# Dual Mode Industrial Automation Controller

## Devendra Kumar Patel[1], Prof. B.H.Soni[2], Nirav Ingrodia[3]

Department of Electronics and Communication,
U.V. Patel College of Engineering,
Ganpat University,
Kherva 384012, Gujarat, India

**Abstract-** **There are many standard industrial communication protocols with their own Features applied in diversification industrial automation applications. Recently the development of Ethernet technique grows up very fast and makes it very popular in industrial control system. A design of ARM processor-based embedded Ethernet interface along with CAN is presented. In the Ethernet interface, an existing SPI serial device can be converted into a network interface peripheral to obtain compatibility with the network. By typing the IP-address of LAN on the web browser, the user gets a web page on screen; this page contains all the information about the status of the devices. The user can also control the devices interfaced to the web server by pressing a button provided in the web page. However, many different protocols used in the industrial control network make the system performance inefficiency and handicap the application flexibility of field bus devices. In Control area network interface special software is installed in a pc designed in visual basic 6.0. Software will contain the required fields and the buttons required to control the equipments. It also contains the records of all the process along with the time. Dual mode industrial automation controller will provide an option on display to select one of the two module Ethernet and CAN.**
**This paper proposes a communication converter solution to integrate the different industrial field bus protocols into a into a single system having a dual mode option 1) Ethernet module and 2) Control area network module**.

## I. INTRODUCTION

   Computer communication systems and especially the Internet are playing an important role in the daily life. Using this knowledge many applications are imaginable. Home automation, utility meters, appliances, security systems, card readers, and building controls, which can be easily, controlled using either special front-end software  or a standard internet browser client from anywhere around the world in case of Ethernet module. Web access functionality is embedded in a device to enable low cost widely accessible and enhanced user interface functions for the device. A web server in the device provides access to the user interface functions for the device through a device web page. A web server can be embedded into any appliance and connected to the Internet so the appliance can be monitored and controlled from remote places through the browser in a desktops PDAs and smart phones. Temperature, Pressure, displacement, motion and sound are the most often measured environmental quantities. Among these environmental quantities, temperature is the most often measured parameter in industries. For example, some processes work only within a narrow range of temperatures; certain chemical reactions, biological processes, and even electronic circuits perform best within limited temperature ranges. So, it is necessary to measure the temperature and control if it exceeds some certain limit to avoid any misbehaviour of the systems. To accurately control process temperature without Extensive operator involvement, a temperature control system relies upon a controller, which accepts a temperature sensor. An ARM processor based embedded Ethernet interface system is designed. In the system, the introduced microcontroller LPC2129 can communicate with serial data acquisition equipments at the terminal through SPI interface and can transmit data to remote host computer through Ethernet interface. Compared with the system that a host is connected to many serial devices, the task of host is only to complete a single Ethernet communication and its load is lower. automatic hyphenation and check spelling. Digitize or paste down figures.

Since the above communication interfaces are difficult to establish a control network with multi-master devices, the network control system can be very valuable when the master controller malfunctions [14]. Therefore, CAN bus is proposed and designed to fulfill the requirements of real-time control applications for local control network. Basically, CAN bus adopts two wires communication and provides a half-duplex transmission interface. However, it also uses the arbitration technology to approach the full-duplex functionality. Therefore, there is no problem when two CAN bus devices; at least, send individual messages to the same CAN network simultaneously. In the definition of CAN bus standard, the communication cables include five lines: two data lines, two power source lines and one shield line. Therefore, building CAN bus network instead of RS-485 or RS-422 network can reduce the hardware wiring problems. Moreover CAN bus provide several error detection mechanisms so that it can increase the reliability and reduce the probability of communication errors. According to the definition of its

application layers, CAN network supports on-line update of the network status for a CAN device and dynamically expands the amounts of devices within the control network. Therefore, it is usually called as an intelligent filed bus. Besides, its maximum transmission speed is up to 1 Mbps, and its maximum transmission length is about 5 km [14].

## II. SYSTEM DESIGN

Many embedded systems have substantially different designs according to their functions and utilities. In the design, structured modular design methods adopted and the system is mainly composed of SPI communication module, processor module and Ethernet interface module, as shown in Fig. 1. The figure shows that the typical architecture of an embedded Ethernet monitor and control using web browser architecture CAN interfacing. Here all the devices are connected to the processor and the ADC converters are used to convert analog data into digital data. Serial communication is done in between processor and Ethernet controller CS 8900A.It is connected to LAN cable through RJ 45 registered jack and the whole device is connected to remote PC through internet .software is to be install in computer to use CAN module. Fig. 1.
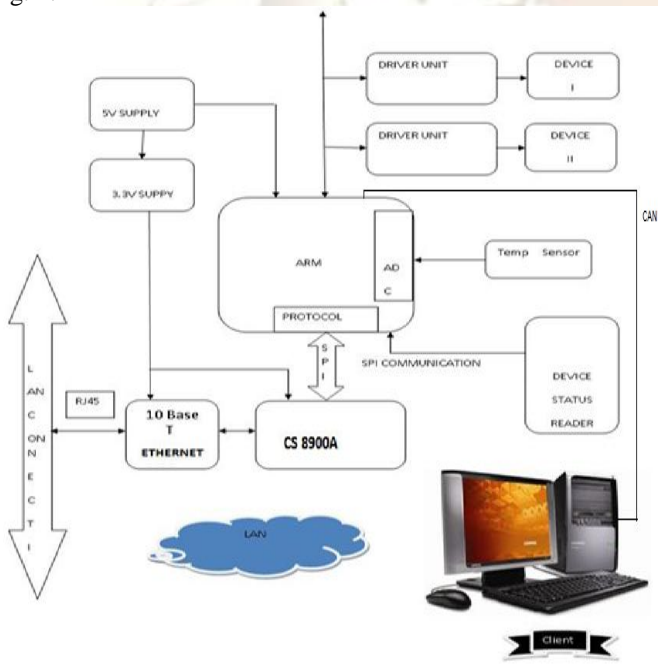


### A. LPC2129 Processor

LPC2129is a microcontroller which is based on a supporting embedded tracking 32bit ARM7TDMI-STM CPU and real-time simulation, with a high-speed Flash memory of 256KBembedded,
make the 32 bit code to run in the maximum clock rate. part features of lpc2129, Four channel 10-bit A/D converter with conversion time as low as 2.44 .

Two 32bit timer/counter (with 4 ways to capture and 4 comparison channels) and PWM unit (6 output roads) and watchdog. Real-time clock has independent power source and clock source, and in power saving mode, it dramatically reduced energy consumption. Several serial interface, include two 16C550 industrial standard UART, two high-speed I2C interface (400kbit/s) SPITM and SSPC (with buffer function, the data length variable). Vector interrupt controller. It can be configurable priority and vector address. The scope of crystal frequency within the piece 1~30MHz. Two low power consumption patterns free and power down. The CPU operating voltage range 3.0~3.6V (3.3v+/-10%). I/O port can with stand the maximum voltage of 5v. It is applied in industrial control, medical systems, POS machines, communication gateways, embedded software modern aspects.

### B. Control Area Network

The CAN bus (Controller Area Networking) was defined in the late 1980 by Bosch, initially for use in automotive applications.  It has been found to be very useful in a wide variety distributed industrial systems as it has the following characteristics:

- Uses  a single terminated twisted pair cable
- Is multi master
- Maximum Signal frequency used is 1 Mbit/sec
- Length is typically 40M at 1Mbit/sec up to 10KM at 5Kbits/sec
- Has high reliability with extensive error checking
- Typical maximum data rate achievable is 40KBytes/sec
- Maximum latency of high priority message <120 μsec at 1Mbit/sec

CAN is unusual in that the entities on the network, called nodes, are not given specific addresses.  Instead, it is the messages themselves that have an identifier which also determines the messages' priority. Nodes then depending on their function transmit specific messages and look for specific message. For this reason there is no theoretical limit to the number of nodes although in practice it is ~64.

Two specifications are in use:

- 2.0A sometimes known as Basic or Standard CAN with 11 bit message identifiers which was originally specified to  operated at a maximum frequency of 250Kbit/sec - ISO11519.
- 2.0B known as Full CAN or extended frame CAN with 29 bit message identifier which can be used at up to 1Mbit/sec - ISO 11898.

### A. Nuts and Bolts

From the systems and design viewpoint the detailed management of sending and receiving CAN messages will normally be done by dedicated hardware, on or off chip, (e.g. SJA1000) but an overview of these functions will be useful in order to design, setup and control a CAN system.

*B.   Signal Characteristics*
CAN may be implemented over a number of physical media so long as the drivers are open-collector and each node can hear itself and others while transmitting (this is necessary for its message priority and error handling mechanisms). The most common media is a twisted pair 5v differential signal which will allow operations in high noise environments and with the right drivers will work even if one of the wires is open circuit. A number of transceiver chips are available the most popular probably being the Philips 82C251 as well as the TJA1040.

When running Full CAN (ISO 11898-2) at its higher speeds it is necessary to terminate the bus at both ends with 120 Ohms. The resistors are not only there to prevent reflections but also to unload the open collector transceiver drivers. We recommend that you terminate the bus correctly in all circumstances.
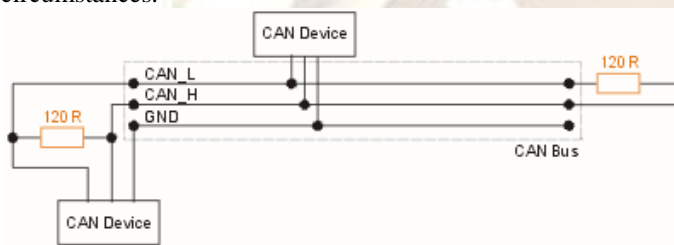


## III. SOFTWARE DESIGN

In order to transmit the data from SPI serial to Ethernet, two system tasks are established in OS μC / OS-Π. One is to receive front-end data through SPI interface and the other is to transmit data to Ethernet.

.
*A.   SPI receiving task*
       For the case that the data are transmit    to Ethernet, the data which have been arrived at SPI port are stored into SPI sending buffer and packaged according to TCP/IP protocol and then are added IP and UDP message head on the condition that the PC with SPI interface is set to SPI slave mode and the SPI interface is enabled. At last, the converted data are sent to the host through the corresponding UDP port.

*B.  Ethernet receiving task*
       In the Ethernet task, in order to receive the data from Ethernet in the system, the local IP address and subnet mask must be set firstly, and the appropriate UDP port is opened to monitor whether there are data in UDP port. As UDP packet,

the data which have been reached the UDP port, are analysed according to TCP/IP protocol and then stored into SPI receiving buffer. At last, the analysed data are sent to the SPI serial device through SPI interface driver. In the process above, an infinite loop is used .

*C.   CAN*
CAN arm 7 ic already contain 2 advance CAN channels this all create a master module.that is directly connected to the slave module. Each equipment is connected to the slave module this different slave modules connected to the slave module. Specially designed software in visual basic 6.0 receive data through rs 232 cable that is connected to the master circuit.software in vb sends the commands to master circuit  which then sends commands to the slave circuit

Advantages And future implementation
As the system is dual mode there is several advantages compared to the other controlling circuits As the whole system is designed using the arm controller..The main advantage is low cost which is the most required part of the industries. Another advantage is that as by implementing this system manual and labor work will decrease. Which in turn decrease the labor cost. Further it increases the accuracy and precision. future plan on this system is to make system more reliable and providing more features to the user by providing the facilities of data backup .memory card or usb interface.

### REFERENCES

[1]    Arul Prabahar A, Brahmanandha Prabhu, **"**Development of a Distributed Data Collection System based on Embedded Ethernet" 978-1-4244-9799-71111$26.00 ©2011 IEEE.

[2].    Hua Fu, Tao Wang, Cui Yang. Gas monitoring system based on ARM and information fusion [J]. Application of electronic technique. 2009(11) 39-42.

[3]    CHEN Guo-ju, "Design of a monitoring system based on ARM and Etherne applied to AC motors," Journal of Nanjing Institute of Technology (Natural Science Edition), Magn. China, vol.7 (2), pp.46- 51, Jun. 2009.

[4]    YU Cheng-bo, LIU Jie, and TAO Hong-yan, "Reseach on remote monitor technology of equipment," Information and Control, Magn. China, vol.31 (3), pp.236-240, June 2002.

[5]    Tao Lin ,Hai Zhao ,Jiyong Wang ,Guangjie Han and Jindong Wang ,"An Embedded Web Server for Equipment ",School of Information Science & Engineering, Northeastern University, Shenyang, Liaoning, China.

[6]    B. Rajesh Kumar*, Member, IEEE*, K. Sridharan*, Senior Member, IEEE*, and K. Srinivasan,"The Design and

Development of a Web-Based Data Acquisition System", ieee transactions on instrumentation and measurement, vol. 51, no. 3, june 2002

[7]    Zhao Hai, "Embedded Internet – an information technology revolution of 21st century," Beijing: Tsinghua University Press, 2002, pp. 198–225

[8]    Ximin Zhang, Junding Sun, Lihua Zhou, "Development Of an Internet Home Automation System using Java and Dynamic DNS Service", Sixth International Conference on Parallel and Distributed Computing, Applications and Technologies, 2005.

[9]    Atmel Corporation. Embedded web server. A VR 460, January 20 I 0, Available from www.atmel.com.

[10]   YU Cheng-bo, LIU Jie, and TAO Hong-yan, "Reseach on remoto monitor technology of equipment," Information and Control, Magn. China, vol.31 (3), pp.236-240, June 2002.

[11]   Zhao Hai, "Embedded Internet – an information technology revolution of 21st century," Beijing: Tsinghua University Press, 2002, pp. 198–225.

[12]   Moon Ho Kang, Byoung Wook Choi, Kyung Chul Koh, et al. Experimental study of a vehicle detector with an AMR sensor[J]. Sensors and Actuators A, 2005, 118(2):278-284.

[13]   Mo Guan, Guangjie Han, Hai Zhao, "The Embedded Internet Technology Based on a Real-Time Kernel for non-PC Devices", Proceedings of 2004 IEEE International Conference on Networking, Sensing and Control, Taipei, Taiwan, March, 2004, pp.343-348

[14]   W. Lawrenz, *CAN System Engineering from Theory to Practical Application*, Springer-Verlag, NewYork, 1997.

[15]   M. M. A. Salama, N. Manojlovic and V. H. Quontana, Real-time optimal reactive power control for distribution networks, *Electrical Power Energy System*, vol.18, no.3, pp.185-193, 1996.