European Journal of Academic Essays 1(2): 40-47, 2014
ISSN: 2183-1904
www.euroessays.org

A Real Time Based Intelligent System Designed for the Process Automation & Control Applications

Tiwari Rajinder[1], Singh R. K.[2]

[1]Department of Electrical & Electronics,
Amity University Uttar Pradesh, Lucknow (U.P.), India
trajan@rediffmail.com
[2]Prof & COE,
Uttarakhand Technical University, Dehradun, Uttarakhand, India
rksinghkec12@rediffmail.com

Abstract: LabVIEW is a graphical programming tool based on the dataflow language G. Recently, runtime support for a hard real time environment has become available for LabVIEW, which makes it an option for embedded system prototyping. Due to its characteristics, the environment presents itself as an ideal tool for both the design and implementation of embedded software. In this project we study the design and implementation of embedded software by using G as the specification language and the LabVIEW RT real time platform. One of the main advantages of this approach is that the environment leads itself to a very smooth transition from design to implementation, allowing for powerful co simulation strategies (e.g. hardware in the loop, runtime modeling). In order to evaluate the effectiveness and possible improvements on G as an embedded software description language we prove that, under certain conditions and semantic restrictions, a non-terminating G program is strictly bounded in memory. Home automation is an application of ubiquitous computing in which the home environment is monitored by ambient intelligence to provide context-aware services and facilitate remote home control. This paper discusses the approach of real-time system development using the data acquisition tool of LabVIEW. The system can monitor the temperature, humidity, lighting, fire & burglar alarm, gas density of the house and have infrared sensor to guarantees the family security. The approach combines hardware and software technologies. Virtual instrumentation uses a general-purpose computer to mimic real instruments with their controls and displays.

Keywords: ATmega16, Data acquisition, GSM, LabVIEW, Home Automation, Sensors, ADC, LabVIEW, Microcontroller, CPLD, Graphical Coding Language, Process Automation, Intel's processors.

1. Introduction

LabVIEW, developed by National Instruments, is a graphical programming environment based on a dataflow model. It was originally targeted towards the test, measurement, and automation industries. In recent years there has been a tremendous growth in the embedded software systems market. It was motivated by, among other factors, the reduction in the cost of hardware and the need for fast portable solutions with short time to market. National Instruments developed LabVIEW RT (Real Time) to answer these demands. The objective of this project is to develop a framework for using the LabVIEW RT software and hardware environment for embedded systems design. To define a consistent framework for embedded design, we prove that the underlying model of computation of LabVIEW i.e. the Graphical Coding Language satisfies the fundamental requirements for languages for embedded systems specification. As an example of the advantages of using the LabVIEW embedded environment for development, we implement an embedded motion controller using LabVIEW RT. The home automation system is a key for energy conservation that can be equipped in normal buildings. Now-a-days the demand for home automation systems in homes and offices are invariably increasing. These systems directly work on the household appliances and provide effortless operation and control of the devices[2]. In this paper we have presented the concept of smart home automation in an effort to reduce the energy consumption and wastage using advanced graphical software called LabVIEW. It provides the programming tools to code power system applications more easily, which saves programming time. With the development of low cost electronic components home automation migrated from being an industrial application to home automation. The home automation, our point of concern deals with the control of home appliances from a central location [1 - 5].

A smart home is a space or a room which is provided with the ability to get accustomed by itself to certain situations to make the occupants feel comfortable. This smart home control system provides both less expensive home

Corresponding Author: Rajinder Tiwari, Amity University, Lucknow, trajan@rediffmail.com, Tel: +91-9451897137

environments, as well as a great level of flexibility and control for the building administrators and great comfort for the occupants. Examples of such hard real-time systems are more and more. In the measurement world, complex test systems composed of many electronic instruments operating in concert are used to verify the performance of even more complex electronic or electromechanical devices. In the field of control, combinations of computers, controllers, sensors and actuators collaborate, great importance has regulate and control processes or communications systems operate to pass information from source to destination. A hard real-time system is one that must meet its performance objectives every time and all the time. As soon as one of these systems does not meet one of its performance criteria, it fails. An example of a hard real-time system is a fly-by-wire flight control system, where if the system does not respond to a pilot's commands within microseconds, then the system fails with potentially catastrophic circumstances. Our everyday life seems to be governed by the clock. Real-time application appears in the field such us [2 - 4]:

1. In-vehicle data acquisition, data logging and control;
2. Machine condition monitoring and protection;
3. Embedded system prototyping;
4. Remote and distributed monitoring;
5. Embedded data logging;
6. Custom multi-axis motion control.

In programming these devices, the time which something is to happen is entered as well as the time at which the activity is to cease or in some cases, the duration of the activity. Never is there a list of activities executed based on the speed at which the device operates. The limitation of existing systems is that their architecture makes it hard to offer control strategies that require dynamic adaptation. For example, deployment of sophisticated control strategies for high accuracy, such as multiple-input and multiple output control, requires a precise identification of the system under control. In many cases, optimal implementation lacks flexibility and tends to require fairly sophisticated hardware design techniques.

2. LABVIEW Real Time (Rt) Module

LabVIEW Real-Time extends the LabVIEW graphical development environment to deliver deterministic, hard real-time performance. The LabVIEW RT architecture consists of the following three components: LabVIEW, the Real-Time Development System and the Real-Time Engine. In real-time applications the code-part of the vi requiring absolute reliability and extended duration run time. Develop application (fig.1) will be transferred to the over Ethernet to Real-Time Engine to run on a variety of dedicated hardware target with a real-time operating system (RTOS), whereas the user-interface will remain on the LabVIEW PC. When the program has started running, the PC with the user-interface can be turned off and on again at a later time. The communication between the real-time hardware and the originating PC or any other PC, can be achieved in several ways.

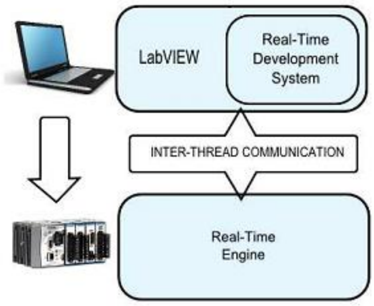

Figure 1: Components of LabVIEW Real -Ti me Architecture [5]

The LabVIEW Real-time Module provides native tools for debugging application. The Real-Time System Manager can be use to monitor system resources such as CPU and memory usage of your real-time target. With other debugging tools, keep track of memory buffer allocation and the amount of memory consumed by each VI as it downloads to target. Additionally, LabVIEW Execution Trace Toolkit is used to advanced debugging to visualize the task execution of application and control assign the appropriate execution priority to each real-time task. The embedded RTOS then uses a combination of roundrobin and preemptive scheduling to ensure deterministic execution of time-critical tasks. Additionally, can be implements multirate applications to include independent tasks running at unique priorities.

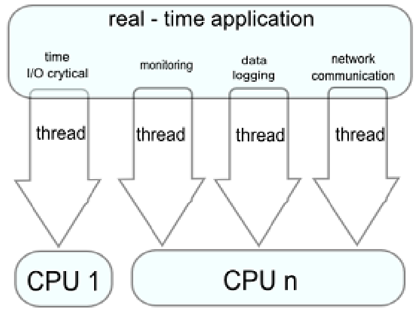

Figure 2: Real Time System to a Specific processor [6]

The solutions based on LabVIEW Real-Time offer variety of real-time hardware targets that contain an embedded processor running a real-time operating system for maximum reliability and deterministic performance. PXI industrial platform or desktop PC, dedicated to RTOS, takes additionally advantage of multicore performance for create deterministic applications. LabVIEW Real-Time Module implement high-performance real-time applications on multi-core systems and take advantage of high performance multi-core processor technology. To further increase the performance and reliability ofa real-time system, LAbVIEW Real-Time can be by programming assign to specific processor cores and dedicate them to execute a time-critical control thread and isolate it from less important thread that run on different cores (fig.4). Multithreading extends the idea of multitasking into applications, so can subdivide specific operations within a single application into individual threads. Each of the threads can run in parallel [7].

3. Requirement of Data Acquisition System in Process Automation

As used in this paper, the term data acquisition and industrial I/Orefers to the process of acquiring and measuring real-world signals from sensors, transducers, and devices. Data acquisition and I/O devices typically consist of some combination of analog and digital input and output capabilities, including signal conditioning, analog-to-digital (A/D) converters, digital-to-analog (D/A) converters for analog outputs, and timing I/O. Data acquisition and I/O products are commonly used to interface directly to sensors, such as thermocouples, RTDs, strain gauges, load cells, pressure sensors, flowmeters, and 4-20 mA transmitters. High-speed data acquisition devices can capture waveform signals, such as electrical transients, vibration and audio waveforms. Today, data acquisition and I/O products are usually used in conjunction with a desktop, industrial, or notebook PC.

Plug-in boards with high-speed data acquisition capabilities are widely available for PCI, ISA, and even PCMCIA. External data acquisition devices typically connect to the PC using a serial (RS-232), IEEE-488, or USB connection. Products used in more industrial application provide I/O and control with interfaces for industrial networks, such as DeviceNet, Profibus, or other fieldbus. The demands put on the communications interface by data acquisition and I/O applications vary widely. Many process and environmental monitoring applications involve relatively low bandwidth signals that are sampled at less than 10 Hz. Higher speed data acquisition applications such as audio and vibration measurement involve the capture of waveforms at sampling rates up to 100 kHz per channel. Electronic data acquisition applications with A/D sampling rates in the multiple-megahertz range are becoming more and more common. Measurement devices for these higher speed applications typically include local memory for temporary storage of data before it is transmitted over the communications port.

While the focus of this paper is on data acquisition and industrial I/O, a closely related function is that of real-time control, in both the equipment used and the nature of the functionality. Traditionally, real-time control devices integrate the processor and I/O into a single device, ensuring deterministic behavior in the execution of input measurement, control algorithm calculation, and control output generation. The use of remote I/O, however, requires a communications link between the control processor and I/O. For reliable control, this communications link must provide deterministic sampling or scanning of inputs

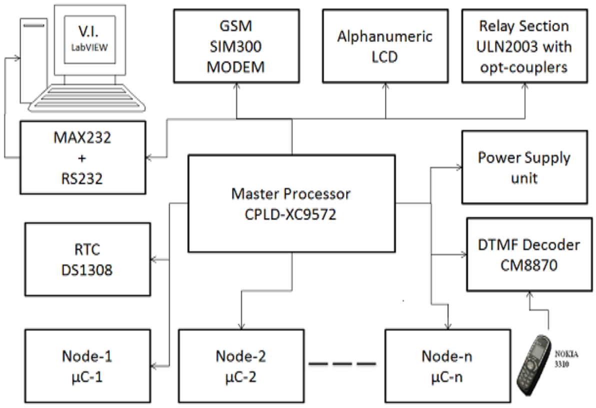

Figure 3: Logical Diagram of Real Time Data Acquisition System [8]

4. Design & Implementation of Process Automation Systems

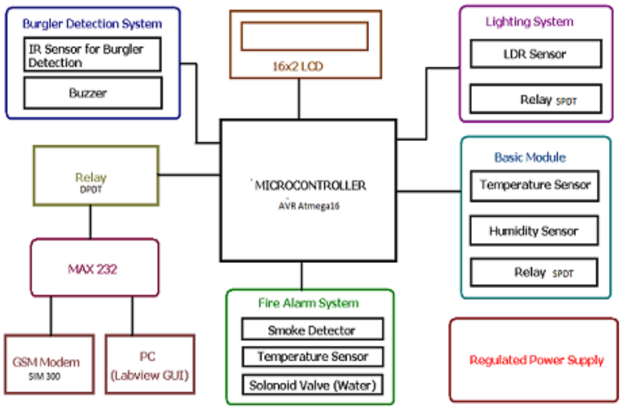

Figure 4: Block diagram showing different parameters for real time monitoring [9]

The overall block diagram of the system is shown in figure 4. Here AVR Atmega16 microcontroller is used to acquire data from different types of sensors.GSM modem is used to get the real time information of different parameters like temperature, humidity, and lighting system when we are outside the home and without any computer system with us. It can also be used for wireless communication. The system is categorized into four modules explained below.

1. Basic Module: It consists of temperature sensor, humidity sensor and a relay circuitry. LM35 temperature sensor is used because it does not require any external calibration or trimming to provide typical accuracies of ±1/4 0 C at room temperature and ±3/4 0 C over a full -55 to +150 0 C temperature range. Humidity sensor module SY-HS-220 is used which convert the relative humidity to the output voltage.

2. Lighting System: The presence of light can be detected by using LDR (Light Dependent Resistor) sensor. It is a type of semiconductor and its

conductivity changes with proportional change in the intensity of light.

3. Fire Alarm System: The fire alarm system is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. In general, a fire alarm system is classified as either automatically actuated, manually actuated, or both. Automatic fire alarm systems are intended to notify the building occupants to evacuate in the event of a fire or other emergency, report the event to an off - premises location in order to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke. We used a smoke detector, a temperature sensor and a solenoid valve for water.

4. Burglar Detection System: A burglar alarm is a system designed to detect intrusion–unauthorized entry into a building or home. Infrared sensors are used within the system.

Real time monitoring of different parameters can be displayed on 16×2 LCD display. All the parameters from different sensors are acquired on LabVIEW GUI (Graphical User Interface). LabVIEW (Laboratory Virtual Instrumentation Workbench) software is a highly productive development environment that engineers and scientists use for graphical programming and unprecedented hardware integration to rapidly design and deploy measurement and control systems.

Within this flexible platform, engineers scale from design to test and from small to large systems while reusing IP and refining their processes to achieve maximum performance. LabVIEW is a graphical programming platform that helps engineers scale from design to test and from small to large systems. It offers unprecedented integration with existing legacy software, IP, and hardware while capitalizing on the latest computing technologies. LabVIEW provides tools to solve today's problems and the capacity for future innovation faster and more effectively [10 - 14].

5. System Design & Implementation of Process Automation Systems

Hardware Module: Real time parameters are monitored using the communication between hard ware and software through microcontroller and GSM. We have an option of NI-DAQ card that interfaces the sensor output directly to the computer but here we are using a serial port communication via AVR Atmega16 microcontroller [15].

Communication using the serial port: LabVIEW can perform serial communication (either RS-232, RS-422, or RS-485 standards) using built-in or externally attached (for example, USB serial adaptors) serial ports on your computer. Serial communication uses a transmitter to send data one bit at a time over a single communication line to a receiver. You can use this method when data transfer rates are low, or when you must transfer data over long distances. The old-fashioned serial communication protocol, RS-232, is slower and less reliable than the GPIB, but you do not need a board in your computer to do it, your instrument does not need to conform to the IEEE 488 standard, and many devices still work with RS-232. Figure 5 shows a typical serial communication system [16].

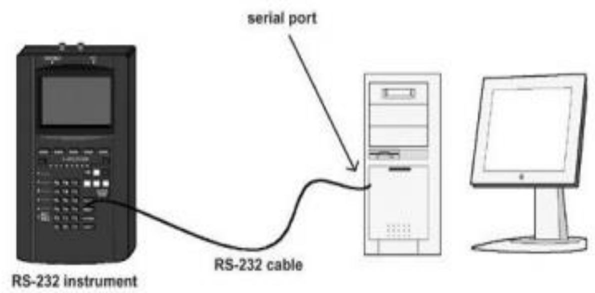

Figure 5: System with one RS-232 enabled instrument connected to computer via its serial port [17].

Serial communication is handy because most PCs have one or two RS-232 serial ports built in you can send and receive data without buying any special hardware. Some newer computers do not have a built-in serial port, but it is easy to buy a USB to RS-232 serial adaptor for about the cost of a USB mouse. Although most computers also now have USB (universal serial bus) ports built-in, USB is a more complex protocol that is oriented at computer peripherals, rather than communication with scientific instruments.

Serial communication (RS -232, RS-422, or RS-485) is old compared to USB, but is still widely used for many industrial devices. Many GPIB instruments also have built-in serial ports. However, unlike GPIB, an RS -232 serial port can communicate with only one device, which can be limiting for some applications. Serial port communication is also painstakingly slow and has no built-in error-checking capabilities.

However, serial communication has its uses (it is certainly economical), and the LabVIEW Serial library contains ready-to-use functions for serial port operations. If you have a cable and a device to "talk" to, you are all set to try out serial communication [18].

Data Acquisition System: Data acquisition, or DAQ for short, is simply the process of measuring a real world signal, such as a voltage, and bringing that information into the computer for processing, analysis, storage, or other data manipulation. Physical phenomena represent the real-world signals you are trying to measure, such as speed, temperature, humidity, pressure, flow, pH, start-stop, radioactivity, light intensity, and so on.

We use sensors (sometimes also called transducers) to evaluate the physical phenomena and produce electrical signals proportionately. For example, thermocouples, a type of sensor, convert temperature into a voltage that an A/D (analog to digital) converter can measure. Other examples of sensors include strain gauges, flow meters, and pressure transducers, which measure displacement in a material due to stress, rate of flow, and pressure, respectively.

In each case, the electrical signal produced by the sensor is directly related to the phenomenon it monitors. LabVIEW can command DAQ devices to read analog input signals (A/D conversion), generate analog output signals (D/A conversion), read and write digital signals, and manipulate the on-board counters for frequency measurement, pulse generation, quadrature encoder measurements, and so on, to interface with the transducers. In the case of analog input, the voltage data from the sensor goes into the plug-in DAQ devices in the computer, which sends the data into computer memory for storage, processing, or other manipulation.

Data Acquisition System consists of a microcontroller and a sets of sensors connected through the existing digital inputs as well as through the analog inputs which has a resolution of 10 -bit ADC [19 - 30].

GSM SIM-300 Module Interfacing:

SIM300 is a Tri-band GSM/GPRS module that operate on frequencies 900 MHz to 1900 MHz, SIM300 can use in many application, such as Smart phone, PDA phone and other mobile device. The physical interface to the mobile applications made through a 60 pins board-to-board connector, which provides all hardware interfaces between the module and customers‟ boards except the RF antenna interface.

SIM300 Specifications:

Two serial ports to interface with Microcontrollers or PCs
Two audio channels include two microphones inputs and two speaker outputs.
This can easily configure by AT command.
SIM300 provide RF antenna interface with two alternatives: antenna connector and antenna pad.

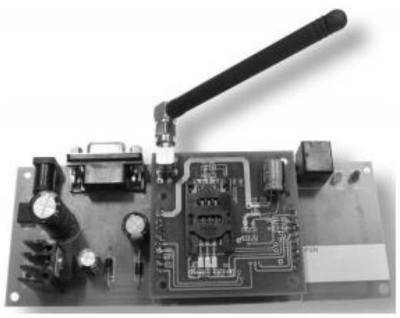

Figure 6: GSM Module SIM-300 [31]

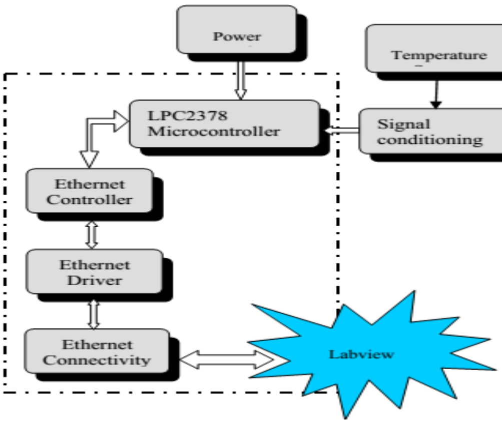

Figure 7: Process Monitoring System [32 - 34]

I. Simulation Results & Discussion

Temperature signal can be easily analyzed using NI USB6008 DAQ device. The steps we will follow are:

- Configure the DAQ device in the Measurement & Automation Explorer (MAX).
- Open LabVIEW.
- Create the DAQ Assistant on the block diagram window.
- Configure the measurement.
- Create the conversion equation from volts to ºC on the block diagram window.
- Create the chart indicator on the front panel window.
- Wire the DAQ Assistant, conversion equation, and chart indicator.
- Save and run the program.

Figure 7 shows the real time variation of temperature on front panel while figure 5 shows experimental set -up for temperature monitoring. In the next stage we can reduce the system cost by replacing DAQ device. We used serial line communication through ATmega16 microcontroller. In this application commands are given through GUI and transmitted through serial port interface. First the VISA configures serial port VI is initialized, where different serial port parameters are specified. Then the serial port read and writes units are activated.

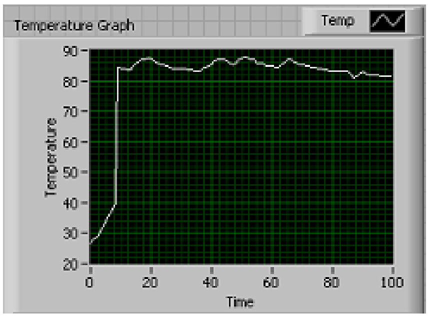

Figure 8: Temperature Signal Analysis

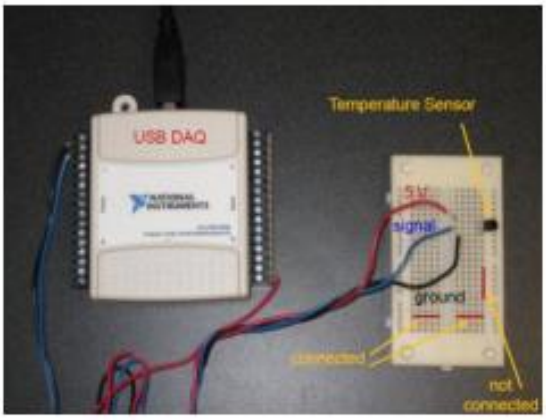

Figure 9: Experimental Set-up for temperature monitoring

The system has been implemented, tested successfully and achieved reliable transmission of data to the remote site and representation of waveform along with logging of data in excel sheet using LabVIEW.

Acquired data display at each node and sent to master processor that compile the acquired information and send to remote location using GSM technology and simultaneously display and log into spreadsheet the variations in quantity under measurement to local and remote system configured with LabVIEW platform.

Figure 9 shows the parameters monitoring on LabVIEW GUI. It shows the power and temperature monitoring. Actual code using VISA flush input-output function and VISA close function[9]. The VISA Configure Serial Port VI initializes the port identified by VISA resource name to the specified settings. Timeout sets the timeout value for the serial communication. Baud rate, data bits, parity, and flow control specify those specific serial port parameters.

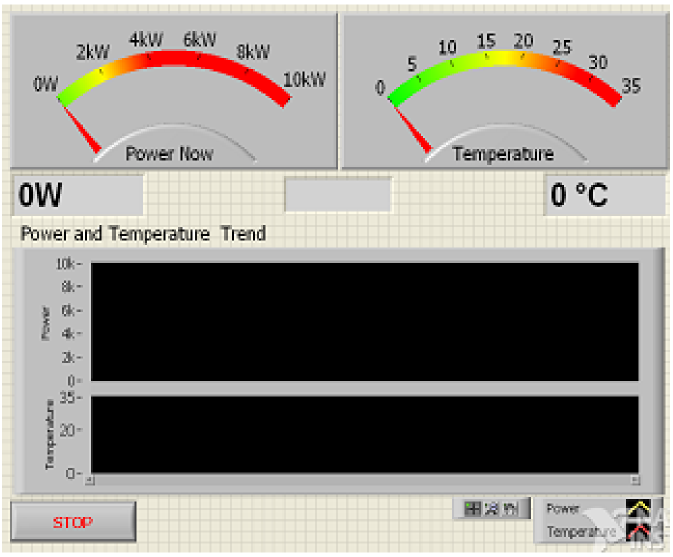

Figure 10: Power and temperature monitoring GUI

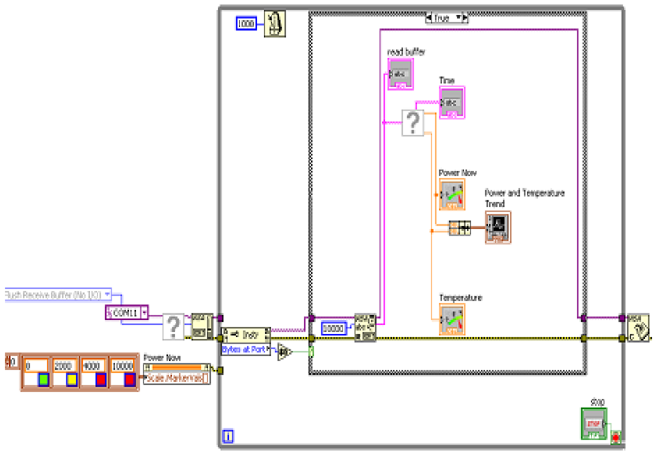

Figure 11: Power and temperature monitoring block diagram using VISA resource.

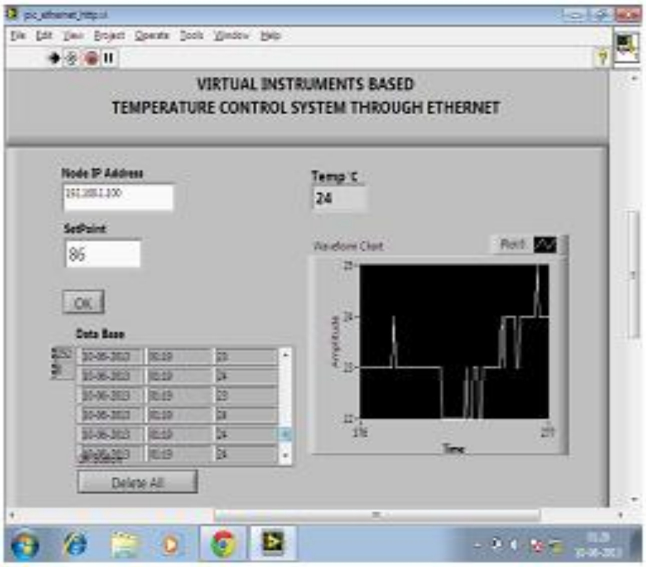

Figure 12: Output design in LabVIEW

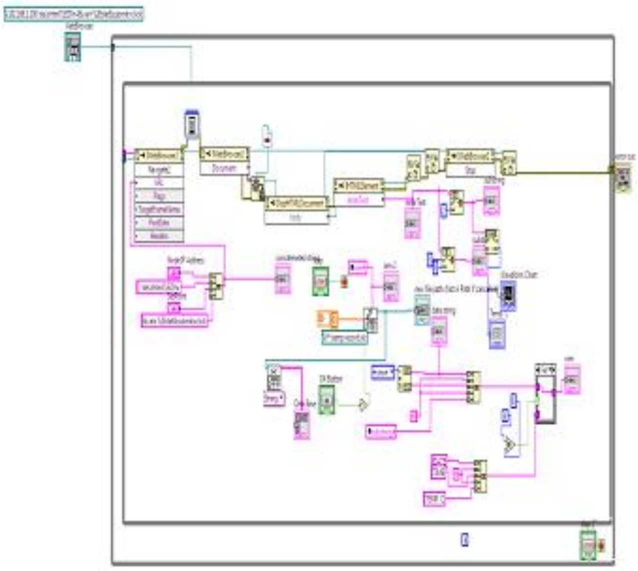

Figure 13: LabVIEW block diagram design

The temperature sensor is the transducer that reads temperature of the particular environment, which we want to measure and converts the temperature into corresponding electrical signal. This analog signal is amplified by signal conditioning circuit and then the analog value is converted into digital by means of analog to digital converter in order to read microcontroller. Microcontroller is programmed to read this digital value corresponding to temperature and it is stored in the embedded microcontroller. Data can be displayed in LCD by programming the microcontroller. Through the ethernet port it can communicate with the LabVIEW module in the computer. In LabVIEW the temperature point is set and the set point is read by microcontroller and is displayed in LCD. This output is shown in the figure 13.

6. Conclusion

Industrial automation through 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 in LAN. Each PC are connected with LAN network connection, is identified by the unique address called IP address. The communication within this 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 observe the temperature reading taken from the workplace and control the temperature from his PC by accessing the web page through web browser.

Acknowledgement

The authors are thankful to Mr. Aseem Chauhan (Additional President, RBEF and Chancellor AUR, Jaipur), Maj. General K. K. Ohri (AVSM, Retd.) Pro-VC & Director General,Amity University, Uttar Pradesh Lucknow, Prof. S. T. H. Abidi (Director ASET, Lucknow Campus), Brig. U. K. Chopra (Director AIIT & Dy. Director ASET), Prof O. P. Singh (HOD, Electrical & Electronics) and Prof. N. Ram (Dy. Director ASET) for their motivation, kind cooperation, and suggestions.

References

[1] Muhammad Tahir Qadri, M. Irfan Anis, Totally integrated Smart energy system through data acquisition via remote location, World Academy of Science, Engineering and Technology 50, 2009.

[2] Dhiren Tejani, Ali Mohammed A. H. Al-Kuwari, Energy Conservation in Smart Home, 5th IEEE International Conference on Digital Ecosystems and Technologies, Daejeon, Korea, May 2011.

[3] Jian Li, Jae Yoon Chung, Jin Xiao,On Design And Implementation of a Home Energy Management System,published in IEEE,2011.

[4] Dae-Man Han and Jae-Hyun Lim, Smart Home Energy Management System using IEEE 802.15.4 and ZigBee, published in IEEE, 2010.

[5] Chuyuan Wei; Yongzhen Li, Design of Energy Consumption Monitoring and Energy-saving Management System of Intelligent Building based on the Internet of Things, published in IEEE, September 2011

[6] Cheah Peng Huat, Siow Lip Kian, Liang Hong Zhu, Vo Quoc Nguyen, Creating a Microgrid Energy Management System Using NI LabVIEW and DAQ, published by National instruments.

[7] Indoor environment monitoring,‖ in ASHRAE Hand Book. Hong Kong: ASHRAE, 2001, ch. 9, pp. 9.1–9.20.

[8] Li Bing and Sun JianPing, "Remote Video Monitoring System Based on Embedded Linux and GPRS", Proceedings of the 2nd International Conference on Computer Engineering and Technology 2010 volume 3.

[9] Nation Instruments, "LabVIEW Reference Manual", USA, 2010.

[10] Ying-Wen Bai and Cheng-Yu Hsu, "Design and Implementation of an Embedded Remote Electronic Measurement System",Proceedings of the IMTC 2006 – Instrumentation and Measurement Technology Conference Sorrento, Italy 24-27 April 2006.

[11] K. Rangan and T. Vigneswaran, An Embedded System Approach to Monitor Green House, 978-1-4244-9182-7/10 2010 IEEE.

[12] Matt Matoushek, Internet Data Acquisition,2nd IEEE International Conference on Space Mission Challenges for Information Technology, 2006.

[13] Keil-Embedded Development Tools, ARM Germany GmbH.

[14] Proteus Professional 7, Labcenter Electronics, England.

[15] AT Commands Set, SIM300_ATC_V1.06, SIM Com 2006.

[16] Ying-Wen Bai, Hong-Gi Wei, Chung-Yueh Lien and Hsin-Lung Tu, A Windows-Based Dual-Channel Arbitrary Signal Generator, Proceedings of the IEEE Instrumentation and Measurement Technology Conference, pp. 1425-1430 May 2002.

[17] Padhee. S and Singh. Y, ―Data Logging and Supervisory Control of Process Using LabVIEW‖, Students Technology Symposium, IEEE 2011.

[18] Honggun Zhang and Yuanyuan Yan, ―System of Wireless Temperature and Humidity Measurement

Based on LabVIEW‖, International Conference on Electronics Measurements and Instruments, IEEE 2009.

[19] A. Alheraish, ―Design and Implementation of Home Automation System,‖ IEEE Transactions on Consumer Electronics, vol. 50, no. 4, pp. 1087-1092, Nov. 200

[20] H. Andrade and S. Kovner, "Software Synthesis from Dataflow Models for Embedded Software Design in the G Programming Language and the LabVIEW Development Environment", Proc. IEEE Asilomar Conference on Signals, Systems, and Computers, Nov. 1998, pp. 1705-1710.

[21] T. H. Cormen, C. E. Leiserson, and R. L. Rivest, Introduction to Algorithms, McGraw Hill Pub. Co., ISBN 0070131430, 1990.

[22] K. Dutton, S. Thompson, and B. Barraclough, The Art of Control Engineering, Addision-Wesley Longman, ISBN 0201175452, 1997.

[23] A. Girault, B. Lee, and E. A. Lee, "Hierarchical Finite State Machines with Multiple Concurrency Models", IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, vol. 18, no. 6, June 1999, pp 742-760.

[24] S. Han, M. Lee, and R.R Mohler, "Real-time implementation of a robust adaptive controller for a robotic manipulator based on digital signal processors", IEEE Transactions on Systems, Man and Cybernetics, Part A, vol. 29, no. 2, March 1999, pp 194-204.

[25] E. A. Lee and D. G. Messerschmitt, "Static Scheduling of Synchronous Dataflow Programs for Digital Signal Processing", IEEE Transactions on Computers, vol. C-36, no. 2, Feb. 1987.

[26] T. M. Parks, "Bounded Scheduling of Process Networks", Technical Report UCB/ERL-95-105, University of California at Berkeley, Berkley, CA 94720, Dec. 1995.

[27] Flex Motion Software Reference Manual, National Instruments, 1999 (www.ni.com/support).

[28] Nie Chun-yan1, Xu Shan-shan2, and Ji Shu-jiao1, "Data Acquisition and Realization of Communication Transmission Based on LabVIEW", 2012 International Conference on Computer Science and Electronics Engineering, DOI 10.1109/ICCSEE.2012.191.

[29] Shyam. R. Nair, Venkatesh Thalaimalayan, "Design of a LabVIEW Based Real Time Simulator for ABS Tester", International Journal of Scientific and Research Publications, Volume 2, Issue 5, May 2012.

[30] Subhransu Padhee, Yaduvir Singh, "Data Logging and Supervisory Control of Process Using Lab VIEW", Proceeding of the 2011 IEEE Students', Technology Symposium 14-16 January, 2011, lIT Kharagpur.

[31] Guangling Guo, Zhiqiang Li, Fan Yang, "Design of High Speed Pulse Data Acquisition System Based on FPGA and USB", 2011 International Conference on Multimedia Technology (ICMT).

[32] Nader N. Barsoum, Pin Rui Chin, "Ethernet Control AC Motor via PLC Using LabVIEW", Intelligent Control and Automation, 2011, 2, 330-339, Published Online November 2011 (http://www.SciRP.org/journal/ica).

[33] Piotr Bilski and Wieslaw Winiecki, "Virtual Spectrum Analyzer Based on Data Acquisition Card", IEEE transactions on instrumentation and measurement, vol. 51, no. 1, February 2002.

[34] Gary W. Johnson, Richard Jennings, "LabVIEW Graphical Programming", 4th ed. McGraw-Hill

Author Profile

Mr. Rajinder Tiwari, PhD (P), M.Tech, MIETE is a member of academic staff of Department of Electronics & Electrical Engineering (ASET), Amity University Uttar Pradesh, Lucknow, where he is serving in the capacity of Asstt. Professor in the Department of Electronics Engineering (ASET). He has done M.Tech (I&CE) and M.Sc (Electronics) from NIT, Kurukshetra and University of Jammu, respectively. Presently, Mr Tiwari is pursuing Ph.D. (ECE) from Department of Electronics Engineering, Kumaon Engineering College, Dawarahat (Almora) under Uttarakhand Technical University which is likely to be submitted. Mr. Tiwari has given his contribution to the area of Microelectronics (Modeling & Simulation of the Analog CMOS Circuits for ASP Applications), Embedded System Design, Digital System Design and Process Industries Automation and Control System Design (using Graphical Programming Language with dedicated Hardware). He has published several research papers in International/National Journals/Seminar/Conference. He is associated with several technical institutions and bodies as a life member.

Before taking the assignment of Amity University, Uttar Pradesh, Lucknow, he had worked in Electronics for Societal Group, CEERI, Pilani, as a Project Scientist and a Multi – National Company as a Sr. Software Engineer (Bridge Instrumentation Division). He is also associated with the successfully implementation of the Hardware and Software for number of projects undertaken by him and in organizing number of International/National Conferences and Seminars.