July - Sep © 2015 Transactions; 2(7): 346-350

International Journal of Research and Applications

ISSN (online): 2349-0020 ISSN (print): 2394-4544 http://www.ijraonline.com/

Research Article

Web Based Monitoring System for Nuclear Plant

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DOI:
http://dx.doi.org/
10.17812/IJRA.2.7(59)2015

Manuscript:
Received: 18th July, 2015
Accepted: 31st Aug, 2015
Published: 20th Sep, 2015

Publisher:
Global Science Publishing Group, USA
http://www.globalsciencepg.org/

ABSTRACT

This paper presents the wireless sensor network and Monitoring of Atmosphere at nuclear Power Plant is the main agenda in this paper by using Wireless Sensor Network (WSN). Zigbee and Ethernet are the Wired Communication Protocols used in this paper. Different types of Sensors like temperature sensor, nuclear fluid level sensor and fire sensor which sense the atmosphere changes and convert these changes into different voltage levels. These voltages from each sensor are given to microcontroller for analog to digital conversion. If the conversion is completed it will send the data through zigbee. In receiving side zigbee module is connected to an Ethernet which is used for updating the values in to web server database. The system consists of several distributed monitoring stations that communicate wirelessly with a backend server using machine-to-machine communication. Each station is equipped with different type of sensors as well as data logging and wireless communication capabilities. The backend server collects real time data from the stations and converts it into information delivered to users through web server. Data can be collected and performance analysis and assessment are performed.

Keywords: Zigbee, Sensors, Ethernet, Web page.

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IJRA - Year of 2015 Transactions:
Month: July - September
Volume – 2, Issue – 7, Page No's:346-350
Subject Stream: Electronics

Paper Communication: Author Direct

Paper Reference Id: IJRA-2015: 2(7)346-350

DOI: 10.17812/IJRA.2.7(59)2015

International Journal of Research and Applications
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eISSN : 2349 - 0020
pISSN : 2394 - 4544

ELECTRONICS RESEARCH ARTICLE

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ABSTRACT

This paper presents the wireless sensor network and Monitoring of Atmosphere at nuclear Power Plant is the main agenda in this paper by using Wireless Sensor Network (WSN). Zigbee and Ethernet are the Wired Communication Protocols used in this paper. Different types of Sensors like temperature sensor, nuclear fluid level sensor and fire sensor which sense the atmosphere changes and convert these changes into different voltage levels. These voltages from each sensor are given to microcontroller for analog to digital conversion. If the conversion is completed it will send the data through zigbee. In receiving side zigbee module is connected to a Ethernet which is used for updating the values in to web server database. The system consists of several distributed monitoring stations that communicate wirelessly with a backend server using machine-to-machine communication. Each station is equipped with different type of sensors as well as data logging and wireless communication capabilities. The backend server collects real time data from the stations and converts it into information delivered to users through web server. Data can be collected and performance analysis and assessment are performed.

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1. INTRODUCTION

Safety is the most vital part of any type of industry. In any hazardous work environment plants, safety of human life is an important concern, Negligence in the safety part may cause damaging of high quality equipment hampering of production or may cause loss of human life also in extreme cases. In the atmosphere industry safety and security is a fundamental aspect of all. To avoid any types of unwanted phenomena all atmosphere industry follows some basic precaution and phenomena. Communication is the most vital key factor today, to monitor different parameters continuously and to take necessary actions accordingly to avoid any types of hazards related to production, security, managing of human resources. To avoid loss of material and damaging of human health, security and safety system as well as reliable continuous faithful communication system is essential. To enhance security, safety and productivity in atmosphere, a reliable communication system must be established between workers, and a fixed base station. It is very difficult to reinstall the wireless communication system inside atmosphere after damage due to any reason. If due to some reason any wire of the communication network damages, it may cause temporary interruption of the continuous process or may cause a long term break down of the system. To improve life safety, many systems have been designed, and have even been implemented in some countries today.

2. HARDWARE DESIGN SCHEME

A. Hardware Implementation

Hardware implementation deals in drawing the schematic on the plane paper according to the application, testing the schematic design over the breadboard using the various IC's to find if the design meets the objective, carrying out the PCB layout of the schematic tested on breadboard, finally

preparing the board and testing the designed hardware. The above Hardware implementation in this we are using LPC2148 micro controller this is ARM7TDMI microcontroller.
And Iam using different sensors and below fallows.

B. Transmitter and Receiver

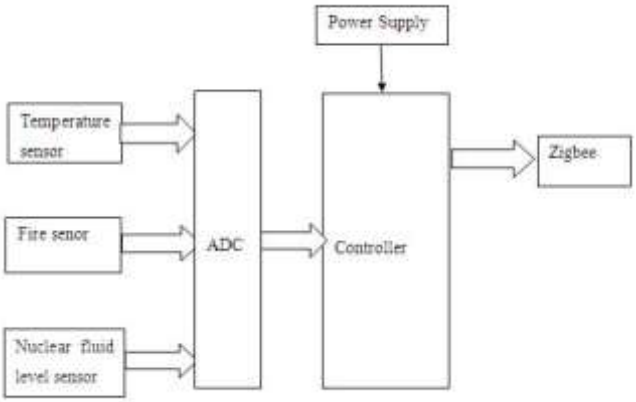

Figure 1 Transmission block diagram

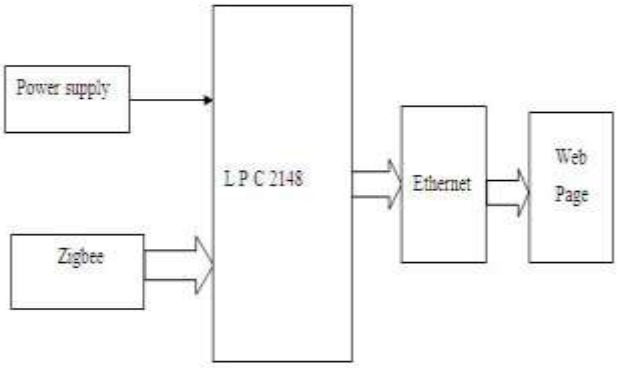

Figure 2 Receiver block diagram

The design and development of this wireless sensor network is completed in the laboratory, the main devices of the including a ARM7 development board with the LPC2148 processor produced by NXP Electronics microcontroller modules. This wireless microcontroller has a lot of advantages, such as low cost, low power consumption. As shown in Figure 2 is the structure of hardware.

C. Power Supply

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

D. ARM Processor

ARM is the industry's leading provider of 32 bit embedded microprocessors. Offering a wide range of processors based on a common architecture that deliver high performance, industry leading power efficiency and reduced system cost. ARM is a 32-bit RISC instruction set architecture developed by ARM Holdings. It was named the Advanced RISC Machine and before that, the Acorn RISC Machine. The ARM architecture is the most widely used 32-bit instruction set architecture in numbers produced. Originally conceived by Acorn Computers for use in its personal computers, the first ARM-based products were the Acorn Archimedes range introduced in 1987.

The ARM architecture includes the following RISC features:

1) Load/store architecture.
2) No support for misaligned memory accesses.
3) An orthogonal instruction set.
4) Uniform 16 × 32-bit register file.
5) Fixed instruction width of 32 bits to ease decoding and pipelining, at the cost of decreased code density.
6) Mostly single-cycle execution.

The ARM7TDMI core is a member of the ARM family of general-purpose 32-bit microprocessors. The ARM family offers high performance for very low power consumption, and small size. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles. The RISC instruction set and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

This simplicity gives:

- A high instruction throughput
- An excellent real-time interrupt response
- A small, cost-effective, processor macro cell.

The instruction pipeline: The ARM7TDMI core uses a pipeline to increase the speed of the flow of instructions to the processor. A three-stage pipeline is used, so instructions are executed in three stages.

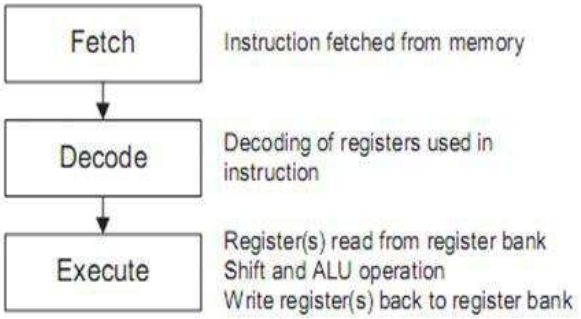

Figure 3 ARM Instruction pipeline

ARM7TDMI: An integer core with three-stage pipeline delivering high performance together with very low power consumption on a small die size. This outstanding combination makes the ARM7TDMI processor the most widely shipped 32-bit embedded RISC processor in the world

Key features are:

- Hard macro cell
- Portable down to 65nm
- Performance up to 133 MHz
- Thumb and ARM instruction sets
- Three-stage pipeline
- Unified bus architecture
- Low power, fully static design
- Small die size
- Coprocessor interface
- Embedded ICE-RT debug logic
- Embedded Trace Microcell™ (ETM™) interface

Memory access: The ARM7TDMI core has a Von Neumann architecture, with a single 32-bit data bus carrying both instructions and data. Only load, store, and swap instructions can access data from memory.

Data can be:

- 8-bit (bytes)
- 16-bit (half words)
- 32-bit (words).

Memory interface: The Embedded ICE-RT logic provides integrated on-chip debug support for the ARM7TDMI core. The Embedded ICE-RT logic contains a Debug Communications Channel (DCC), used to pass information between the target and the host debugger. The Embedded ICE-RT logic is controlled through the Joint Test Action Group (JTAG) test access port.

The ARM720T core retains the coprocessor and ETM interfaces for system expansion and real- time debug capabilities

ARM{x}{y}{z}{T}{D}{M}{I}{E}{J}{F}{-S}

X—family

Y—memory management/protection unit

Z—cache

T—Thumb 16-bit decoder

D—JTAG debug

M—fast multiplier

I—Interrupt

E—enhanced instructions (assumes TDMI)

J—Jazelle

F—vector floating-point unit

S—synthesizable version

All ARM7 family processors share a range of common features:

- High performance: up to 133 MHz on 0.13μm
- Low power consumption
- Small die size
- High code density
- Real-time debug facilities
- Coprocessor interface

E. WIZNET3150

WIZNET3150 is a gateway module that converts RS-232 protocol into TCP/IP protocol. It enables remote gauging, managing and control of a device through the network based on Ethernet and TCP/IP by connecting to the existing equipment with RS-232 serial interface

Key Features:

1. Direct Connection to the Serial Device
2. Adding Network Function Simply and Quickly
3. Providing Firmware Customization
4. System Stability and Reliability by using W5100 Hardware Chip
5. Configuration Tool Program
6. 10/100 Ethernet Interface and max 230Kbps Serial Interface
7. RoHS Compliant

WIZ110SR is a protocol converter that transmits the data sent by serial equipment as TCP/IP data type and converts back the TCP/IP data received through the network into serial data to transmit back to the equipment. When the data is received from serial port, it is sent to W5100 by MCU. If any data is transmitted from Ethernet, it is received in the internal buffer, and sent to the serial port by MCU. MCU in the module controls the data according to the configuration value that user defines. If WIZ110SR is set as TCP Client, it tries to establish connection to the server. To operate this mode, Local IP, Subnet, Gateway Address, Server IP, and Server port number should be set. If server IP had

domain name, use DNS function. In TCP Client mode, WIZ110SR can actively establish a TCP connection to a host computer when power is supplied data transmission proceeds as follows.

1. As power is supplied, WIZ110SR board operating as TCP client mode actively establishes a connection to the server.

2. If the connection is complete, data can be transmitted in both directions – from the host to the WIZ110SR and from WIZ110SR to the host.

F. TEMPERATURE SENSOR

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ºC). The LM35 - An Integrated Circuit Temperature Sensor Use of LM35s To Measure Temperature.

- You can measure temperature more accurately than a using a thermistor.
- The sensor circuitry is sealed and not subject to oxidation, etc.
- The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified.

Figure 4 LM35 Temperature Sensors

G. Fire sensor

A Fire detector is a device that detects Fire. Commercial, industrial, and mass residential devices issue a signal to a fire alarm system, while household detectors, known as Fire alarms, generally issue a local audible or visual alarm from the detector itself.

Figure 5 Fire Sensor

Internally fire sensor contains Darlington transistor pair. Here fire sensor gives digital output i.e. vcc or ground. Fire sensor gives logic high when the light or fire fall on it, otherwise it gives ground voltage.

In the diagram current flowing from collector to the emitter in the case of fire occurring. so due to this we are getting voltage drop across the RL resistor.

3. SOFTWARE DESIGN SCHEME

In order to protocol conversion of gateway, This paper presents the following solutions Establish address at the application layer, ZigBee and Ethernet Addresses to the address mapping of application layer to provide a basis for data transfer Unified the format of data transmission, which is a good solution to the data conversion issues, Build a frame by bytes transmitted in the application layer.

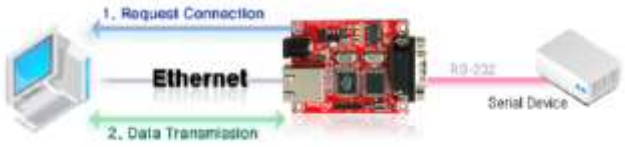

Figure 6 TCP Client mode

Wireless sensor network management model is consisted of end device, Zigbee and management monitoring center, End device is responsible for collecting wireless sensor network data, and sending them to parent node after simple operation, The transmission process of data from Ethernet to wireless sensor network is contrary. In the data transmission of wireless sensor network and Ethernet, mainly completes the address mapping and data message transformation between ZigBee protocol and TCP/IP protocol.

The service logic program of the gateway running in the web page as process and it's mainly used for realize the service logic of the gateway. The programs included ZigBee-Ethernet process program and Ethernet-ZigBee process program. The application run on the ZigBee board used to receive process and transmit data which comes from ZigBee wireless sensor network. The method of sharing memory is used for realizing the synchronism and communication of data in different processes.

4. RESULT AND DISCUSSIONS

Assemble the circuit on the PCB .After assembling the circuit on the PCB, check it for proper connections before switching on the power supply. This paper consists of controller, and ZIGBEE all the units are working independently and in collaboration with each other as well In total complete system (including all the hardware components and software routines) is working as per initial specifications and requirements of our paper. Because of creative nature of the design, some

features could not be fine tuned and are not working properly. As the users work with the systems, they develop various new ideas for the development and enhancements of the paper.

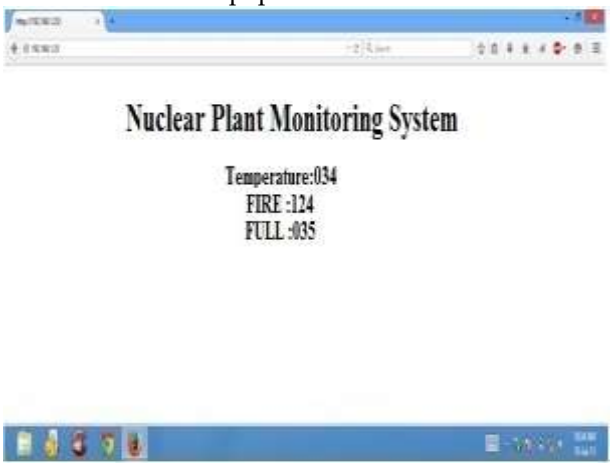

Figure 7 Web Page Display Output

5. CONCLUSION AND FUTURE SCOPE

A. Conclusion

In this paper we have designed a prototype of an embedded wireless sensor network based on LPC 2148 microcontroller and XBEE [zigbee protocol] for connectivity, The temperature, fire, fluid level were considered as essential for monitoring of atmosphere at nuclear power plant any changes in the atmosphere the sensors are capturing the levels of temperature ,fire, fluid. Then this information passes through zigbee to Ethernet connected to the web server in the computer

Development of light waited gateway using microprocessor which support low power zigbee to Ethernet on a single chip solution will reduce the complex design of wireless sensor and true power of internet for emerging application at low cost system with efficient protocol stack to control the entire system.

B. Future Scope

In this paper we have presented an approach of using the Wireless technology for Web page display, from web page and explained the application for the purpose of device. The Zigbee has been implemented successfully with temperature, fire, fluid level and Ethernet outputs have been verified. As part of further research, Remote Terminal System (RTU), database, historical database and other system together can also be developed in the overall enterprise information system or for the automation of energy management system and monitoring. There is future scope for monitoring from smart phones and apps. To receive the updates and alerts on to smart phones or to designated mobile numbers.

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