Real Time Internet based Remote Sensor Monitoring and Control

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Abstract: *The World Wide Web has made it possible to send a lot of data from anywhere in the world to the other side in almost no time. Web based remote monitoring and controlling system should directly connect the equipment to the network using Atmega16 microcontroller and Serial to Ethernet module. The clients may monitor and control the current condition of equipment through web browsers. The web is developed by php.net framework and microcontroller based hardware is interfaced to the internet by C# application. This structure is advantageous as it can realize flawless connection between equipment and their management. It greatly decreases the cost of system infrastructure. With the development of industrial Ethernet technology, the real time performance of system is improved further. This technology is not limited to home or industrial uses, but can also be used in the field of medicine, education, etc.*

Keywords: World Wide Web, Atmega16 microcontroller, php.net, thermocouple, resistive soil moisture sensor

1. Introduction

By integration of web and embedded technology, the equipment monitoring and controlling system based on web management can be developed. By using a web browser without limit of region and time managers can remotely access, monitor, maintain or control the on-site equipment through the network. It can appreciate the inter-access between the diverse equipment. The function of Web-based equipment monitoring system is to collect real-time data of the on-site equipment, publish it through a Web form, and remotely send the data on user command in the form of the user-defined data transmission style [1]. It will provide flexible remote monitoring and diagnosis function combining the configuration software based on standard browser. The data will be published through web page form by the web server in various user defined formats. If the sensor parameter value is different from the original set value by the user, a correcting action will be taken automatically by the microcontroller. The sensor current values and status can be seen on web for monitoring and the status can be updated thus defined parameter can be controlled through the microcontroller via internet. In a similar fashion various other parameters for control and monitoring can be added to customize the hardware to suite the user requirements.

This structure has the following advantages:
a) It achieves flawless connection between equipment and their management.
b) It greatly decreases the system infrastructure cost.
c) With the development of industrial Ethernet technology, the real-time performance of system can be improved further.

Two parameters selected for the system are temperature and moisture of soil. The reasons behind these parameter selections are firstly temperature is the most measured parameter for industries. Secondly India is a developing nation with huge population. Food and water are basic needs which are to be satisfied. We are using water at very high rate. The most water consumption field is farming and is unavoidable. There should be ways to conserve the water for future generations. If water is used efficiently in farming we can save a large extent of water. This can be achieved by appropriate watering the plants in the farm by checking water content in the soil.

2. Inside the System

2.1 The Functional Design of System

The idea was to take a system with some parameters and connect the system to internet/server and then monitor or control these various parameters through remote location via web or internet. The function of Web-based equipment monitoring system is to collect real-time data information of the onsite equipment, publish it through a Web form, and remotely send the data in the form of the user-defined data transmission style. It will provide flexible rich remote monitoring function combining the configuration software based on standard browser. The data will be published through web page form by the web server [2]. The remote computer will collect the data and running status through the network and will provide the comparison on the historical data. If the temperature value is different from the original set value a signal will be given to the heater accordingly and will turn it on or off. And if the soil moisture content value is other than the set bound the water pump will be turned on or off. Thus the microcontroller sends the control signal to the control unit. Light bulb is directly turned on or off from the website thus defined parameters can be monitored or controlled through the microcontroller via internet [3]. In order to connect the embedded devices to the Internet and enable users to monitor the embedded devices using a standard Web browser, a website will be developed and ported onto the remote computer (ISP server). The Web server provides the Web-based graphical interfaces to users of the Internet to carry out unified supervision and

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management of various devices linked to network. In this project, the analog parameters planned for monitoring are temperature and soil moisture. The heart of the hardware is the microcontroller ATmega 16 [4]. The signals are picked by the sensors (Thermocouple and resistive soil moisture sensor). The sensed signals are fed to the analog to digital (A/D) converter in built in the microcontroller. The A/D converter converts the analog input signal into digital signal and transmits this data to the LCD for display and website for publishing and storage.

2.2 Hardware Definition

For the purpose of hardware architecture definition for sensor data acquisition, digitization and network establishment for internet connectivity, various books on microcontrollers-microprocessors and chip sets were studied to identify the components best suited for the intended application. The heart of the hardware architecture is the microcontroller (ATmega16) around which the chip set is developed. The microcontroller exchanges the sensor data with Data port module which consists of Monitoring module (ADC sub-module) and Control module i.e. Relay driver unit. The ADC converts the sensor data into digital format and supplies to ATmega16 for data processing. The control module converts the digital command generated by ATmega16 into power signals for regulating the target outputs. The figure 1 shows the detailed hardware structure of the project.
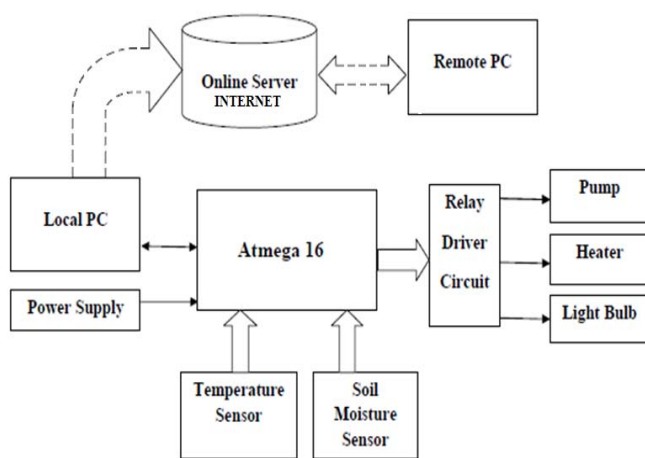

Figure 1: Block diagram of the system

The hardware part of system consists of Atmega16 core board, A/D convertor, signal conditioning, sensors, and communications interface. The Atmega16 microcontroller chip consists of FLASH, 8-channel 10-bit ADC, one/two 16/8-bit timers. It is an 8-bit RISC microcontroller with the characteristics of high cost performance, low power, small size and high integration.

The thermocouple sensor used is of type k has an attached IC AD 595 as thermal compensation and instrumentation amplifier. Its range is $0\text{-}1250^0$C and output as 10 mV/^{0}C [5].

The resistive soil moisture sensor used is specially designed as a low cost sensor. It works on the principal of voltage divider bias. The output voltage is dependent on the soil's moisture content changes. The voltage across output decreases as resistance of this sensor increases hence the drop across it increases with increasing soil dryness. When the moisture is high resistance decreases; voltage drop across resistance decreases and output voltage increases.
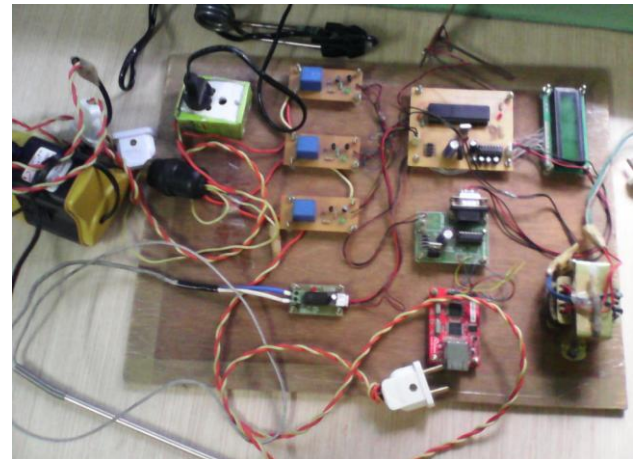

Figure 2: Hardware components of the system

The target outputs are water pump and water heater which are operated by relays. Relays are used where it is necessary to control a circuit by a low-power signal. Relay selected is cube type (JM-2P) which is sugar cube relay with 25A Inrush current and has application for automotive electrical systems [6].

2.3 Software Definition

The web is developed using php.net framework. Php.net programming is easy to use as it uses html base. For web interface with the hardware is done using C# programming application. MySQL is the free database software available on net so decided to use it. It is also easy to use software and user friendly. It is used to form database on the server [7].

3. Result and Discussion

The applications are the temperature of a process in plastic industry and moisture content of soil. For temperature application in which it is needed to have constant temperature; so the required temperature is set point.
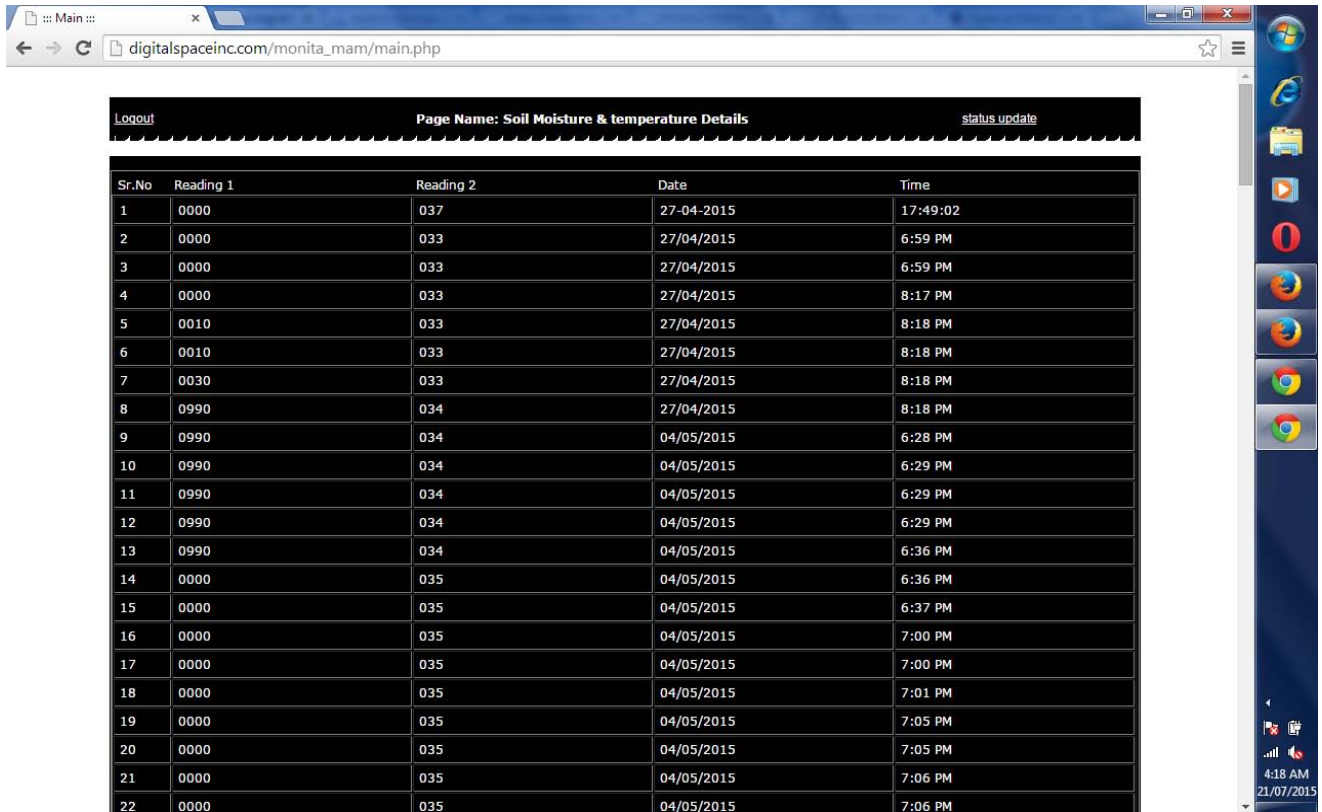
Figure 3: Snapshot of the Main Page

If the temperature is below set point heater will be on and if it is above set point then it will on the heater. And if soil moisture is below or above defined levels pump will be turned on or off accordingly. The figure 3 shows admin panel of the web on which the current temperature and soil moisture value is displayed. On-off control of light is also done. The delays associated with on-off is calculated as average and summarised as follows. The on time average delay is 1.275sec and off time average delay is 1.389sec.

The main design considerations were security, performance, ease of use, availability and scale. Security is paramount when we consider exporting private and confidential information outside of the firewall. We must assure that only valid users can access the web, while active attackers on the Internet cannot.

The issue of communication security at the present scenario is handled by having the user id and password to access the website controls. The technology is advancing day by day. The security issues involved in the system will be completely removed out by applying latest concepts of internet.

Then the system like this can be easily implemented by small to large scale industries for remote monitoring and controlling the plants.

4. Conclusion

A low-cost, Internet-based control system has been designed and implemented. The application possibilities are virtually unlimited by attaching modules with appropriate interfaces, although the usage of the system is demonstrated with only a few sample devices. Compared with other applications, this system has advantages in terms of allowing direct bidirectional communication and reducing overhead, which can be vitally important for some real-time applications. In future more number of sensors can be applied and wireless mode of operation can be developed.

5. Acknowledgment

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