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WSN Based Mobile and PC Control Room Environment for Industrial Applications

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Abstract:

The use robotics is increasing day by day to replace the manpower for many reasons and uses with high navigational intelligence.

The aim of the development of modern robot control systems at the Institute of Robotics Research is to provide higher flexibility and autonomy for robot systems, together with consistent and user-transparent concepts for installation, programming and operation of robots in their working environment. An important feature of a flexible future-oriented robot controller is the capability to incorporate information from different classes of sensors and to have standardized communication interfaces with other factory-automation components.

In recent years there is a vast technology improvements in industrial control rooms for monitoring the entire field of Industrial plants. High end PLC's are being implemented for controlling the entire process of fields. But a problem is that even though automation takes the complete control of total plants few authentication and manual actions are needed from user side for completing the control action. Hence there is a must situation for users presence at all times in the control room for taking some timely needed control actions. Due to the static nature of control room environment, the user should always be static to monitor the process. The proposed system approach provides a good solution to this problem. The whole control room environment is additionally implemented in the microcontroller platform and the same is communicated to the process through GSM and ZigBee. Now the user in control room can be mobile at anytime, anywhere to monitor and control the whole plant. At the same time the control parameters can be send to the desktop computer. A microcontroller board is used here for acquiring process control parameters from the sensors and transmitting it via a GSM module to an android device. Hence the parameter values can be monitored and stored simultaneously. The main objective of this proposed work is to acquire the level sensor values with the help of microcontroller device and transmit the signals via GSM device interfaced with controller and thereby monitoring and storing the process variable parameters in a microcontroller platform. We can monitor the industrial parameters such as gas, liquid level, human detection, fire. If fire detected buzzer will on and a cooling fan switched on. If gas leaked buzzer will on. If liquid overflows buzzer will on. For security purpose human detection sensor can be used. If any obstacle find the robot will change the direction by using IR sensor. All the parameters are send via GSM and ZigBee.

This project uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation.

- **Keywords:** ARM, GSM, ZigBee.

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I. INTRODUCTION

In recent years there is a vast technology improvements in industrial control rooms for monitoring the entire field of Industrial plants. High end PLC's are being implemented for controlling the entire process of fields. But a problem is that even though automation takes the complete control of total plants few authentication and manual actions are needed from user side for completing the control action. Hence there is a must situation for users presence at all times in the control room for taking some timely needed control actions. Due to the static nature of control room environment, the user should always be static to monitor the process.

Data logging is a process in which a computer/controller is used to collect the process control parameters with the help of sensors and analyze and store the results for further future analysis. Scada system is a high end current control system. which is implemented in all major automation industries and power plants. A visual approach of entire process station is provided in a single computer monitor so that an user can monitor the entire process from a single screen. A control engineer or an user must always be present in front of the monitor to take an effective and timely control action. The only problem is that it is difficult for a human operator or an user to be at all times nearby monitoring the process control stations.

Hence an effective system has to be developed for avoidance of the difficulties exerted to the operator/user in the monitoring of process control stations. The proposed work is based on overcoming above all difficulties with the use of GSM-ZigBee modules. which has the advantage of being widely used for real time applications.

The whole control room environment is additionally implemented in the microcontroller platform and the same is communicated to the process through GSM and ZigBee. Now the user in control room can be mobile at anytime, anywhere to monitor and control the whole plant. At the same time the control parameters can be send to the desktop computer. A microcontroller board is used here for acquiring process control parameters from the sensors and transmitting it via a GSM module to an android device. Hence the parameter values can be monitored and stored simultaneously. The main objective of this proposed work is to acquire the level sensor values with the help of microcontroller device and transmit the signals via GSM device interfaced with controller and thereby monitoring and storing the process variable parameters in a microcontroller platform. We can monitor the industrial parameters such as gas, liquid level, human detection, fire. If fire detected buzzer will on and a cooling fan switched on. If gas leaked buzzer will on. If liquid overflows buzzer will on. For security purpose human detection sensor can be used. If any obstacle find the robot will change the direction by using IR sensor. All the parameters are send via GSM and ZigBee.

This project uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

II. BLOCK OF THE PROPOSED SYSTEM WITH IMPLEMENTATION

The block diagram of the transmitter proposed system is shown in Fig.1. In this work, five process variables like gas leakage, fire detector, moving motion detector , obstacle identifier and fuel level of a tank are taken for measurement with the help of Gas Sensor, Fire Sensor, IR Sensor, PIR Sensor and Ultrasonic Level Sensors. These sensors are attached to the

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Microcontroller. These sensors are used to detect the leakage of gas, fire detection, moving motion detection for security purpose, obstacle identifier and fuel level of a tank and finds its application for industrial purposes.

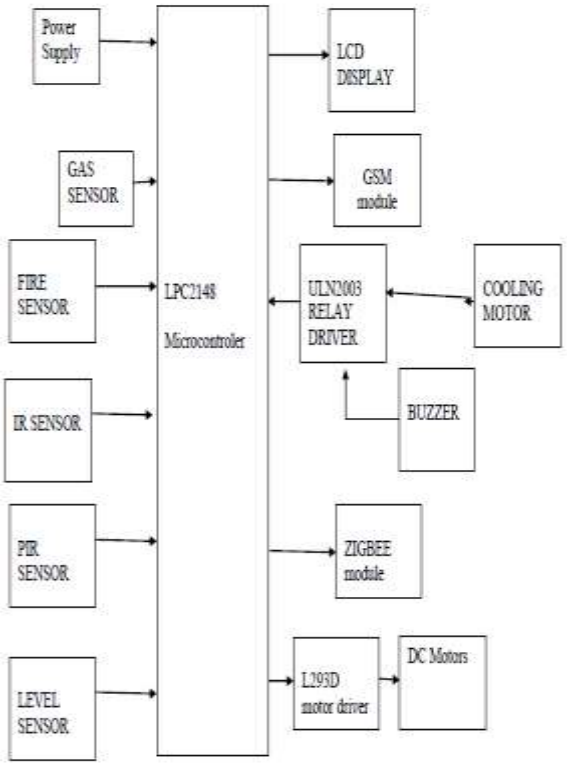

Fig. 1. Block diagram of the transmitter for the proposed system.

The block diagram of the transmitter proposed system is shown in Fig.1. In this work, The sensors output obtained from gas leakage, fire detector, moving motion detector , obstacle identifier and fuel level of a tank is given to microcontroller device for further processing. The microcontroller device used here is an LPC2148 Microcontroller board which comprises the controller, GSM module and ZigBee module.

The block diagram of the receiver for the proposed system is shown in Fig.2.The GSM module board contains the algorithm for communicating with the mobile using GSM Sim through cellular mobile communication. The mobile has an algorithm to communicate with the GSM module device via cellular mobile communication as well as to store and display the results in terms of SMS . The monitor screen on the mobile exhibits the real time values of level detector, gas detection, fire detection, moving motion detection and obstacle detection by displaying the message continuously and thereby helping the operator to monitor the messages or values in the process environment in a movable manner.

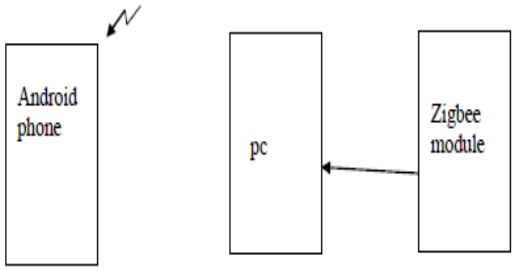

Fig. 2. Block diagram of the receiver for the proposed system.

We can monitor the industrial parameters such as gas, liquid level, human detection, fire. If fire detected buzzer will on and a cooling fan switched on. If gas leaked buzzer will on. If liquid overflows buzzer will on. For security purpose human detection sensor can be used. If any obstacle find the robot will change the direction by using IR sensor. All the parameters are send via GSM and ZigBee.

III. HARDWARE USED IN THE PROPOSED SYSTEM

This section discusses the major hardware's used in the proposed system in brief.

A. ARM- LPC2148

ARM- LPC2148 is a microcontroller board capable of performing very easy accessibility of the interacting environments. This board has a specially designed circuit board for programming and prototyping with microcontrollers. ARM- LPC2148 is an open source platform in which many real time hardware's can be interfaced with greater compatibility. Also any hardware or software upgradation is easily possible. The ARM-LPC2148 shown in Fig. 3 is just a microcontroller board . ARM- LPC2148 is a 32-bit ARM7TDMI-S microcontroller. It has40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.

It consists of In-System Programming/In-Application Programming (ISP/IAP). It has 8 kB of on-chip RAM accessible to USB by DMA. It has Two 10-bit ADCs provide a total of 14 analog inputs. It has 10-bit DAC provides variable analog output. It has Two 32-bit timers/external event counters (with four capture and four compare channels each). It has PWM unit (six outputs).ARM-LPC2148 consists of watchdog timer, Real-Time Clock (RTC) with independent power. ARM-LPC2148 consists of Multiple serial interfaces including two UARTs, Two Fast I2C-bus (400 kbit/s), SPI and SSP with buffering and variable data length capabilities. It has Vectored Interrupt Controller (VIC) with configurable priorities and vector addresses. It has 45 general purpose I/O pins. It has 21 external interrupt pins available. It has On-chip integrated oscillator operates with an external crystal from 1 MHz to 25 MHz.

Fig.3. ARM- LPC2148

B. GSM Module

GSM stands for Global System for Mobile Communications.GSM is one of the leading digital cellular systems. GSM was first introduced in 1991and as of the end of 1997. GSM service was available in more than 100 countries and has become the de standard in Europe and Asia. GSM uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency.

Any GSM module is using the normal GSM network. GSM modules can be communicated to LPC2148- microcontroller using normal serial USART protocol. Communication is being done using regular GSM modem AT commands. The GSM module is shown in Fig.4.

Fig.4.GSM Module

C. ZigBee Module

ZigBee is a new wireless technology .ZigBee is a technological standard created for control and sensor networks. ZigBee is based on the IEEE 802.15.4 Standard. ZigBee is created by the ZigBee Alliance. Philips, Motorola, Intel, HP are all members of the alliance. ZigBee is designed for low power consumption allowing batteries to essentially last forever. ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. It provides network, security and application support services operating on the top of IEEE.

In future all devices and their controls will be based on this standard. Since Wireless personal Area Networking applies not only to household devices, but also to individualized office automation applications, ZigBee is here to stay. It is more than likely the basis of future home-networking solution.The ZigBee module is shown in Fig.5.

Fig.5.ZigBee Module

IV. SOFTWARE USED IN THE PROPOSED SYSTEM

The software's used in this work have been categorized into two sections as mentioned below.

A. Keiluv4 IDE Tool

Keil was founded in 1982 by Gunter and Reinhard Keil; initially as a German GbR. In April 1985 the company was converted to Keil Electronic GmbH to market add-on products for the development tools provided by many of the Silicon vendors. Keil implemented the first C compiler designed from the ground-up specifically for the 8051 microcontroller. Keil provides a broad range of development tools like ANSI C compiler, macro assemblers, debuggers and simulators, linkers, IDE, library managers, real-time operating systems and evaluation boards for Intel 8051, Intel MCS-251, ARM, and XC16x/C16x/ST10families.

B. Proteus_v7.8i

The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. The Proteus Design Suite is the tool used for simulation before executing the code in a circuit board because of safety of a kit. It is developed in Yorkshire, England by Lab center Electronics Ltd with offices in North America

and several overseas sales channels. The software runs on the Windows operating system and is available in English, French, Spanish and Chinese languages..

C. HYPERTERMINAL

HyperTerminal is also known as HyperAccess. HyperTerminal is used to show the output in a personal computer with the help of ZigBee. HyperAccess is a family of terminal emulation software by Hilgraeve. A version of HyperAccess, called HyperTerminal is included in some versions of Windows.

D. Flash USB

The uc Flash USB Programmer is an affordable, reliable, and fast programmer for MCS51/AVR Microcontrollers and 24Cxx I2C EEPROMs. This uc Flash USB tool is used to dump the code into a device. The programmer is designed to operate with the Intel Pentium-based IBM-compatible desktop computers. The menu-driven software interface makes it easy to operate.

Easy to use integrated HEX Editor on main software window, Supports Intel (linear & segmented) HEX (INHX8M). Auto Batch Program function for faster programming i.e. Mass Production mode. Automatic device identification before programming. Support for programming only a selected memory in the microcontroller. e.g. Data memory or Fuse Bits.

V. ADVANTAGES OF THE PROPOSED SYSTEM

The proposed system is highly secured. It is used in real time applications. Its cost is less. It is reliable for long period of time. It can easily handle. It saves energy by activating and deactivating devices, When the device is idle stage. It is versatility. Which is to adapt many different situations. It is portability.

VI. UTILITIES AND APPLICATIONS OF THE PROPOSED SYSTEM

The proposed system increases the essential security and safety to our industry, homes and for other control applications . This system can also automatically controls the fan, light etc. Thus the system is fully automated and provides high level security and safety . This device increases the security and safety level in home, offices, military , industries etc.

VII. FUTURE SCOPE OF THE PROPOSED SYSTEM

The proposed system increases the usage of mobile technology and PC to provide essential security to our industry and for other control applications . This system can also automatically controls the fan, light etc. Thus the system is fully automated and provides high level safety and security . The proposed WSN system captures information and transmits it via a SMS through GSM module and PC through ZigBee module. LPC2148 Microcontroller operates and controls motion detectors, fire detection, gas detection, obstacle detection and level detection for remote sensing and surveillance. For example , when motion is detected, The person detected text is displayed on LCD display and at the same time the text is forwarded to mobile with the help of GSM module and at the same time the text is displayed on PC. Similarly all the parameters are displayed on LCD display are send to mobile and PC.

VIII. RESULTS AND DISCUSSION OF THE PROPOSED SYSTEM

The proposed WSN system captures information and transmits it via a SMS through GSM module and PC through ZigBee module. LPC2148 Microcontroller operates and controls motion detectors, fire detection, gas detection, obstacle detection and level detection for remote sensing and surveillance. For example , when moving motion is detected, The person detected text is displayed on LCD display and at the same time the text is forwarded to mobile with the help of

GSM module and at the same time the text is displayed on PC. Similarly all the parameters are displayed on LCD display are send to mobile and PC respectively.

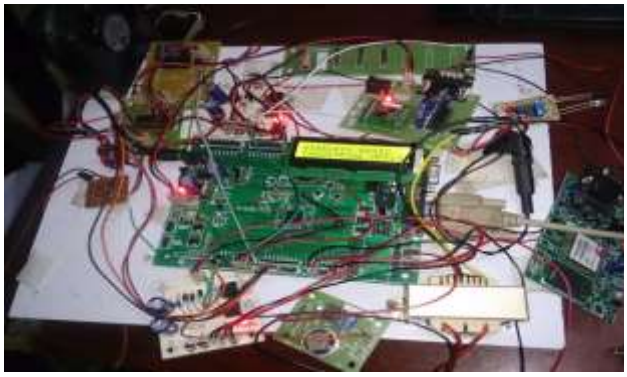

Fig.6. Project with title

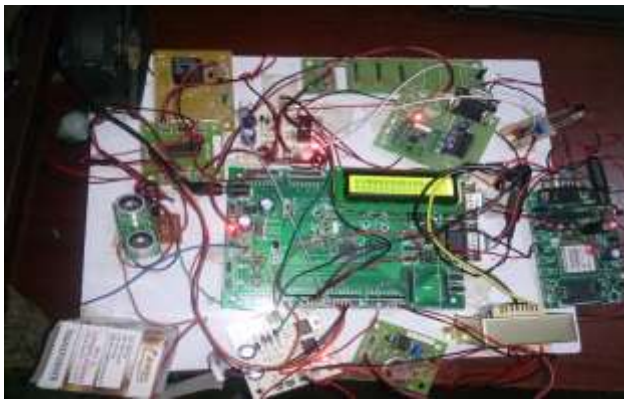

Fig.7. MONITORING

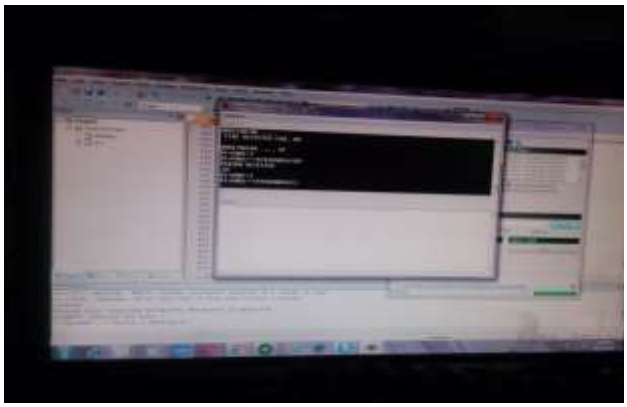

Fig.8. Fire Detected Fan On, Person Detected Buzzer On System with AT Commands GSM

IX. CONCLUSION OF THE PROPOSED SYSTEM

The proposed system promotes the control engineer to obtain the data values anywhere and everywhere within the control room of an industry. This new system is suited for acquiring the control parameters like gas leakage, smoke detection, fire detection, obstacle detection and level process variables of an existing process controller. Sensors acquire the data and with help of LPC2148 Microcontroller- GSM module-ZigBee module the data values are transmitted to a mobile by SMS and monitored in PC also. where parameter values are stored in memory while simultaneously the user can view and analyze the readings obtained in real time. Hence the proposed system behaves like a good user friendly device of the control engineer as the user can always be mobile anywhere and also it doesn't require the person sitting in front of a panel display at all times monitoring the process. Here the process can be visualized in the screen of an ordinary mobile.

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