vary between 0-30 bars.

VI. WEB SERVER TECHNOLOGY

Embedded web server refers to a Web Server to monitor and control the system remotely with support of proper hardware and software systems. It transfers monitor and control data into an internet based web page, with TCP/IP protocol as the communication protocol between client and server and web server technology as its core. The protocol used for the communication between web server and web browser is Hyper Text Transfer Protocol or HTTP protocol. An embedded web server consists of HTTP protocol stack that is used to handle HTTP requests. This protocol defines all the basic frame work of web communications by handling requests and also by providing control information to be transferred between web browser and server. The browser and server should establish a connection at Port 80 in order to communicate with each other. The Internet protocol suite is computer networking model and set of communications protocols used on the internet . It is commonly known as TCP/IP as TCP stands for Transmission Control Protocol and IP for Internet Protocol. TCP/IP provides end-to-end connectivity and specifies how data is divided in packets, addressed, transmitted, routed and received at the destination successfully. When the correct configured IP address is entered in the browser, web server provides access to the client by uploading web pages on the browser as per the request of client. The client can monitor the various parameters of the system. Client can select the device status

and can control the devices by toggling the switches on the browser.

B) Controlling:

VII. FLOW CHART

A) Monitoring:

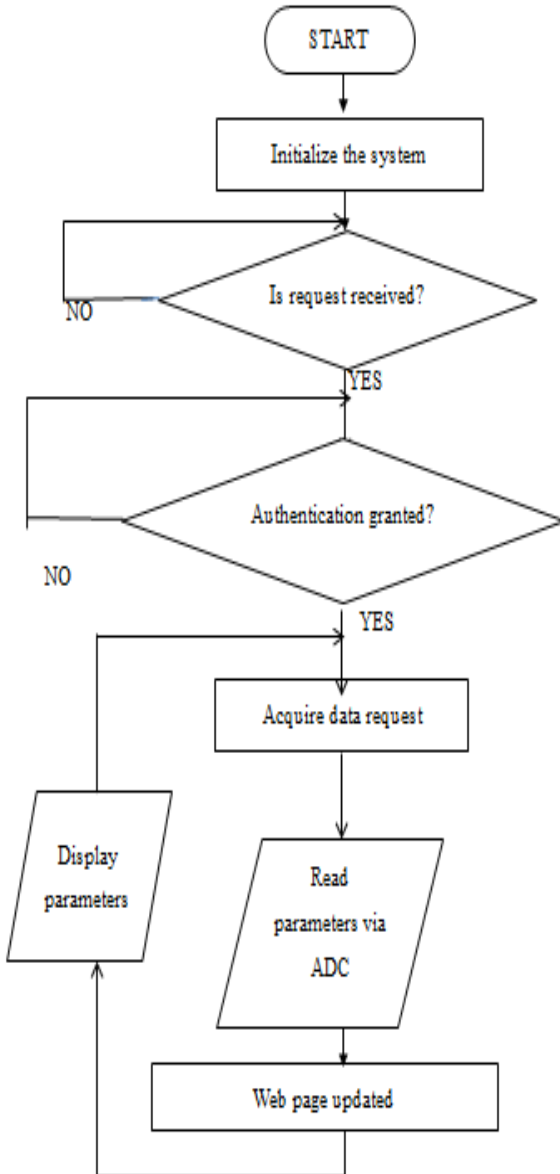


Figure 4: Flowchart for monitoring the system

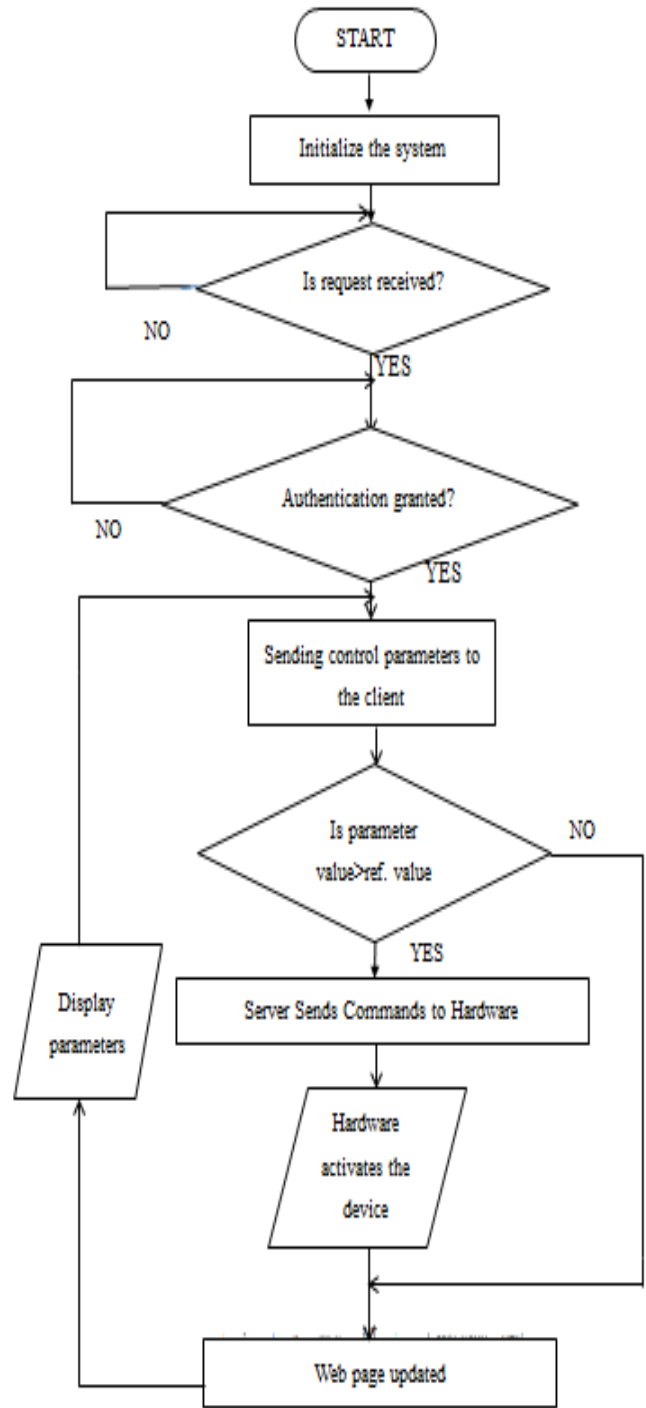


Figure 5: Flowchart for controlling the system

VIII. RESULTS

The simulation results of system are shown below:

1. Arm 7 interfacing with temperature sensor:

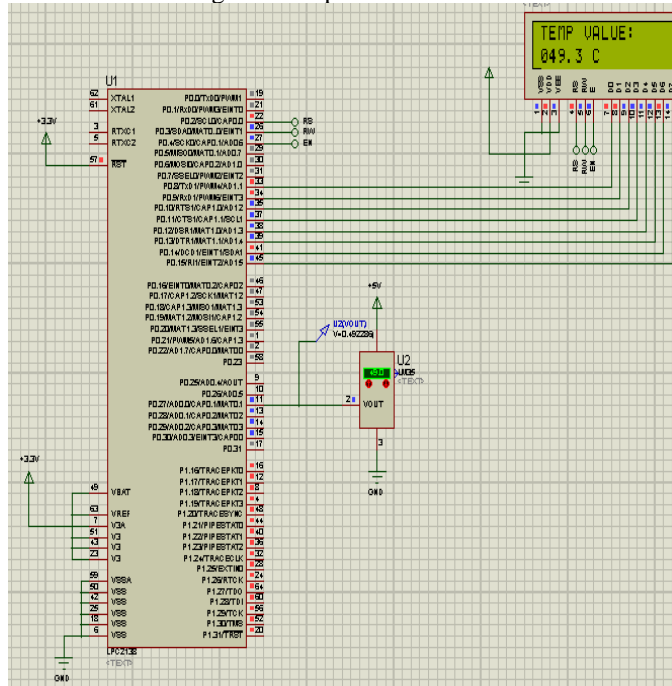


Figure 6: ARM 7 interfacing with temperature sensor

2) Arm 7 interfacing with relay:

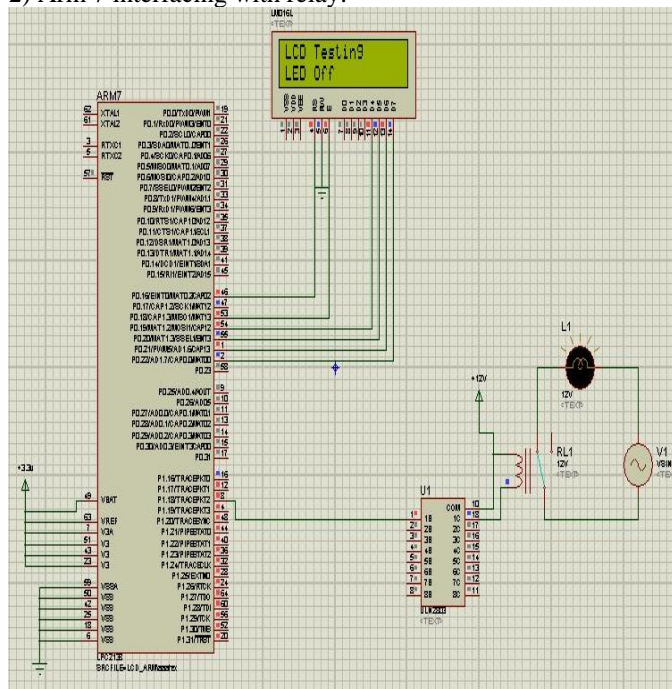


Figure 7: ARM 7 interfacing with relay

IX. CONCLUSION

The system is used to monitor boiler parameters remotely such as temperature, pressure, water level and gas leakage. These parameters are monitored from anywhere through internet. The system is implemented using ARM 7

processor and Ethernet controller. The sensors used in the system can match the actual boiler specifications.

X. ACKNOWLEDGEMENT

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XI. REFERENCES

- [1] Mr. Abhishek Vichare, Ms. Shilpa Verma “Embedded Web Server for Home Appliances”, International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 National Conference on Emerging Trends in Engineering & Technology (VNCET-30 Mar’12).
- [2] M Poongothai “ARM Embedded Web Server Based on DAC System”, IEEE, 2011.
- [3] Mo Guan and Minghai Gu “Design and Implementation of an Embedded Webserver Based on ARM”, 2010 IEEE Mr. Vijay Bhamrae & Mr. Chirinjeevi “CAN based real time implementation in automobile using ARM” (IJARCET) Volume 2, Issue 3, March 2013
- [4] Nagisetty Sasidhar and Monica P. Suresh. “ARM microcontroller based Wireless Industrial Automation System”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Special Issue 4, April 2014.
- [5] Sushma M. Gawali, Snehal M. Gajbhiye “Design of ARM based Embedded Web Server for Agricultural Application”, International Journal of Computer Science and Information Technologies (IJCSIT), Vol. 5 (1), 2014.
- [6] Marko Paavola and Kauko Leiviskä, “Wireless Sensor Networks in Industrial Automation”, Intech, Mar-2010.