GSM & Ethernet Based Monitoring & Controlling Of Real Time Industrial Parameters

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Abstract- **Networked embedded systems have become quite important nowadays, especially for monitoring and control the industrial devices. The World Wide Web is a global system of interconnected computer networks that used the standard Internet Protocol Suite (TCP/IP) to serve billion of users worldwide and allows the user to interface many real time embedded applications like data acquisition ,Industrial automations and safety measures etc,. This paper approached towards the design and development of Interactive Data Acquisition and Control System (IDACS) using ARM. Single chip IDACS method improved the processing capability of a system and was solved the problem of poor real time and reliability. This system used the ARM7 controller. In industries or in home appliances, most of the time we need to monitor and control different parameters using controllers. There are several I/O pins available at the controller which were used to interface with sensors and relays for monitoring and controlling operations. Sensors acquired data. That data transfers to the client on remote location with the help of Ethernet. From that data acquisition controlling action was performed by the client on remote location. This system also used short message service to send SMS to client via GSM & particular controlling action performed through GSM modem.**

Keywords- **TCP/IP, IDACS, GSM, RTOS, ARM, SCM**

I. INTRODUCTION

In numerous environmental factors, temperature, pressure is the most important and the most difficult to control environmental factor. And in some industrial areas there is some special requirements for it. In addition in recent years, energy and environmental problems become the hot topics that people concern, so we need energy conservation and environmental protection .[1] Monitoring and control is very important in realizing industrial automatization and high efficiency[2]. With the development of modern industry, the requirement for industrial monitoring system is getting higher. The system is required to be able to acquire, save, analyze, and process real time datas. It is also required controlling related instruments to change those environment factors and monitoring in long distance so that it realizes modern, intelligent, and accurate control [3]. Currently, most environment monitoring systems are using a distributed framework .However, under the framework, wired communication is usually used between host and front-end node, because of difficult wiring ,limitation of control range of the system and high maintenance cost, these system can't be used widely. In order to solve these problem, focus on the combination of embedded technology, GPRS and internet technology to realize industrial monitoring. system.[4].So, we use embedded technology& Ethernet technology for monitoring & controlling action .We will replace SCM (single chip microprocessors) with microprocessors based on ARM technology, which will greatly improve the overall performance of the system. The application of ethernet and embedded technology makes the remote monitoring possible and give the stability, reliability, security, and real-time of the data transmission. [5] It will effectively improve the scalability and maintainability of the control system and reduce the cost of the equipment maintenance. Base on these reasons, the system will meet the requirement of the centralized control.

Online Interactive Data Acquisition and Control system plays the major role in the development of the fast popularization and control in the field of measurement and control systems. It has been designed with the help of many electrical, electronic and high voltage equipments; it makes the system more complicated and not reliable.[6] So we use a new system that contains inbuilt Data Acquisition and Control system (DACS).In data acquisition unit data collected from sensors& in control system user on remote location takes controlling action. It is the great demand in consumer applications and many industries.There are data-acquisition and control devices that will be a substitute for a supervisor in a multisite job operation. [7] A single person can monitor and interact with the ongoing work from a single base station. An acquisition unit designed to collect data in their simplest form is detailed in [8], which is based on Linux[[9], which is a popular choice for embedded PC systems. Linux operating system is simple but difficult to recognize so to overcome this limitation we use ARM 7 processor which have Real Time Operating system & we design data acquisition unit with embedded language.

Fig.1 shows the overview of IDAC system. Every client can access the industry directly without any interaction with additional server and modules. This system contains single (ARM7/9) processor which is portable with Real Time Operating System (RTOS). It

handles two modes at same time, DAC and Web server. During DAC mode Processor can measure signals which are coming from various external sources and applications. And it can control the industry machineries by the control instruction sent by client via embedded web server. During signal measurements Analog to digital converter is very important, because almost every external source is giving analog signal only. While converting these analog to digital,processor has to handle asynchronous interrupts. The real time operating system manages all the tasks such as measuring signals, conversion of signals, data base up-dation, and connecting/communicating with new users etc. The RTOS manages all the required tasks in parallel and in small amounts of time.

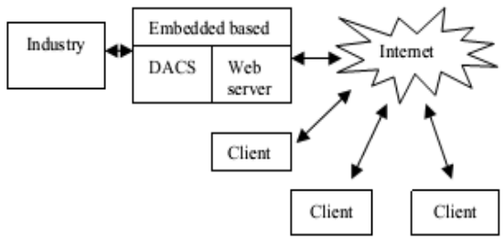


Fig. 1 System Overview

Similarly during web server mode processor will handle client request and response to the particular client. client can interact the industry by giving instruction on remote location. This setup can be suitable for inter communication with other nodes via Ethernet and higher end ports. This system have many advantages: user-friendly, low-development cost and high maintainability.

II. Structure Of The System

Fig. 2 shows Block Diagram of the overall system. Each I/O channel of ARM processor can select a variety of industrial process parameter such as Speed, Temperature, Pressure, Level through sensor bank. Digital acquisition are done by special ADC. The measured data are stored in external memory in which the memory is act as a data base during web server mode.

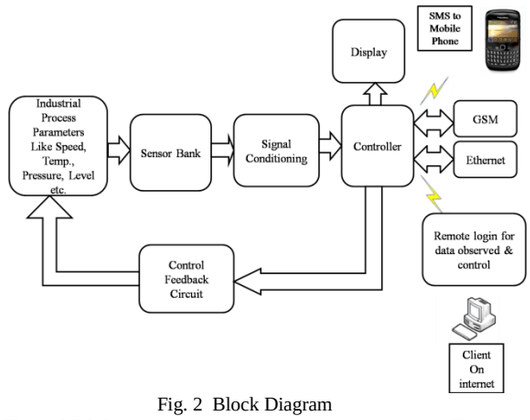


Fig. 2 Block Diagram

The ARM processor directly supports the Ethernet service communication. Hence the data has been stored and controlled by some other PCs or network via Ethernet. Remote data exchange between the application becomes easy due to Ethernet interface. This system has 16*2 LCD to display the information and measured parameters which makes the debugging and modification of the parameter easy. The controlling action of industrial process parameter is done through control feedback circuit via client through Ethernet modem. GSM sends the message to the client. The controlling action of industrial process parameter is done through control feedback circuit via client through GSM modem.

LPC 2148 has two UART ports UART0 & UART1.

Fig. 3 ARM 7 Controller

This is used for communication with external RS 232 based peripherals. This UART is used by controller for communication with GSM & Ethernet at a time. It has In-System/In-Application Programming (ISP/IAP) via on-chip boot-loader software. 8 to 40 kB of on-chip static RAM and 32 to 512 kB of on-chip flash program memory. USB 2.0 Full Speed compliant Device Controller with 2 kB of endpoint RAM.[10]

B.Serial to Ethernet Module:

Fig. 4 shows Serial to Ethernet module which is used in system. The Serial-to-Ethernet (S2E) module is a simple product that provides serial to Ethernet communications. Existing systems that lack Ethernet connectivity but have a UART or RS-232 port can be easily upgraded by the addition of the S2E module. Client can access this serial to Ethernet Module on remote location through ip

address.TCP/IP protocol is used for communication to the client on remote location.[11]

III. HARDWARE IMPLEMENTATION

A. LPC 2148(ARM 7 Processor):

Fig. 3 shows ARM 7 controller. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those microprogrammed Complex Instruction Set Computers.

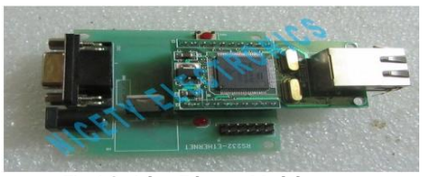


Fig.4 Serial to Ethernet Module

The MDL-S2E module provides the following features:

- LM3S6432 microcontroller.
- 10/100 Mbit Ethernet port.
- Two serial ports, configured as data communication equipment (DCE), include RTS/CTS for flow control.
- Module supports 5 V and 3.3 V supplies.
- Protocols include ARP, IP, ICMP, UDP, TCP, HTTP, DHCP, Telnet.
- Multiple mounting options.

C. GSM Modem-300:

Fig.5 GSM Modem

The system is used GSM modem for sending message in case of fault condition to the user on remote location which is shown in fig.5. It has Input voltage: 5V-30V. 0.25 current during normal operation & 1A current during transmission. It has operating baud rate is 9600bps. Temperature range: Operating -30 to +85 degree Celsius; Storage -30 to +85 degree Celsius.[12]

D. LM 35 Temperature Sensor :

As per system requirements for measuring Temperature the Precision Centigrade Temperature Sensor LM 35 is selected as shown in Fig.6.The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies.

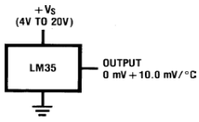


Fig.6 LM35 Temperature Sensor

The operating range of this sensor is 4-30 volts. It gives 10mv/^{0}c output. Rated for full −55° to +150°C range.[13]

E. Level Sensor:

Fig.7 Level Sensor

As per system requirements for measuring level of liquid selected Level Sensor as shown in fig. 7. This level sensor gives the output in the form of resistance So, by using constant current source supply converted that value into voltage. So we got level of liquid in the form of voltage. That voltage is amplified by using differential amplifier.[14]

F. Speed Sensor MOC 7811:

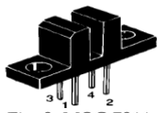


Fig. 8 MOC 7811

Fig.8 MOC 7811 shows Speed Sensor. It has internally LED & transistors. It gives output in between ground &

+vs. By measuring pulses in between these two outputs we measured the speed of device in rpm. That output of speed sensor is directly connected to the interrupt pin of LPC 2148.

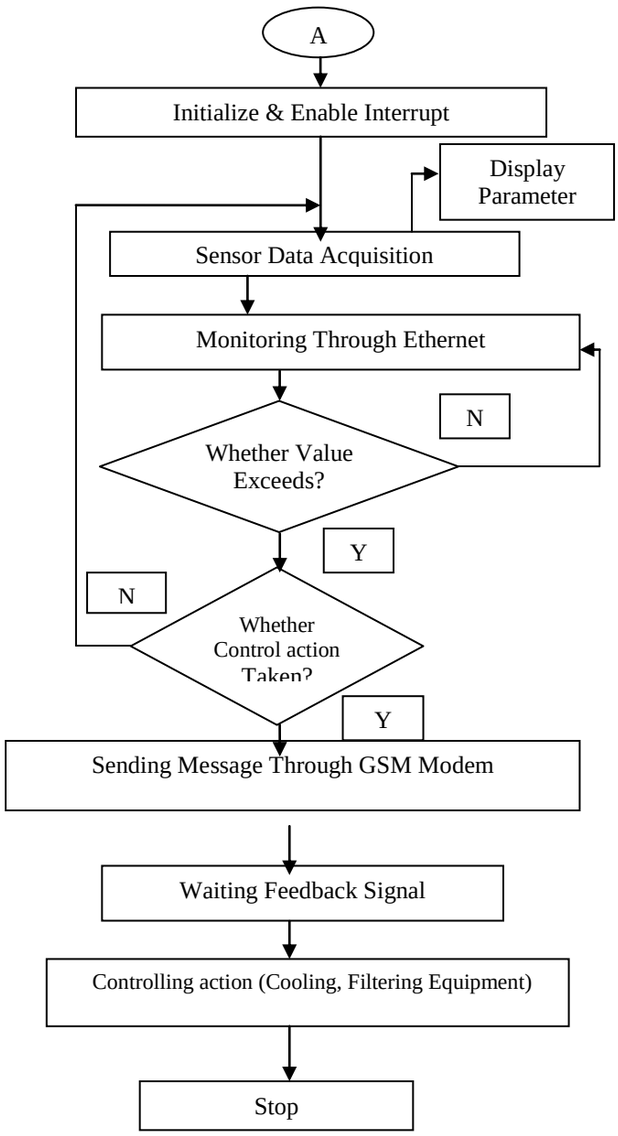
G. Pressure Sensor MP3V5050:

As per system requirements for measuring pressure of device the MP3V5050 series silicon piezoresistive Pressure Sensor is selected. This sensor provide a very accurate and linear voltage output, directly proportional to the applied pressure. Fig.9 shows various types of pressure sensor. [15]

Fig.9 Pressure Sensor

IV. SOFTWARE IMPLEMENTATION

Fig. 10 shows the how monitoring & controlling action is taken. It also shows how industrial parameters are controlled through ethernet & GSM modem. The system software is Keil with embedded C Program language is used.



V. RESULTS

Fig. 11 Parameter Results

Fig. 13 Testing Of GSM Modem

A. *For Temperature Sensor Parameter*

TABLE 1

Temperature Sensor	Result
Monitoring Value	31^0 c.
Set Point	40^0 c

B. *For Level Sensor Parameter*

TABLE 2

Level Sensor	Result
Monitoring Value	10
Set Point	20

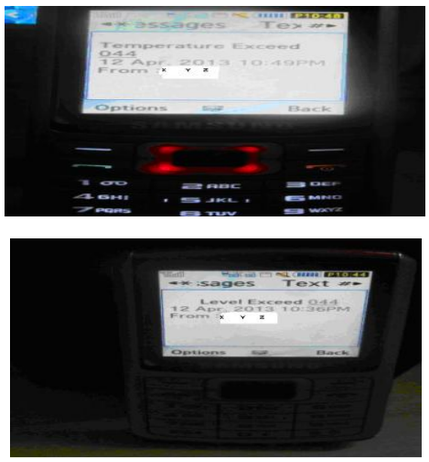


Fig 14 fault condition

C. *For Pressure Sensor Parameter*

TABLE 3

Level Sensor	Result
Monitoring Value	04
Set Point	10

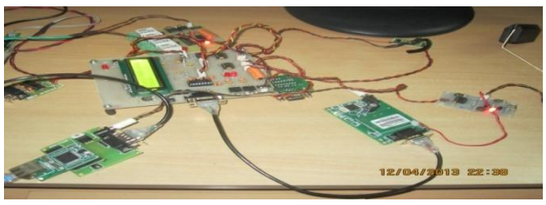


Fig 15 Ethernet Interfacing

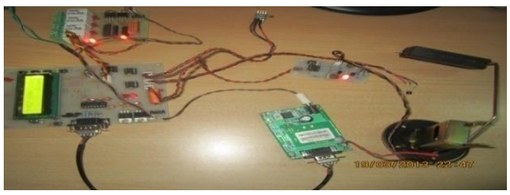


Fig. 12 Sensor & GSM Interfacing

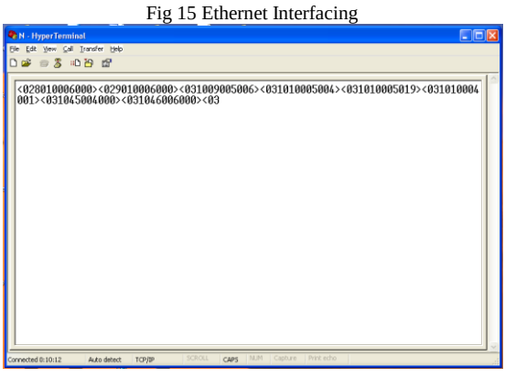
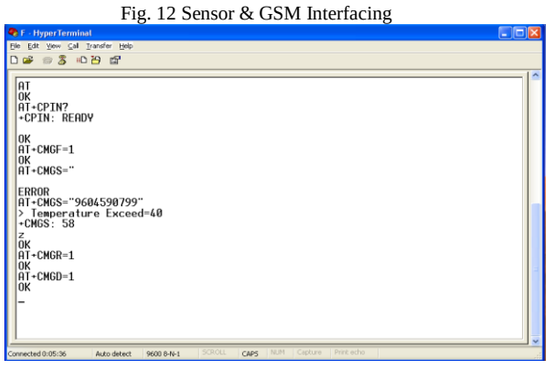


Fig 16 Ouput of Ethernet On Hyperterminal



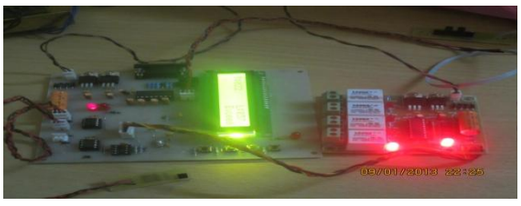


Fig.17 Control feedback Circuit

This system display data on the LCD. Figure 11shows the real time data of Temperature ,Level Speed &Pressure on the LCD before set point. And figure 12 shows the sensor interfacing& GSM to the controller. Fig.13 shows testing of GSM on hyperterminal before interfacing. Fig.14 shows message displayed on mobile phone when fault condition occurs.fig 15 & 16 shows Ethernet interfacing to controller & output of it on hyperterminal fig.17 shows control feedback circuit after the value exceeds the set point. As I have displayed data on the LCD, I have displayed Temperature, Level, Pressure and Speed parameters on to the remote location. & respective control action is taken out.

Fig. 18 shows the GUI of the system on which parameters are displayed & respective control action is taken out through relay operation. This GUI is connected to the system by accessing ip address of Ethernet. The user can access the ethernet by typing IP address on the hyperterminal with port no. 23 throughTCP/IP (winsock) as shown in fig.19.

Fig. 18 GUI For System

Fig. 20 shows the overall system in which all the sensor data is displayed on GUI. Ethernet is connected to the LAN switch & on remote location we monitored ,controlled all the parameters.

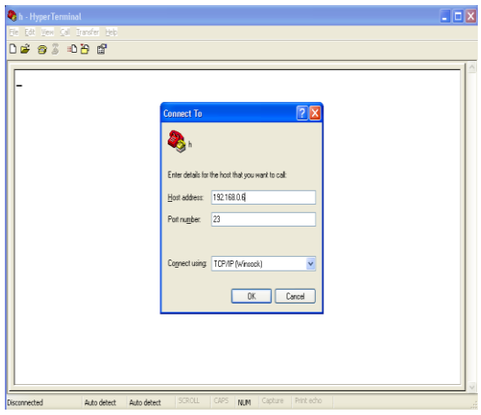
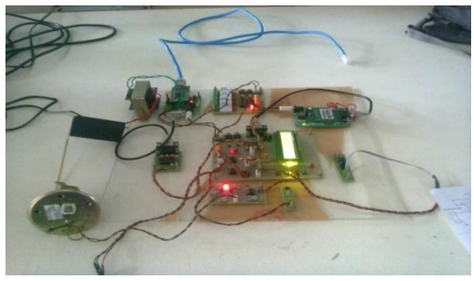


Fig 19 Ethernet Access



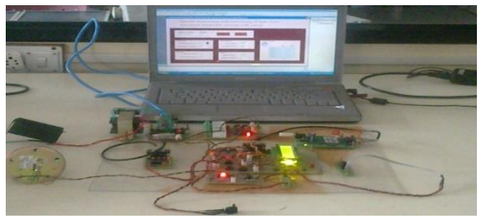


FIG.20 OVERALL SYSTEM

VI. MERIT OF THE SYSTEM

A. Existing System

The use of single chip Data acquisition system (DAS) method in Instrumentation and process control application is not only limited in processing capacity but also the problem of poor real time and reliability. General web server requires more resources and huge amount of memories. This system can only measure the remote signals and it cannot be used to control the process.

B. Proposed System

Limited processing capacity and the problem of poor real time and reliability of DAS system has been overcome by the substitution of embedded ARM processor for single chip method to realize interactive data acquisition and control (IDACS). This IDACS system can able to measure signals and can control the remote devices through reliable protocols and communication network. This system uses RTOS Multi-tasking operating system to measure and control the whole process. And the embedded web server mode requires less resource usage, high reliability, security, controllability and portability.

VII. CONCLUSIONS

Ethernet enabled digital I/O control system is designed for multiple input and output arrangements for industrial as well as non industrial applications. The module is small, simple and flexible which can perform different I/O operations remotely over Ethernet& also through GSM Modem.

Our system can be extended for sensing malfunctioning in industrial machines and making corrective measures in it. More and more automation is being handled via remote communication. This Ethernet Embedded system gives the way to numerous applications for developement in the area of monitoring and automation.

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