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An Embedded System Based Monitoring System For Industries By Interfacing Sensors With ATmega Microcontroller

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Abstract— **Nowadays for monitoring large scale industries and Nuclear Power Plants, periodic transmission of accurate and reliable measurements is central to safe, efficient and economic operation. Various sensors are being used for measuring the temperature, pressure, gas etc. These sensor values must be in real time and accurate in order to avoid faults. In the proposed system, sensors are interfaced with the microcontroller ATmega328p. The measured values are sent from monitoring station to the controlling station using Zigbee and then sent via WAN to the Internet if needed. Then the measured values are compared with the threshold value. In case of mismatch the workers will be informed to take corrective measures. This is a new approach using ATmega microcontroller in order to avoid serious disasters in nuclear power plants and large scale industries.**

Index Terms— **Wide Area Network (WAN), Read Only Memory (ROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), Million Instructions Per Second (MIPS), Complex Programmable Logic Device(CPLD), Integrated Development Environment (IDE).**

I. INTRODUCTION

The monitoring task in Nuclear Power Plants and large scale industries are of crucial importance with respect to safety and efficient operation. The operators have a wide range of variables to observe and analyze. The quantity of variables and their behavior determine the time they have to take correct decisions. The complexity of such aspects in a Nuclear Power Plant influences both the plant operational efficiency and the general safety issues. An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. Usually embedded system includes hardware and mechanical parts and also it controls many devices in common use. The program instructions written for embedded systems are referred to as firmware and are stored in read-only memory or flash memory chips. The AVR microcontrollers from Atmel are low cost general purpose micro-controller, with an excellent open-source, fully-featured C compiler. These controllers are low cost, low power consumption that is only a few milliamps at 3.3 or 5V. It consists of hardware interrupts that are used to monitor the state of a pin and in real-time to find out when it changes, hardware timers/counters, digital I/O allow interaction with the world of electronics, Analog to Digital Conversion allow interaction with dozens of sensors which output analog voltages between 0 and 5V, Serial protocols to allow AVRs to talk with other high-level chips and computers. It also consists of flash ROM , EEPROM that is byte-addressed which is easily changed at run-time and RAM that stores variables and data at run time. There are two main branches of AVR chips and they are ATTINY and ATMEGA branches.

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II. THEORY

A. MICROCONTROLLER

The ATmega328P is a high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB flash memory with read-while-write capabilities, 1024B EEPROM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable, a byte-oriented 2-wire serial interface, serial port, a 6-channel 10-bit A/D, programmable watchdog timer with internal

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oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

B. SENSOR

A sensor is a device used for the detection of changes in quantities and it provides a corresponding output, generally as an electrical or optical signal. In everyday, sensors are used in objects such as touch-sensitive elevator buttons and lamps which dim or brighten by touching the base. With advances in micro machinery and easy-to-use microcontroller platforms, the uses of sensors have expanded beyond the more traditional fields of temperature, pressure or flow measurement. A sensor's sensitivity indicates how much the sensor's output changes when the input quantity being measured changes. Making the sensor smaller often improves its performance of measuring and it can be designed to have a small effect and also introduces many advantages. The smallest change it can detect in the quantity that it is measuring is the resolution of a sensor. Various sensors used here are for measuring temperature, gas, humidity, light intensity and pressure.

C. ZIGBEE

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15 standard. Though its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is used in applications that require low data rate, long battery life and secure networking . ZigBee has a data rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other wireless personal area networks such as Bluetooth or Wi-Fi. ZigBee protocols are intended for embedded applications requiring low data rates and low power consumption.

III. EXISTING SYSTEM

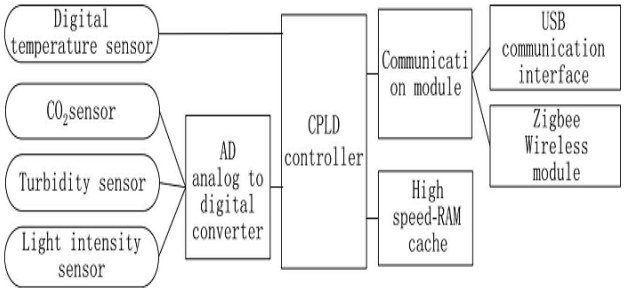

Fig.3.1 System's block function design.

In 2014 Qingping Chi in et al.., proposed an"A Reconfigurable Smart Sensor Interface for Industrial WSN in IoT Environment"

Stated that

- A sensor interface device for sensor data collection of industrial wireless sensor networks (WSN) environments .
- Complex Programmable Logic Device (CPLD) is the core controller. and using the analog to digital converter sensors are interfaced to it.
- The communication module used to transmit the data both in wire and wireless standards.

IV. PROPOSED SYSTEM

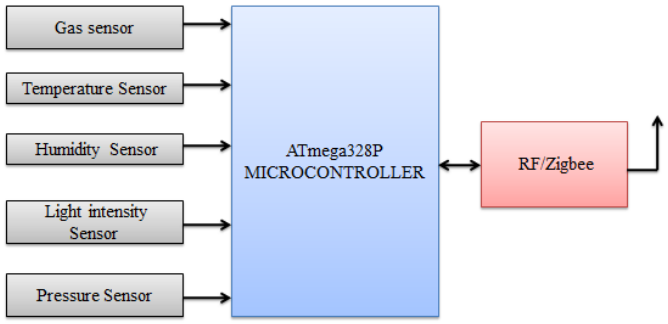

Fig.4.1.Monitoring unit

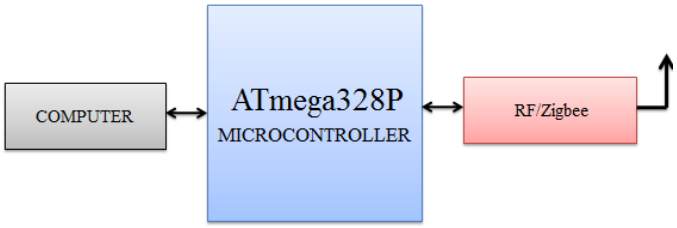

Fig.4.2.Control unit

An embedded system based monitoring and control system for Nuclear Power Plants and large scale industries is designed. In the existing system, Complex Programmable Logic Device(CPLD) is used as a core controller and sensors

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are interfaced to it. But CPLD is limited in function and logic density compared with a microcontroller. Microcontrollers are more versatile than a CPLD and also denser logic functions may be performed in it while comparing a CPLD. Hence in the proposed system microcontroller is used as a core controller. The programming module is implemented using embedded c coding. The system mainly consists of two units and they are monitoring and control unit. The monitoring unit is placed near the plant the control unit is far away from the plant. The monitoring unit consists of sensors ,micro controller and Zigbee. The measured sensor values of the plant or industry are sent to the controller and they are transmitted to the control unit via Zigbee. The control unit consists of the Zigbee, microcontroller and computer. The transmitted values from the monitoring unit are received via Zigbee and they are compared with the threshold values in the controller and they are displayed in the computer and then sent via WAN to the Internet if needed. In case of mismatch the workers will be informed to take corrective measures.

V. SIMULATION RESULTS

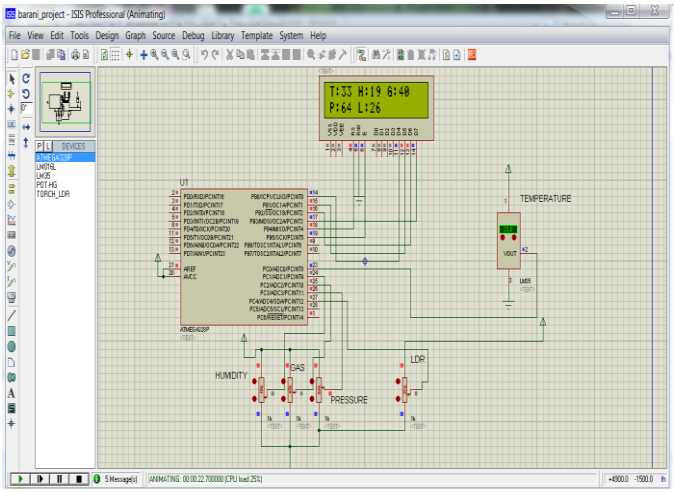

Fig.5.1.Sensor values are displayed on LCD

The simulation is done in Arduino IDE using embedded c coding and the output is seen via Proteus 7/8 ISIS Professional. Here sensors such as temperature, humidity, gas, pressure, light intensity is interfaced with the ATmega328p microcontroller and the measured values are displayed via Liquid Crystal Display(LCD).

VI. CONCLUSION

For Nuclear Power Plants and large scale industries, monitoring and controlling systems are of crucial importance with respect to safety and efficient operation. Since the system operation mainly depends on high level programming, we can extend the system as our interest. In this system, all the measurement is sent to the analog channel of the ATmega328p microcontroller and displayed. The performances of the channels are distinguished on the basis of its accuracy. The accuracy indicates how closely the sensor can measure the actual or real world parameter value. The more accurate a sensor is, better it will perform. Then temperature displayed in LCD is compared with the standard temperature .This system is time saving, portable, affordable, consumes less power and can be made easily available so that the user can use this system whenever and wherever.

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