SURVEILLANCE OF INDUSTRIAL ELECTRONIC REAL TIME MODULES BASED ON ETHERNET TECHNOLOGY

[1] C.Sudharshan Reddy [2]S.Thaslim Ahmed [3]M.Ravi Theja Reddy [4]P. Uday Kumar

[1,2,3]UG Scholar of ECE, [4]Assistant Professor in Electronics & Communication Engineering
[1,2,3,4]AVR & SVR College of Engineering & Technology, Nandyal-518501,A.P,India

Abstract— **The worldwide familiarity, standardization, and availability of Ethernet, along with its current and potential performance levels, has prompted increased consideration of Ethernet as a viable communications technology for distributing industrial IO and data acquisition tasks. This paper presents very simple and economical way to provide Ethernet connectivity to microcontroller based embedded systems. This system uses ARM7 microcontroller to store the main application source code, web pages and TCP/IP stack which is a vital element of the system software. An Ethernet controller chip, ENC 28J60 is used to handle the Ethernet communication and is interfaced with the Host microcontroller using SPI pins. There are several I/O pins available at the microcontroller which are used to interface with sensors and relays for monitoring and controlling operations. Nowadays, Internet has spread worldwide and most of the internet connections use Ethernet as media for data transfer. In industries or in home appliances, most of the time we need to monitor and control different parameters using microcontrollers. Once we enable Ethernet interface to such systems, we can communicate with them remotely over the internet.**

Index Terms— **Ethernet, TCP/IP, ARM 7, ENC 28J60**

I. INTRODUCTION

While becoming the dominant LAN technology, Ethernet has proven to be a very effective and very economical PC networking solution. With 10 Mbps and 100 Mbps Ethernet components widely available at a relatively low cost, users are increasingly interested in applying this familiar technology directly to their distributed measurement and control applications. However, the requirements of a real-time measurement or distributed control are very different from those of the office or campus LAN. Ethernet is now available as a direct communications link on a growing number of data acquisition instruments and industrial I/O devices. Before the unique issues of Ethernet-based data acquisition and I/O systems are examined, it is useful to described some of the of both data acquisition applications and of Ethernet technology.

An embedded system can be defined as a computing device that does a specific focused job. Appliances such as the air-conditioner, VCD player, DVD player, printer, fax machine, mobile phone etc. are examples of embedded systems. Each of these appliances will have a processor and special hardware to meet the specific requirement of the application along with the embedded software that is executed by the processor for meeting that specific requirement. The embedded software is also called "firm ware". The desktop/laptop computer is a general purpose computer. You can use it for a variety of applications such as playing games, *word* processing, accounting, software development and so on.

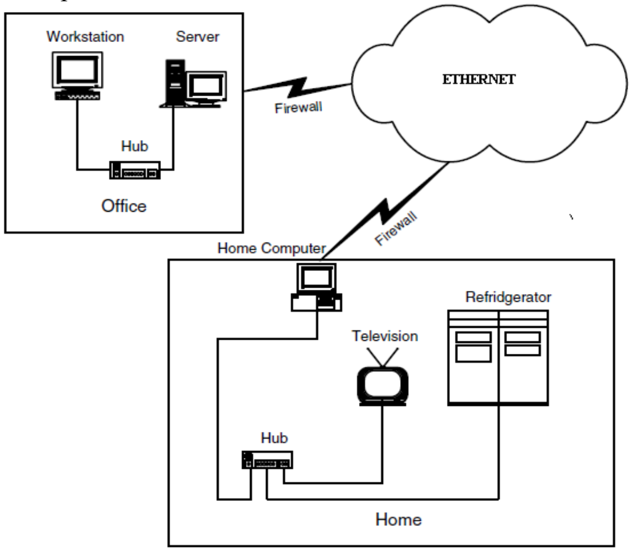

Figure 1. Surveillance of home equipment from the office with Ethernet enabled digital I/O

· Embedded systems do a very specific task, they cannot be programmed to do different things. . Embedded systems have very limited resources, particularly the memory. Generally, they do not have secondary storage devices such as the CDROM or the floppy disk. Embedded systems have to work against some deadlines. A specific job has to be completed within a specific time. In some embedded systems, called real-time systems, the deadlines are stringent. Missing a deadline may cause a catastrophe-loss of life or damage to property. Embedded systems are constrained for power. As many embedded systems operate through a battery, the power consumption has to be very low. Some embedded systems have to operate in extreme environmental conditions such as very high temperatures and humidity.

II. LITERATURE SURVEY

In numerous environmental factors, temperature, pressure are most important and the most difficult to control environmental factors. In some industrial areas there are some special requirements for it. In addition in recent years, energy and environmental problem becomes the hot topics that people concern, so we need energy conservation and environmental protection. [2] Monitoring and control is very

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important in realizing industrial automatization and high efficiency [3]. 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 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 [4].

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 cannot be use widely. In order to solve these problem, focus on the combination of embedded technology, GPRS & internet technology to realize industrial monitoring. system.[5].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. [6] 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.

In many process plants, the network is also expected to be intrinsically safe, meaning that a cable break will not cause flammable gases to ignite. Wireless networks definitely have the advantage of not using wire and are inherently safe. So we use a system that contains inbuilt Data Acquisition and Control system (DACS).In data acquisition unit data collected from Zigbee sensor nodes & 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] User who use web browser in the remote area can easily access wireless sensor network with help of Boa server.[8] Boa server is the single tasking HTTP server. Currently it is developed on Linux platform. Linux operating system is simple but difficult to recognize so to overcome this limitation we use ARM 7 processor which has Real Time Operating system & we design data acquisition unit with embedded language. For better industrial automation we can use modbus enabled Zigbee WSN. The modbus protocol is embedded into Zigbee stack. The modbus protocol allows the user to select the particular node & keep all other nodes deactivated for saving lot of power.[9].

III. Block diagram for Ethernet controller

The ENC28J60 is a stand-alone Ethernet controller with an industry standard Serial Peripheral Interface (SPI™). It is designed to serve as an Ethernet network interface for any controller equipped with SPI. The ENC28J60 meets all of the IEEE 802.3 specifications. It incorporates a number of packet filtering schemes to limit incoming packets. It also provides an internal DMA module for fast data throughput and hardware assisted IP checksum calculations. Communication with the host controller is implemented via two interrupt pins and the SPI, with data rates of up to 10 Mb/s. Two dedicated pins are used for LED link and network activity indication.

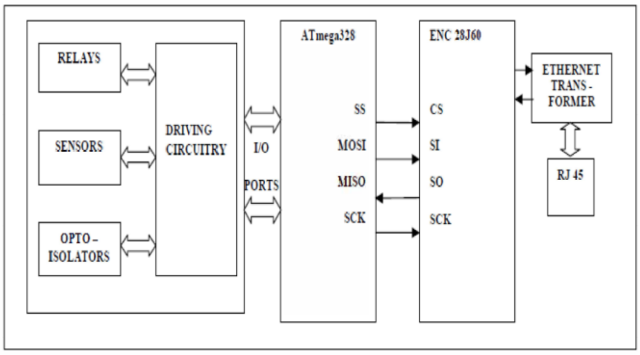

Figure 2. Block diagram of Ethernet enabled digital I/O Control system[1]

Ethernet Controller Features

- IEEE 802.3 compatible Ethernet controller
- Integrated MAC and 10BASE-T PHY
- Receiver and collision squelch circuit
- Supports one 10BASE-T port with automatic
- polarity detection and correction
- Supports Full and Half-Duplex modes
- Programmable automatic retransmit on collision
- Programmable padding and CRC generation
- Programmable automatic rejection of erroneous
- Packets
- SPI™ Interface with speeds up to 10 Mb/s

Package Types

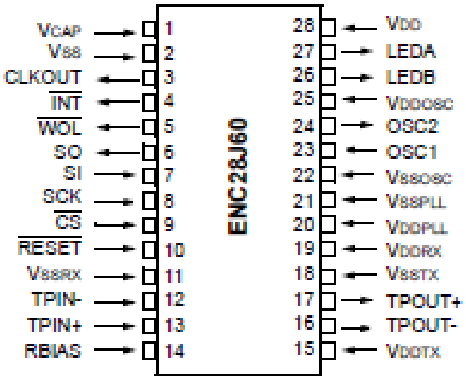

Figure 3. Pin diagram showing SDIP, SSOP, SOIC

Operational

- Two programmable LED outputs for LINK, TX,RX, collision and full/half-duplex status
- Seven interrupt sources with two interrupt pins
- 25MHz clock Clock out pin with programmable prescaler
- Operating voltage range of 3.14V to 3.45V
- TTL level inputs
- Temperature range: -40°C to +85°C Industrial,
- 0°C to +70°C Commercial (SSOP only)

Buffer

- 8-Kbyte transmit/receive packet dual port SRAM
- Configurable transmit/receive buffer size
- Hardware-managed circular receive FIFO

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- Byte-wide random and sequential access with auto-increment
- Internal DMA for fast data movement
- Hardware assisted IP checksum calculation

IV. LPC2141/42 FUNCTIONAL DESCRIPTION OF ARCHITECTURE

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale.

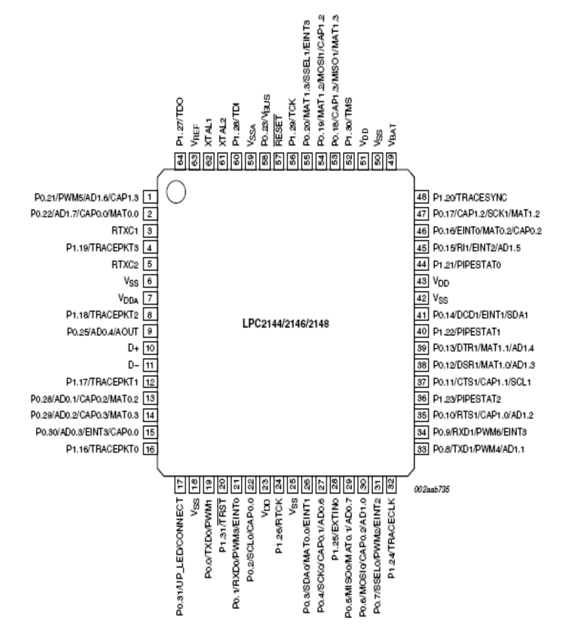

Fig 4. LPC2144/2146/2148 pinning

Figure 4. Pin Configuration LPC2141/42/44/46/48

Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems

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 of microprogrammed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems
can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue. Thumb code is able to provide up to 65 % of the code size of ARM, and 160 % of the performance of an equivalent ARM processor connected to a 16-bit memory system. The particular flash implementation in the LPC2141/42/44/46/48 allows for full speed execution also in ARM mode. It is recommended to program performance critical and short code sections (such as interrupt service routines and DSP algorithms) in ARM mode. The impact on the overall code size will be minimal but the speed can be increased by 30% over Thumb mode.

On-chip flash program memory

The LPC2148 incorporates a 32 kB, 64 kB, 128 kB, 256 kB and 512 kB flash memory system respectively. This memory may be used for both code and data storage. Programming of the flash memory may be accomplished in several ways. It may be programmed In System via the serial port. The application program may also erase and/or program the flash while the application is running, allowing a great degree of flexibility for data storage field firmware upgrades, etc. Due to the architectural solution chosen for an on-chip boot loader, flash memory available for user's code on LPC2141/42/44/46/48 is 32 kB, 64 kB, 128 kB, 256 kB and 500 kB respectively. The LPC2141/42/44/46/48 flash memory provides a minimum of 100,000 erase/write cycles and 20 years of data-retention.

On-chip static RAM

On-chip static RAM may be used for code and/or data storage. The SRAM may be accessed as 8-bit, 16-bit, and 32-bit. The LPC2141, LPC2142/44 and LPC2146/48 provide 8 kB, 16 kB and 32 kB of static RAM respectively. In case of LPC2146/48 only, an 8 kB SRAM block intended to be utilized mainly by the USB can also be used as a general purpose RAM for data storage and code storage and execution.

Memory map

The LPC2141/42/44/46/48 memory map incorporates several distinct regions, as shown in Figure 5. In addition, the CPU interrupt vectors may be remapped to allow them to reside in either flash memory (the default) or on-chip static RAM. This is described in "System control".

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V. RESULTS & CONCLUSIONS

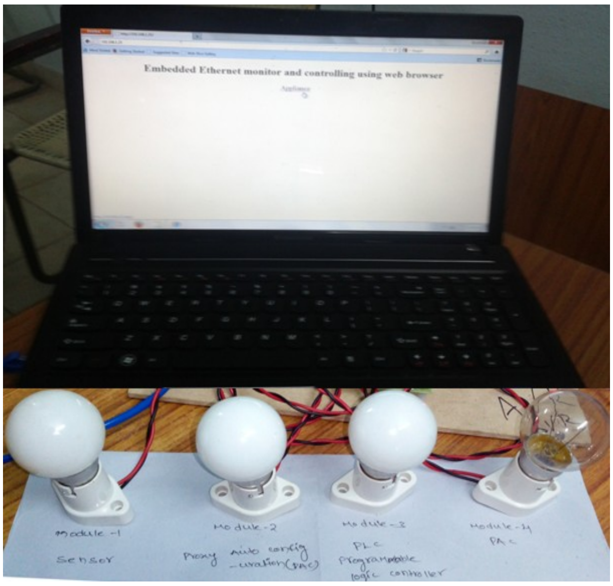

Figure 6. Step 1 of the connection with different modules

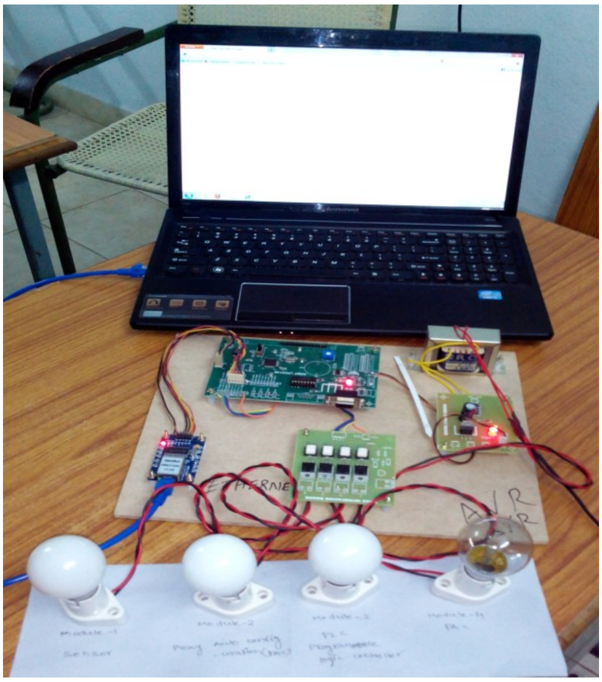

Figure 7. Hardware kit showing the modules are intital Turned – OFF with power supply given before connection establishment

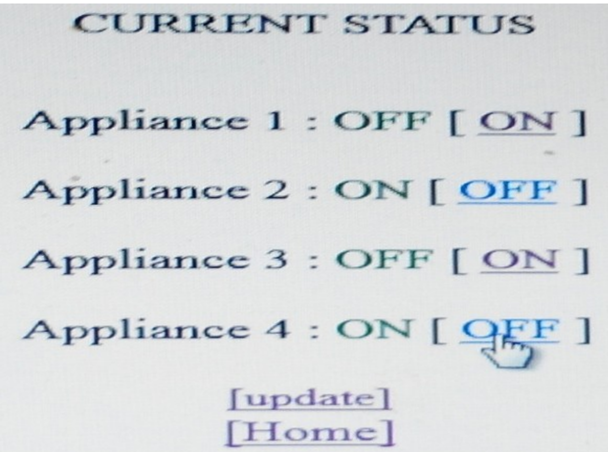

Figure 8. Module 1& 3 are ON

Figure 9. Module 1 & 3 are ON controlled with Ethernet

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BIOGRAPHY

1. Chintala Sudharsan reddy graduated from AVR&SVR College of engineering and technology ,Nandyal, under the university of JNTU Anantapur in Andhra Pradesh , my extra curricular activities during graduation days are attended work shop matlab and its applications in brindavan institute of technology& science kurnool ,and micro controller(8051) course learned at m/s episteme soft pvt.ltd hyderabad . Attended for "information security & ethical hacking" workshop conducted by virscent technologies (an iit kharagpur alumni venture) attended for " national security" workshop conducted by nnsc (an iit delhi acm)

2. S.Thaslim Ahmed graduated from AVR&SVR College of engineering and technology ,Nandyal, under the university of JNTU Anantapur in Andhra Pradesh , attended for "information security & ethical hacking" workshop conducted by virscent technologies (an iit kharagpur alumni venture) attended for " national security" workshop conducted by nnsc (an iit delhi acm)

3. Mayaluri Raviteja Reddy graduated from AVR&SVR College of engineering and technology ,Nandyal, under the university of JNTU Anantapur in Andhra Pradesh , extra curricular activities during graduation days are attended work shop mat lab and its applications in brindavan institute of technology& science kurnool ,and micro controller(8051) course can be learned at m/s episteme soft pvt.ltd hyderabad in summer holidays attended for "information security & ethical hacking" workshop conducted by virscent technologies (an iit kharagpur alumni venture) attended for " national security" workshop conducted by nnsc (an iit delhi acm).

4.P.UDAY KUMAR is currently working as an **Assistant professor** in ECE department of **AVR & SVR CET, Nandyal** which is affiliated to **JNTU Anantapur**, A.P., India. Received the M.Tech degree from JNTU Kakinada, India . and B.TECH degree from JNTU Hyderabad, India.

He is an **Associate Member of IEI**(The Institution of Engineers India) from 30th June 2013**.** He was elected as one of the **Editorial Board Member for IJCAX(International Journal of Computer Aided Technologies)** from 6th September 2013, which is in collaboration with **AIRCC.**

He cordially invited as a **PCM(Program Committee Member) & Reviewer** for the related conferences of **AIRCC(Academy & Industry Research Collaboration Center)** which are **"Third International workshop on Embedded Systems and Applications (EMSA-2014) "** to be held in **Chennai, India.** The **"Sixth International Conference on Wireless & Mobile Networks (WiMoN-2014)"** to be held in **Delhi, India.** And The **"Second International Conference of Soft Computing(SCOM 2014)"** to be held in **Dubai, UAE** in the world wide.

He has many accepted International Journals & Conferences in that one of the Research Paper entitled **"Design of Optimal Digital FIR Filter using Particle Swarm Optimization Algorithm"** with **DOI 10.1007/978-3-319-00951-3_31** was published in **The Fifth International Conference** on **Wireless & Mobile Networks(WIMO-2013),Turkey** which is in conjunction with Computational Science, Engineering and Information Technology **(CCSEIT-2013)** in a book title **Advances in Computational Science, Engineering and Information Technology** by **Springer International Publishing Switzerland June 2013**.

Many of his paper are indexed in **Academic Journal Database, Google Scholar, & DOAJ(Directory of Open Access Journals).** Recently he reviewed some research papers of International Journals like **IJCNC**, **(International Journal of Computer networks and Communication** & also he invited to review a paper from **International Journal of Research in Environmental Science and Toxicology(JREST).**

With his PG Scholar another Research Paper entitled **"Implementation of Time Frequency Block Thresholding Algorithm in Audio Noise Reduction"** which was published in **IJSETR Volume 2 Issue 7 July 2013.**

He is one of the author for the Research Paper entitled **"An Efficient Carry Selelct Adder with Less Delay and Reduced Area using FPGA Quartus II verilog Design"** which was published in **IJSETR Volume 2 Issue 8 August 2013 Page No. 1592-1596.** He acted as **Co-Author** for the Research Paper entitled "**A Verilog Design in FPGA Implementation of QPSK Digital Modulator"** which was published in **IJESRT Volume 2 Issue 7 July 2013 Page No.1904-1909**.

He was **cordially invited** to be an **Editorial Board Member** of International Journal on Information Theory**(IJIT)ISSN : 2319 - 7609 (Online) ; 2320 – 8465 (Print)**Journal. and **PCM(Program Committee Member)** for the related conferences of **AIRCC**. A research paper entitled **"Implementation of Multi Swarm PSO Algorithm for Ripples Reduction in Digital FIR Low Pass Filter"** has **Accepted** for presentation in **ICCCCM 2013**(International Conference on Control Computing Communication & Materials).

His current research interest includes design of Signal, Image Processing, Embedded C, & VLSI System design.

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