Remote Monitoring & Control of Industrial parameters using Embedded Web Server & GSM

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ABSTRACT *Remote Monitoring, Control and intelligent is one of the most important criteria for maximizing production and process plant availability. With the development of modern industry, the requirement for industrial monitoring system is getting higher. System is required to be able to acquire, save, analyze, and process real time data. 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.*

Above advantages will achieve by the substitution of embedded ARM processor for single chip method to realize data acquisition and control (DACS). This DACS system measures the remote signals and controls the remote devices through reliable protocols and communication network as a web server. Also addition of a GSM Mobile Communication will help to providing ubiquitous access to the system when web server is not available to client.

I. INTRODUCTION

Data acquisition systems with remote accessibility are in great demand in industry and consumer applications. In some applications, human beings have been replaced by unmanned devices that will acquire data and relay the data back to the base. There are data-acquisition and control devices that will be a substitute for a supervisor in a multisite job operation [1].

Although these are well-built systems that serve the purpose for a specific task, the user cannot interact with the system, which uses the Global System for Mobile Communications (GSM) a popular wireless choice for connectivity between the data-acquisition units and clients. Similar types of Internet-based systems are designed to gather a bulk of data before serving them upon request. In these applications, data are compiled in a central server and are then served to the clients via the Internet. The client framework is in a central server and has all the applications. A person that needs to access any data must first access the server.

In this system, a reliable bidirectional Point-to-Point Protocol (PPP) link for real-time control and surveillance via a GSM network is formed. However, there is still no effort to minimize the operational costs (including the costs to transfer a large amount of data). In addition, this system is based on an industrial PC, thus making it an expensive solution. Interaction with the embedded unit is also an important issue. In, an embedded PC card placed on the Internet allows limited interaction through commands sent through Transmission Control Protocol/IP (TCP/IP) and User Datagram Protocol [2].

II. HARDWARE DESIGN
a. ARM CORE HARDWARE

The general hardware structure of the remote I/O data acquisition and control system based on ARM processor .The remote I/O data acquisition and control system based on embedded ARM platform has high universality. Sensors are used for process monitoring and for process control.

Each I/O channel can select a variety of electrical and non electrical signals like current, voltage, resistance etc. This signal is taken into LP2148 & digitized using the inbuilt ADC. Measured data are stored in external memory, we can directly show this data on LCD display connected to port 0 & the memory is act as a data base during Accessing web server
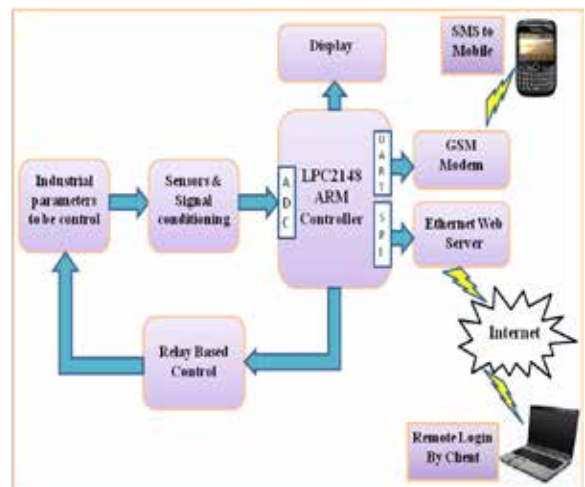
mode & GSM mode.

Fig-Remote Monitoring & Control of Industrial Parameters through Embedded Web Server & GSM Mobile

ARM processor has internal SPI module which directly supports the Ethernet service communication. Hence the data has been stored and controlled by some other PCs or network Ethernet.

Also ARM Processor has serial communication interface (Rx, Tx, GND) Which is used to transferring data to GSM Modem.

a) CLIENT-SERVER ARCHITECTURE

A web server is a system which hosts websites and provides services for any requesting clients. A web server can be embedded in a device to provide remote access to the device from a web browser. The embedded system can be utilized to serve the embedded web documents, including static and dynamic information about industry machineries/systems to web browsers [2].

A Client can access the industry's web server through internet and LAN router. Digitally acquired data are stored in web server's data base. Whenever the client wants to access data, it sends the request to server; this request is taken by the

router, which is connected to the internet.

The web processes the request made and finally connects to the desired web server, access the requested data and sends the data to the client.

Fig.2 shows the proposed concept of DACS with embedded web server on a single chip module. This is a single hardware it contains RTOS portable ARM processor. ARM processor is the responsible part for measuring signals and controlling the devices remotely. Measurements can be done by DACS mode and the data are shared with clients thro embedded web server by embedded web server mode. The real time operating system manages all the tasks such as measuring signals, conversion of signals, data base updating, sending HTML pages and connecting/communicating with new users etc [2].
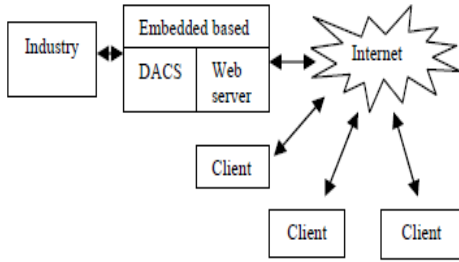

Fig.2 - Embedded Web-Server architecture [2]

SPI (Serial Peripheral Interface) Standard

The SPI has a 4-wire synchronous serial interface. Data communication is enabled with a low active Slave Select or Chip Select Signal (SS) or (CS). Data is transmitted with a 3- wire interface consisting of wires for serial data input (MOSI), serial data output (MISO) and serial clock (SCK) [3].
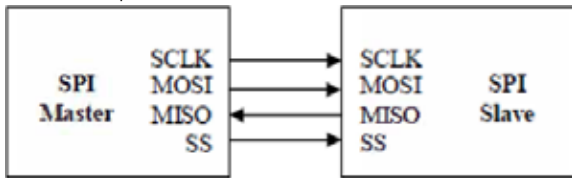

Fig.3-Serial Peripheral Interface [3]

III. SPI INTERFACE WITH ETHERNET MODULE

The serial communication is performed by means of two pins that are SI and SO as shown in Fig.4. SCLK provides clock synchronization and CS is the chip select. This communication technique can be implemented between processor and peripherals that have SPI interface. Serial Peripheral Interface Bus is a synchronous serial data link standard where communication is performed in master/slave mode and master device initiates the data frame. This is a full duplex mode of point to point communication.

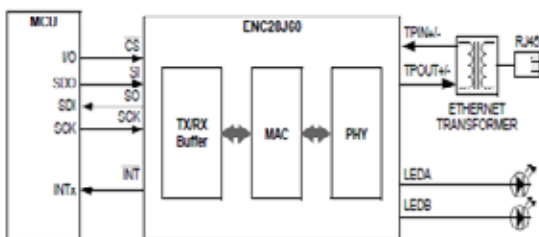A typical application circuit using the device is shown in Figure 4.

Fig.4-Typical ENC28J60 Based Interface
The serial clock, SCLK generated by the master device is used by the slave also. The SS which is the Slave Select signal

should in active low state for the slave to have communication with master. This is a four wire communication as shown in Fig. 4. The SDO or Serial Data Output signal send by the master and after receiving the clock pulse, the slave device responds back with SDI or Serial Data Input signal [4].

Ethernet is the family of wired network technology and is standardized as IEEE 802.3. The data of Ethernet is grouped into bytes often called frame. The start of the frame is preamble which is of 7 bytes length. It contains sets of 0's and 1's arranged alternately. The SFD or start frame delimiter is a 1 byte binary value. Its left most end contains an "11" by identifying it; the receiver gets information about arrival of the new frame.

Then comes the 48-bit MAC address that contains both source and destination address. The type of length which is of 2 bytes gives information about the protocol bound in the succeeding data payload. The frame terminates with a 32-bit checksum that performs CRC checking to identify if any error is present [4]. LPC2148 is embedded with internal MAC but it does not support PHY layer. The Ethernet controller, ENC28J60 constitute for the MAC and PHY layer. So by interfacing with ENC28J60, the required PHY interfaced is achieved.

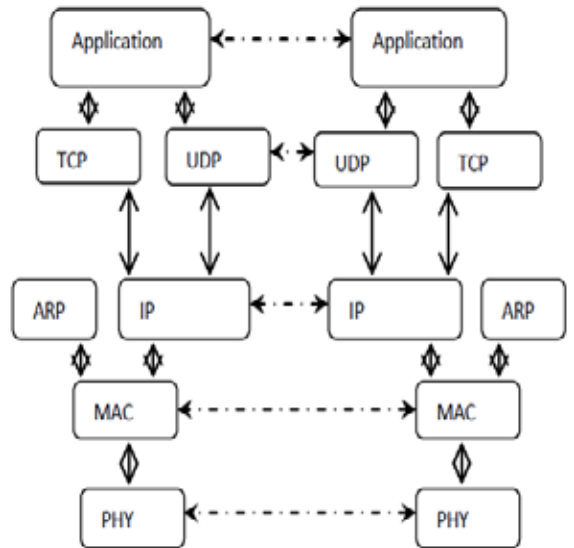The IEEE 802.3 model layered structure is shown in Fig.5.

Fig.5-Layered structure of 802.3 Model [4]

a. TCP/IP Stack

This is one of the most widely used successful network protocol by which the control information can be passed. This protocol stack needs to be simplified to increase the speed of communication [9]. Ethernet communication is achieved through the MAC address. With ARP, the physical address is obtained. Communication of the EWS the other equipments in the network could be achieved by the ICMP and IP especially for data routing. In the application the control of the remote host is to be undertaken and here comes the importance of HTTP protocol. In the transport layer, the TCP maintains the reliability of the communication.

IV. GSM MODEM

A GSM modem is a specialized type of modem, which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone [5]. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it may be a mobile phone that provides GSM modem capabilities.

GSM/GPRS RS232 Modem from rhydo LABZ is built with

SIMCOM Make SIM900 Quad-band GSM/GPRS engine, works on frequencies 850 MHz, 900 MHz, 1800 MHz and 1900 MHz. It is very compact in size and easy to use as plug in GSM Modem [7].

The Modem is designed with RS232 Level converter circuitry, which allows you to directly interface PC Serial port .The baud rate can be configurable from 9600-115200 through AT command. Initially Modem is in Auto baud mode. This GSM/GPRS RS232 Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS as well as DATA transfer application in M2M interface.

The modem needed only 3 wires (Tx, Rx, GND) except Power supply to interface with microcontroller/Host PC. The built in Low Dropout Linear voltage regulator allows you to connect wide range of unregulated power supply (4.2V -13V) to send & Read SMS [7].

a. MOBILE PHONE
A mobile phone also known as a wireless phone, cell phone, or cellular telephone is a little portable radio telephone. Mobile Phone can serve as powerful tool for world-wide communication. The Mobile Phone is a natural choice, since it is a communication resource generally available by people, which makes them practically always contactable and capable to send commands to operate the parameters in the industries.

V. SOFTWARE ReQUIREMENTS
a. KEIL ARM
μVision is a window-based software development platform that combines a robust and modern editor with a project manager and make facility tool. It integrates all the tools needed to develop embedded applications including a C/C++ compiler, macro assembler, linker/locator, and a HEX file generator. The μVision IDE and Debugger is the central part of the Keil development tool chain and has numerous features that help the programmer to develop embedded applications quickly and successfully. The Keil tools are easy to use, and are guaranteed to help you achieve your design goals in a timely manner.

b. FLASH MAGIC
Flash Magic is loaded being performed. This means that other applications that need to use the COM Port, such as debugging tools, may be used while Flash Magic is Windows software from the Embedded Systems Academy that allows easy access to all the ISP features provided by the devices Flash Magic provides a clear and simple user Under Windows, only one application may have access the COM Port at any one time, preventing other applications from using the COM Port. Flash Magic only obtains access to the selected COM Port when ISP operations are being performed. This means that other applications that need to use the COM

Port, such as debugging tools, may be used while Flash magic is loaded. To download the hex file into the microcontroller board we use a programmer called flash magic tool.

VI. HTTP PROTOCOL
The protocol used for the communication between web server and web browser is Hyper Text Transfer Protocol or HTTP protocol. This protocol defines all the basic frame work of web communications by handling requests and also by providing control information to be transferred between browser and server. To obtain a web document, the browser and server should establish a connection at Port.

Establish a connection. To open a web document, client and server should establish their connection to port. This is done by means of sockets. Client will open a socket and bound it on a port. If successful, a virtual document is created where we can measurement and write.

In the server side, firstly the socket is created and it is bound to the server address. Now the socket is converted to listening socket to hear the client request. After this the connection to the client is established. To handle multiple requests, server carries out several processes that prevent the communication interference.

Fig.6- User access of ES with external Ethernet

VII. CONCLUSION
This system will provide a ubiquitously accessible; real time remotely monitored and controlled solution for automation of industries. Here TCP/IP is used which defines a set of rules to enable computers to communicate over a network. Also use of ARM Processor, web server, GSM module, Sensors & actuators provide existing possibilities. Thus this solution can be customized to suit any other industrial requirements related to monitoring and control provided by industrial sensor.

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