

Totally Integrated Smart Energy System through Data Acquisition via Remote Location

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Abstract—This paper discusses the approach of real-time controlling of the energy management system using the data acquisition tool of LabVIEW. The main idea of this inspiration was to interface the Station (PC) with the system and publish the data on internet using LabVIEW. In this venture, controlling and switching of 3 phase AC loads are effectively and efficiently done. The phases are also sensed through devices. In case of any failure the attached generator starts functioning automatically. The computer sends command to the system and system respond to the request. The modern feature is to access and control the system world-wide using world wide web (internet). This controlling can be done at any time from anywhere to effectively use the energy especially in developing countries where energy management is a big problem. In this system totally integrated devices are used to operate via remote location.

Keywords—VI-server, Remote Access, Telemetry, Data Acquisition, web server.

I. INTRODUCTION

THE recent developments in the internet and the introduction of the World-Wide-Web (WWW) are opening the ways to interactive presentations, even remote active opportunities to real-world equipment [1]. With the rapid developments of internet and computer technologies, accessing and operating of real time applications is becoming reality [3]. Especially internet facilities present new approaches and methods to design virtual and real time applications for energy management [3]. Technological advances in communication networks are steadily introduced to improve both the quality of service and the available bandwidth of internet to accommodate the increasing world-wide demand of recourses [6].

The main feature of our system is to control, switch and sense the 3 phase AC loads using telemetry and data acquisition tool through personal computer via remote location. The system also acknowledges the Personal Computer (PC) through the same tool.

The system is also serially interfaced using RS-485 (serial communication) protocol to transfer data to PC. The data is also broadcasted to all controllers to control the devices which are serially connected to the PC. The Texas Instruments

LabVIEW is an advance software to control devices serially and publish them on internet to access from remote location through web publishing tool [7]. In LabVIEW, the execution of the program, called the Virtual Instrument (VI), is placed by the data flow [1]. LabVIEW has become a vital tool in today's emerging technologies and widely adopted throughout academia, industry and government laboratories as the standard for data acquisition, instrument control and analysis software [2]. National Instruments also offers LabVIEW Internet Toolkit that is also very suitable for internet applications [4]. Many web-based applications can be realized with commercial off the shelf hardware and software, linked through a dedicated PC with a suitable network connection [5].

Our system uses RS-485 serial communication protocol. Using this protocol, the PC gets data from serially connected loads and publishes them on World Wide Web. Using LabVIEW, the data can be accessed from all over the world which is a unique feature of this work.

The main attribute of using RS-485 protocol is the range and multipoint transmission. The serially connected system is basically a university with three building blocks (classes, laboratory and administration block) whose energy system is to be monitored and controlled remotely. The data from every block is interfaced with the PC using micro-controller cards. The cards also sense the phases to control the loads.

The opto-coupler is also used to sense the phase to increase the efficiency of the system. In case of any problem in any of the phases the system can automatically transferred to another phase. This information can also be sensed on PC as well as remotely. The change of phase can also be done intentionally through PC.

The Human to Machine Interface (HMI) is based on LabVIEW software. The main task of the HMI is to monitor and control the power consumption of the attached system and publish the current position of loads on internet for controlling remotely. The authentication is also set from the HMI for security so that only authorized persons can use the HMI from remote location.

II. SYSTEM MODEL

The system consists of two parts. The data acquisition part and the remotely control of the system through World Wide Web.

A. Data Acquisition

This part controls the system parameters AC phases, generators and AC loads. The HMI is developed in LabVIEW software and above parameters are controlled using RS-485 protocol from PC. The block diagram of the hardware controlling circuit is shown in Fig. 1.

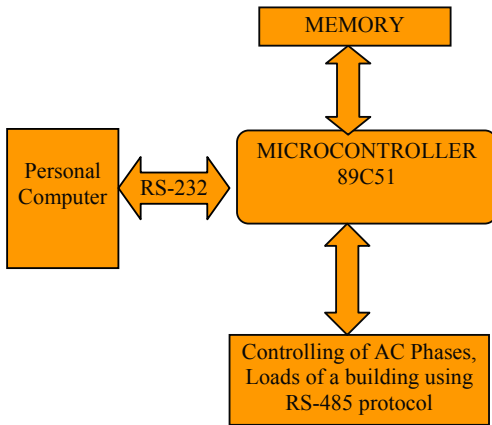


Fig. 1 System model

The building module is a university whose energy system of classes, laboratory and administration block is to be controlled from the PC. The timetable of each class is programmed in microcontroller's memory from PC. The microcontroller controls the power system according to the desired schedule which saves the energy consumption. All of the lights, fans and air-conditioner are attached with microcontroller using RS-485 protocol. The microcontroller also sends the data to the LabVIEW based HMI on PC, with the desired baud rate, which displays the current status of the coming AC phases and the power being used in the rooms. Each class, laboratory and administrator room has its unique address for communicating with the microcontroller. The time table can also be changed from PC and saved to the microcontroller's memory.

B. Publishing the HMI on World Wide Web

LabVIEW is extensively used in this work as it provides very good graphical interface [7]. It is also very powerful tool for interfacing and controlling the connected system via serial port. The main advantage of using this software is the built-in web server which can publish the HMI on internet by using web publishing tool. While publishing the HMI on internet, the administrator on server computer can also set rights to access. For the remotely access, its IP address must be included in the access list on the server computer. The type of access can also be set i.e. for controlling the HMI or just for monitoring. If the remote computer gets controlling access, then it can be observed on server that full control of the HMI is transferred to remote PC and even the server can't control the system unless it disconnects the client first. If the HMI is being accessed remotely, the server computer also displays the

IP addresses of the remote computer with the type of access either monitoring or controlling.

III. HUMAN TO MACHINE INTERFACE

A. Serial Interfacing with assets of LabVIEW

Serial communication is a popular means of transmitting data between a computer and a peripheral device such as a programmable instrument or even another computer []. Serial communication uses a transmitter to send data, one bit at a time, over a single communication line to a receiver. It can be used when data transfer rates are low or to transfer data over long distances. Serial communication requires specifying the following four parameters [8]:

The baud rate of the transmission. The number of data bits encoding a character. The parity bit and the number of stop bits. Each transmitted character is packaged in a character frame that consists of a single start bit followed by the data bits, the parity bit, and the stop bit or bits [8].

Using the serial communication the data from the classes, laboratory and admin blocks is transmitted to the microcontroller which further sends the data to PC where HMI displays the current status of the power used by the system. The system also senses the incoming AC phases, if any of the phase has low voltage or gets failure, the system automatically shifts on generator. This information can also be observed on HMI. The view of HMI is shown in the Fig. 2.

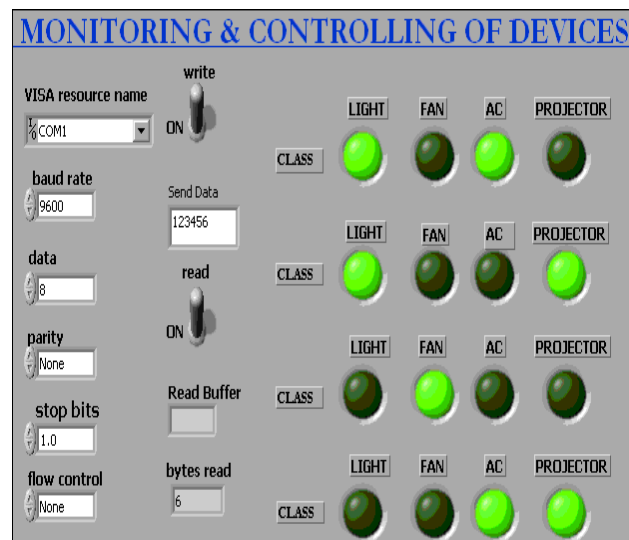


Fig. 2 HMI to control the system serially

The *com1* port is used with a baud rate of 9600 to communicate between PC and microcontroller. The status of four classes is shown in the above figure. The user on HMI can observe the current status of light, fan, air conditioner and projector. The user can also switch ON or OFF the required parameter by sending the command (data) from *Send Data* option to the relevant address of the device.

The block diagram of the above HMI (front panel) is shown in Fig. 3:

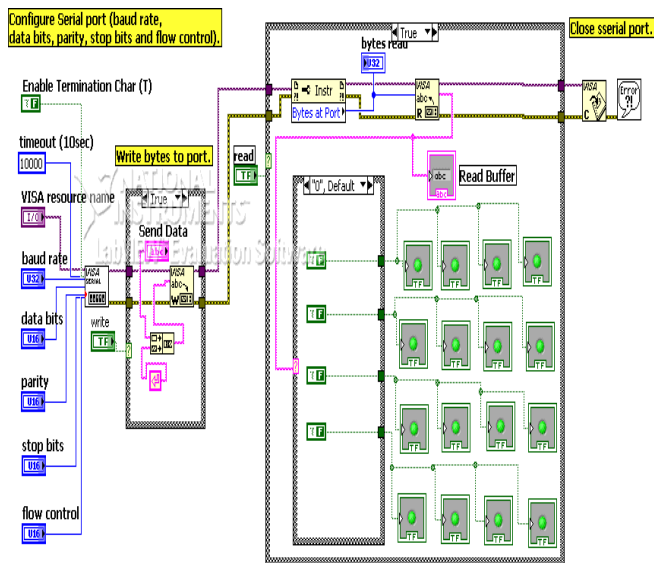


Fig. 3 Block diagram of the HMI

The block diagram of the HMI mainly shows the method of serial communication using LabVIEW. The status of four classes is displayed on the front panel. Four LEDs are used for every class, for light, fan, air conditioner and for projector. Once the time table of each class is saved in the interfaced microcontroller's memory, the four devices will operate according to that. The real time status of devices can be observed on PC using VISA option. To configure the serial port in LabVIEW, first VISA open option is used in which the baud rate, stop bits, data bit and parity bits are defined. Then the VISA READ or VISA WRITE option is used for reading or writing data serially. The user can select read or write option from the front panel. If read option is selected, then the user can only monitor the status of devices. By selecting the write option from front panel, the user can control or change the status of any device. Finally the VISA close option is used for the closure of serial port.

B. Publishing the HMI on Internet

The web publishing tool in LabVIEW is used to publish the HMI on World Wide Web by using the built-in web server in LabVIEW. It can be enabled through the *Tool* menu in LabVIEW. It provides the support for controlling or viewing the LabVIEW based HMI remotely using internet. The name of the VI needs to be selected during publishing.

By clicking the button *Start Web Server*, the VI can be published on internet as shown in Fig. 4 with the exception of the actual IP address. This web address can be used to observe the VI from the remote computer using any internet browser. The LabVIEW web server also provides the option for blocking any particular IP address or to publish a selected HMI. The title of the HTML page and contents can also be written during the web publishing process. The IP address of the remote user can be sensed and it can also be intentionally

disconnected from the server using *Remote Panel Connection Manager* in *Tool* menu.

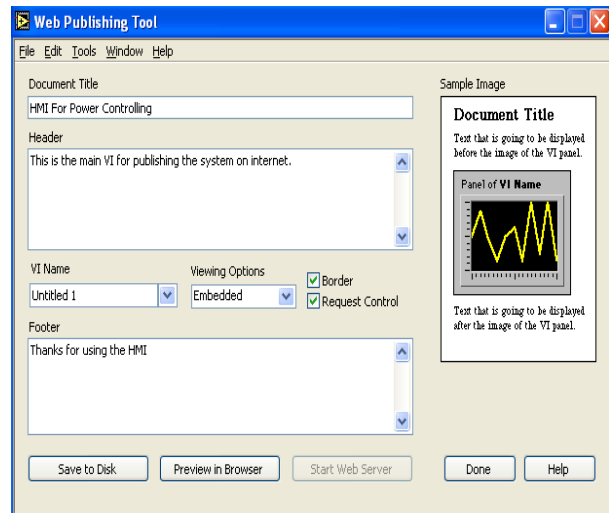


Fig. 4 Publishing HMI on web

C. Controlling the HMI through World Wide Web

The published HMI can be accessed from all over the world by using internet. If the IP address of remote user is included in the access list while publishing the HMI, that user can access the system. The type of access is also important that is the remote user can only monitor or can fully control the system. Any internet browser can be used for accessing the system. In internet browser just type the IP address of the server computer with the application name. The remote view of controlling the system is shown in Fig. 5.

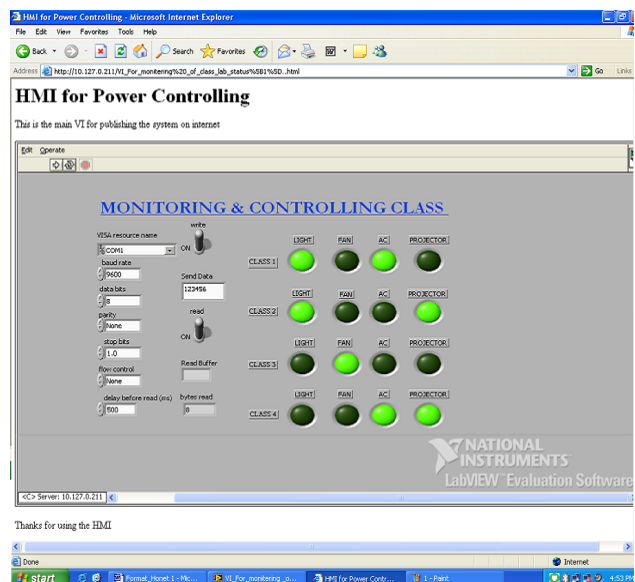


Fig. 5 Controlling the system remotely

The server computer can also see the connected IP addresses and the type of connection either just for monitoring or controlling the system. While controlling the system remotely, the control is fully transferred to the remote computer and the server can not get control unless it disconnects the client computer first by using *Remote Panel Connection Manager* in *Tool* menu. The view of the connected clients is shown in Fig. 6.

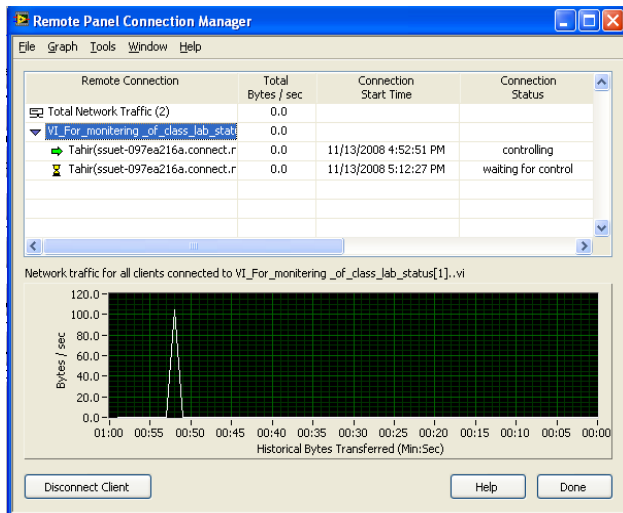


Fig. 6 Remote Panel Control Manager

IV. CONCLUSION

In the boundaries of inspiration are not lemmatizes throughout this total field of controlling and web publishing tool to explore all over world through dynamically and effectively through via remote with personal computer to

access data and telemetry features. In the closing stages conceal about the new initiative of web publishing tool to control the system through personal computer remotely. The previous approaches use wireless system (RF-cards) to control but the RF cards are inadequate. The inspiration is very less admirable as compared to wireless cards system. The essential thing is the data acquisition, telemetry, access control to undiminish in all dimensions. The most appealing is a very cost effectual to utilize the system effortless to control throughout the world.

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