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AN EMBEDDED SYSTEM BASED SMART SENSOR INTERFACE FOR MONITORING INDUSTRIES USING REAL TIME OPERATING SYSTEM (RTOS)

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Abstract— Nowadays, periodic transmission of accurate and reliable measurements is central to safe, efficient and economic operation of Nuclear Power Plants and large scale industries for specific application. Various sensors are being used for measuring the temperature, pressure etc. These sensor values must be in real time and accurate in order to avoid faults. Hence, RTOS is used which can read data in parallel and in real time with high speed on multiple different sensor date rate. The measured values are sent using Zigbee to the monitoring station 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 RTOS in order to avoid serious disasters in nuclear power plants and large scale industries.

Keywords— Real Time Operating System (RTOS), Wide Area Network (WAN), Liquid Crystal Display(LCD), Peripheral Interface Controller(PIC).

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[1][2].

A RTOS is an operating system intended to serve real-time application requests. It must be able to process data as it comes in, typically without buffering delays. Processing time requirements including any OS delay are measured in tenths of seconds or shorter. A key characteristic of an RTOS is the level of its consistency concerning the amount of time it takes to accept and complete an application's task, the variability is jitter. There are two types in RTOS and they are soft and hard. Soft RTOS has less jitter while comparing hard RTOS. An RTOS that can usually or generally meet a deadline is a soft RTOS, but if it can meet a deadline deterministically is a hard RTOS. An RTOS has an advanced algorithm for scheduling. Scheduler is flexible and hence it enables a wider, computer-system arrangement of process priorities [3][4]. Usually a RTOS is more frequently dedicated to applications. Key factors in RTOS are minimal interrupt latency and minimal thread switching latency, a RTOS is valued for more quickly or predictable response than for the amount of work it can perform in a given period of time. Hence an embedded system based monitoring system for Nuclear Power Plants and large scale industries using RTOS is designed [5].

II. HARDWARE COMPONENT EXPLANATION

2.1 Microcontroller

Peripheral Interface Controllers (PICs) are used in industries by developers due to their cost is low, development tools are free and supports serial programming and re-programming with flash memory capability. PIC 16f877A consists of only 35 single-word instructions to learn. All single-cycle instructions except for program branches, which are two-

cycle. It also has low-power, high-speed Flash/EEPROM technology and wide operating voltage range from 2.0V to 5.5V. It will withstand in Commercial and Industrial temperature ranges. It consumes low-power [6].

2.2 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 [7][8]. 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.

2.3 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 [9]. ZigBee has a defined 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 require short-range low-rate wireless data transfer [10]. 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. PROPOSED SYSTEM

An embedded system based monitoring and control system for Nuclear Power Plants and large scale industries is designed. The programming module is implemented using µC/OSII. 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.

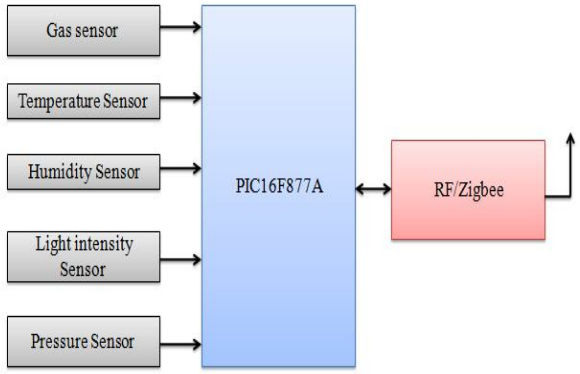

Fig1 : Monitoring unit

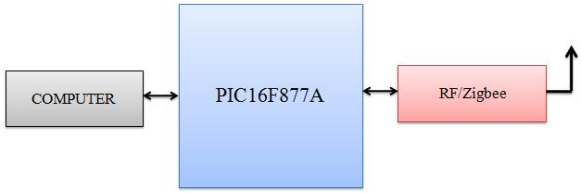

Fig 2: Control unit

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. This is a new approach using RTOS in order to avoid serious disasters in nuclear power plants and large scale industries

IV. SIMULATION RESULTS

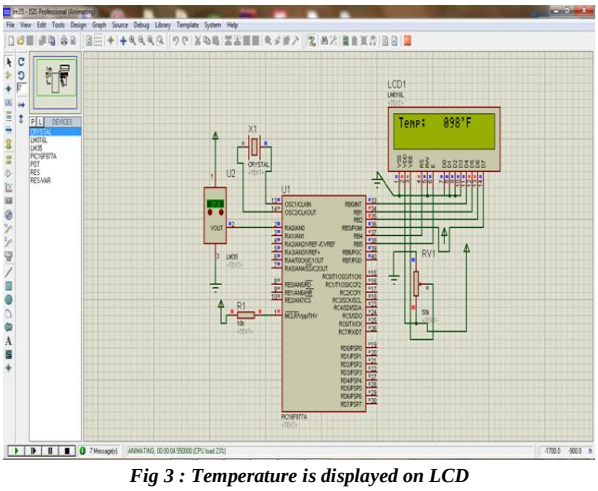

Fig 3 : Temperature is displayed on LCD

The simulation is done in MPLAB IDE using µC/OSII coding and the output is seen via Proteus 7/8 ISIS Professional. Here temperature sensor is interfaced with the microcontroller PIC16F877A and it is displayed via liquid crystal display for example. Likewise all sensors will be interfaced and their values will be displayed.

V. 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, temperature measurement is sent to the analog channel of the controller 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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