

## Design and Development of Ethernet Interface for Industrial Applications

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### ABSTRACT

The majority of microcontrollers in use today are embedded in machineries, such as automobiles, appliances, and peripherals for computer systems. The devices used in industries are not equipped with any network interface. In this design, ARM with Ethernet is used for controlling the speed of the motor with the help of defined IP address, which is present in the embedded web server.

**KEY WORDS**-ARM, Ethernet, embedded web server, Microcontroller, IP Address.

### I. INTRODUCTION

Several technologies have already been introduced for industrial automation. Some newly introduced connectivity solutions such as Ethernet, Wireless LAN, LIN, CAN etc are used in industrial application. There are large numbers of additional automation solutions available in already existing methods. With the help of software we are able to program as per our needs. Data process can be changed or modified with software programs. This paper takes a case study of industrial automation for controlling application with the help of Ethernet.

### II. LITERATURE SURVEY

Many control units in industry uses PLC based communication interfaces like profinet, devicenet, RS232, RS485 and etc. the cost of such devices is quite high and non standard embedded system developed for specific application in the industry has no proper interface to the central control unit. In order to overcome this problem, we propose this paper of design and development of industrial Ethernet which can connect various standard interfaces, machines and embedded systems at low cost.

### III. PROPOSED PROJECT

The existing paper is designed using PIC16F series. In our project we are using ARM which has better tools support than Microchip MIPS. MPLab X is not working for large projects and it is too slow

and unstable. There is no real alternative option for the PIC16. The PIC16 needs more code space than

the ARM target. The ARM has far better debug features. With high performance and low dynamic power consumption the Cortex-M3 processor delivers leading power efficiency.

The ARM used in our design is cortex M3 processor. The central Cortex-M3 core is based on the Harvard architecture characterized by separate buses for instructions and data. The Cortex-M3 processor has been specifically designed to deliver high performance in cost and power sensitive applications. The combination of reduced core size, excellent interrupt latency, integrated system components, flexible configuration, easy high-level programming and a strong software ecosystem make the Cortex-M3 processor a compelling solution for a wide range of systems ranging from complex system-on-chips to low-end microcontrollers.

### IV. ARM BASED ARCHITECTURE

#### 4.1 ETHERNET INTERFACE

Ethernet is the most widely used local area network (LAN) technology. The original and most popular version of Ethernet supports a data transmission rate of 10 Mb/s. Newer versions of Ethernet called "Fast Ethernet" and "Gigabit Ethernet" support data rates of 100 Mb/s and 1 Gb/s (1000 Mb/s). An Ethernet LAN may use coaxial cable, special grades of twisted pair wiring, or fiber optic cable. Ethernet was standardized as IEEE 802.3. In IEEE 802.3 datagrams are called "frames".

A frame begins with preamble and start frame delimiter, followed by an Ethernet header featuring source and destination MAC addresses. The middle section of the frame consists of payload data including any headers for other protocols (e.g., Internet Protocol) carried in the frame. RJ-45 pin is used for interfacing with the Ethernet. Using cat5 cable, the Ethernet ports in cortex M3 processor is connected to the modem.

**4.2 ELECTRICAL LOADS CONNECTED**

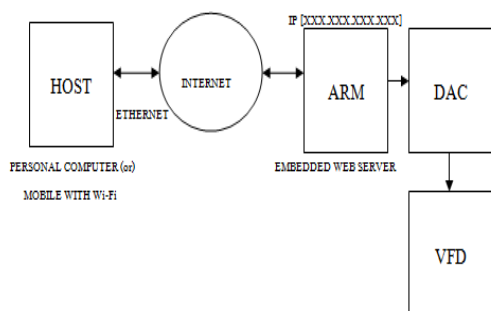
The motor is connected in Variable Frequency Drive (VFD). A variable-frequency drive (VFD) is a type of adjustable-speed drive used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage. VFDs are used in applications ranging from small appliances to the largest of mine mill drives and compressors. A variable frequency drive is a device used in a drive system consisting of the following three main sub-systems: AC motor, main drive controller assembly, and drive operator interface. In VFD, the motor runs according to the speed of the analog value received through Ethernet.

**4.3 ADVANTAGES OF INTERNET OF THINGS**

With the help of internet, we can control the motor even in remote areas. The design can be implemented at a low cost. By allowing physical devices to communicate, it is taking the data that is individually collected, sharing it, and then translating the information into ways to make our current systems more efficient.

**V. STRUCTURE OF HARDWARE SYSTEM**

Fig 1. Hardware Implementation

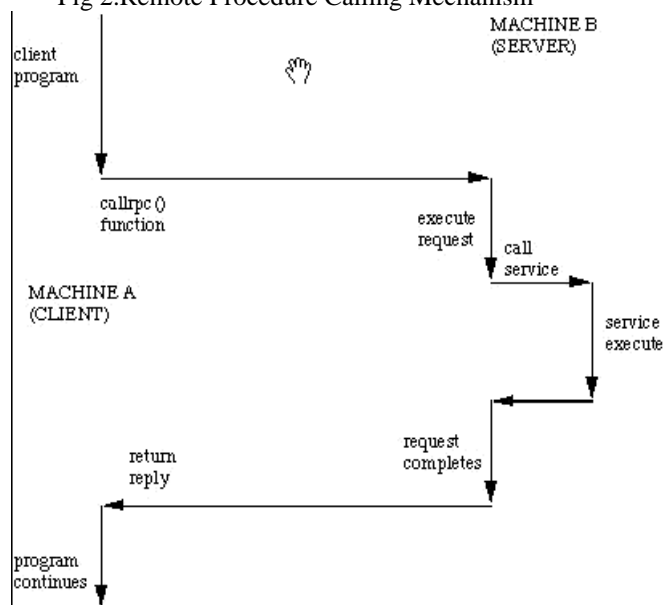


**5.1 RPC MECHANISM**

When an RPC is made, the calling arguments are passed to the remote procedure and the caller waits for a response to be returned from the remote procedure. The Figure 2 shows the flow of activity that takes place during an RPC call between

two networked systems. The client makes a procedure call that sends a request to the server and waits. The thread is blocked from processing until either a reply is received, or it times out. When the request arrives, the server calls a dispatch routine that performs the requested service, and sends the reply to the client. After the RPC call is completed, the client program continues. RPC specifically supports network applications. The value is now passed to ARM and from the ARM it is fed to DAC. In DAC the digital value gets converted to analog value. The analog value is fetched to the variable frequency drive and it controls the speed according to the given value.

Fig 2. Remote Procedure Calling Mechanism

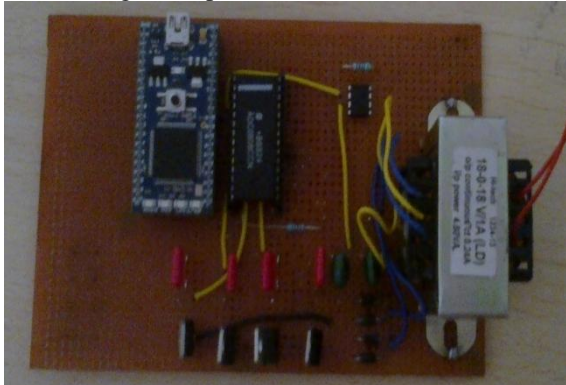


**VI. SOFTWARE**

The mbed Microcontrollers are all supported by the mbed.org developer website including an Online Compiler for instant access to the working environment on Windows, Linux or Mac OS X. The mbed microcontroller uses the online compiler for compiling the program and it runs the program. The program is implemented using RPC variable. The web page with necessary title is created for viewing the input as well as the output in HTML using get and post.

## VII. SNAP SHOT

Fig 3. Snap Shot of Hardware Used



## VIII. CONCLUSION

Industrial automation using Ethernet is a good solution, which is faster and accurate. Ethernet communication supports data rates at the speed range from 100Mbps to several Gbps. It is highly reliable for high speed automation application. A web page designed with HTML coding, provides the data access. Each PC are connected with LAN network connection, is identified by the unique address called IP address. The communication within the network is established with the help of IP addresses. The software model for device control automation is developed in the web page. The user can control the speed of motor from the workplace using the PC by accessing the web page through web browser.

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