

A COST EFFECTIVE WEB SERVER BASED HOME APPLIANCES CONTROL SYSTEM

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Abstract—The paper presents a cost effective approach to control home appliances such as light, fan, heater, washing machine, motor, etc over the Internet. The appliances are connected to the server machine and can be controlled over the Internet using a web browser on a desktop PC, Laptop computer or PDA. The parallel port is used to transfer data from server computer to particular device to be controlled. An interface device is designed to connect the high power loads to the parallel port. The developed web user interface allows the user to control home appliances directly or by using Schedule option. We have developed a system, by which it is possible to properly control eight appliances remotely through Internet.

Keywords—Internet, parallel port, interface box, remote control.

1. Introduction

Personal computers are increasingly becoming the platform of choice to design and implement control algorithms. On the other hand, the Internet which is seen as data highway that connects million of computers into single large network is now extending to control home appliances in different manners. A lot of commercial systems are available to control intelligent appliances from multiple agents [1]-[5]. The attempt to design a low cost internet connection for non-intelligent home appliances such light, fan, motor, etc control system is an important effort for non-development countries now. This paper presents a new technical approach to connect the high power electrical appliances to the Internet to control directly or by using schedule option. By this system the user will

be able to conduct various operations namely selecting a device to be turned ON or OFF, viewing the status of all devices and updating the status of certain devices.

To successfully integrate the digital controller with the analog plant, an interface device is used within the PC that can perform the necessary tasks [6]. In this document, we present the design of the interface box that has been used in our system. The interface box can be controlled by the computer by connecting to the parallel port and written a program in any preferable language. Here we write device driver program to control the interface box through computer. The program will demonstrate the basic idea of how to control devices and monitor events.

The paper first describes the general architecture of the home-appliances control system. The details hardware of the interface box, which is the most important part for interfacing high power loads with the computer, is described in section 3. In section 4, we describe the software development phase. Finally, we represent the web based user interface of the system software and summarize our work in the remaining sections.

2. Architecture of the proposed system

The aim of this project is to develop a client/server-based system to control home appliances over the Internet when a user is not at home. The overall system architecture is shown in Figure-1.

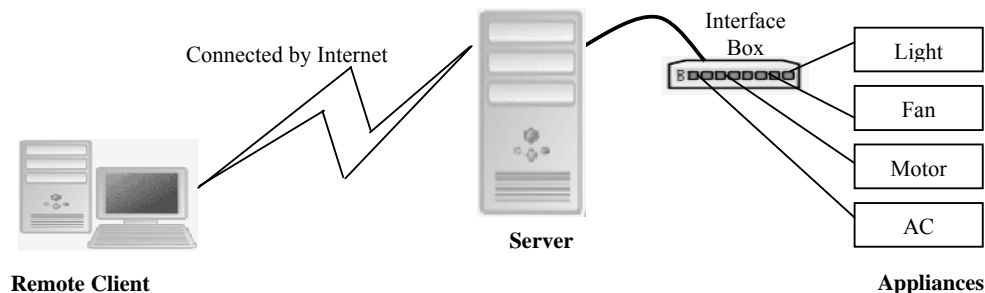


Figure 1: Architecture of the proposed system.

The system consists of three units: a Control unit, an interface unit and a remote unit. The control unit is the standard server computer with a web based user interface software and a device driver which is required to control the high power home devices. The Interface unit is for interfacing the high power loads with the control unit. The remote unit may be a desktop PC, laptop computer or PDA with a web browser. The home appliances can be controlled over the internet by the remote unit.

3. Hardware design of the interface box

In this section, we present the design of the interface box that is used to connect high power loads to the computer. Details about the components that comprise the interface box are also shown here. We have shown how to interface a relay and an AC load.

3.1. External panel

The upper panel of the interface box consists of sockets, which are easily accessible to the electric appliances for proper and safe operation. A snapshot of the external panel of the interface box is shown in Figure-2.

The Front Panel consists of an AC power supply Cable, Power ON switch, Printer cable, Sockets, and LEDs. AC power supply cable connects the interface box to the main AC supply. Power ON switch supplies 220V (50Hz) mains' supply to the interface box when turned on and stop supplies when turned off. Printer cable connects the interface box to the PC's parallel port. Electric appliances are generally connected to Socket. The LEDs indicate the status of the Electric appliances (i.e. ON or OFF).

3.2. Internal modules

The Internal circuitry of the interface box can be divided into three main categories: Relay driver Circuit, Relays and +6V DC power supply.

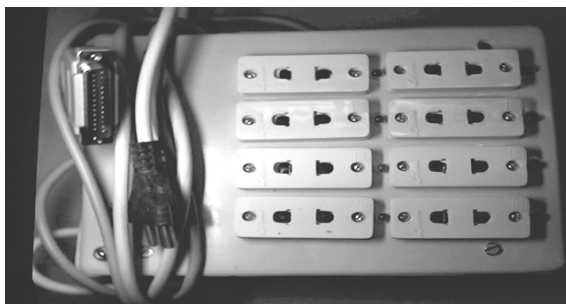


Figure 2: External panel of an interface box.

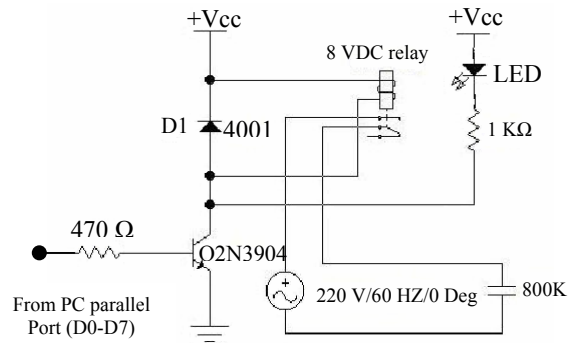


Figure 3: Circuit diagram for the relay driver with relay and socket.

3.2.1. Relay driver circuit

The relay [7] driver circuit is necessary to drive the 6V DC relay. The circuit diagram for each unit in the relay driver with relay and socket is shown in Figure-3. The relay driver circuit is necessary for each socket.

3.2.2. Relays

A total of eight relays are used for the eight output sockets. Eight relays are wired in such a way that the normally closed pin of the relay connects to the Power Resistors and the Normally Open pin connects to a socket.

3.2.3. +6V DC power supply

The DC power supply is needed to provide +6V DC source to the Relay driver circuit.

3.3. Computer interfacing

PC parallel port is a 25 pins D-shaped female connector in the back of the computer [8], [9]. This is an inexpensive and yet powerful platform for implementing projects dealing with the control of real world peripherals. The parallel port is made up of three different sections. These are data lines, control lines and status lines.

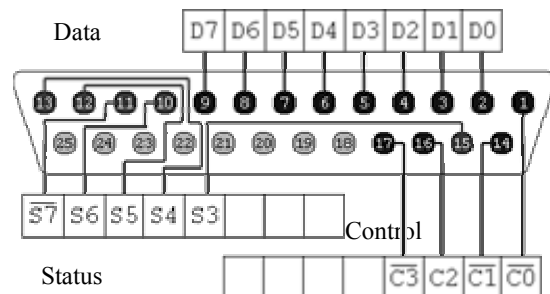


Figure 4: Pins outlines of the parallel port.

Table 1: Parallel port address.

Address	Notes
3BCh-3BFh	Does not support ECP address
378h-37Fh	Usually address for LPT1
278h-27Fh	Usually address for LPT2

There are 8 data lines, and they are the primary means of getting information out of the port. The control lines are another 4 outputs. The status lines are a standard parallel port's inputs. There are 5 of them. The figure-4 shows all the pins of the parallel port. The pins 18,19,20,21,22,23,24 and 25 are all ground pins.

Each section is accessed by its own address and will act independently from the rest. This is almost as if they are different ports. LPT1 is normally assigned base address 378h while LPT2 is assigned 278h. The address may change from machine to machine. The addresses are given in Table-1. The 8 data lines output pins are adequate for the project.

Those data pins are TTL level output pins. This means that they put out ideally 0V when they are in low logical level (0) and +5V when they are in logical level (1). We use the logical level (1) to ON the electrical appliances and logic level (0) to OFF. Data pin 0 is used to control the device 1; pin 2 is used to control the device 2 and so on.

4. Software development

The client/server uses the Transmission Control Protocol (TCP) to make reliable communication among them. An API (Application Program Interface) is created that includes a class, which uses the functions of a device driver which describes in the next section. A web server is configured named IIS (Internet Information Services) and ASP (Active Server Page) is used for server scripting to create server object of the class [10], [11].

We developed a user interface which is the collection of web pages written in HTML using Microsoft FrontPage. A database was created using MySQL to store information about user and device status that is ON or OFF. ASP (Active Server Pages) scripts are written to operate with the client's request sent to the server using a web browser [12].

4.1. Device driver

Visual Basic can not directly access the hardware on a system [13]-[15]. All hardware requests must go through Windows. We use **win95IO.dll** file and the functions **VbOut()** and **VbInp()** for outputting and

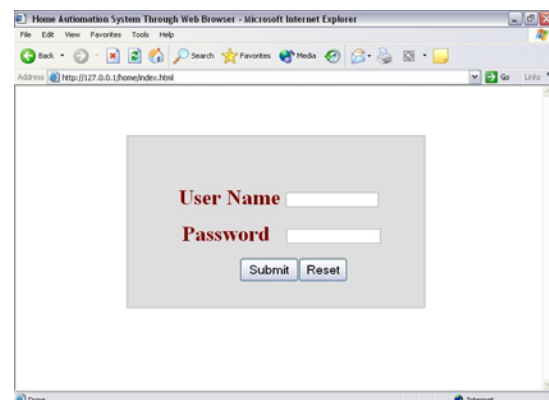
inputting data to and from the parallel port respectively for **WIN95/WIN98** operating system. But the NT clone operating systems like **WINNT/WIN2000/WINXP** assigns some privileges and restriction to different types of program running on it. It classifies all the programs into two categories: *user mode* and *kernel mode*. Device drivers are capable of running in kernel mode. We have write a device driver to handle the "Interface Box" by using the **Inpout32.dll** file and **Inp32()** and **Out32()** function for **WINNT/2000/XP** operating system. An Activex DLL project on Microsoft Visual Basic 6.0 named as **control.dll** has been created to build an API including a class file by using the functions in **Inpout32.dll** to handle the interface box according to the client request through Internet.

5. Operation

The graphical interfaces of the developed software are smart enough to guide a person to extract all functionality of the utility program without any prior experience. First of all, a user should type the valid http URL (Uniform Resource Locator) address of the server in the address bar of any standard web browser to access the server page.

The first page is an authentication page where the user has to submit a user name and password for authentication as shown in figure-5. The authentication is checked by comparing the user name and password with the user table of database.

If the user is found to be valid, a mode selection page will be shown by which a user can choose his way to control the home appliances that is *direct* or *schedule* control. The direct control page contains two push buttons named as ON or OFF for each device to turn ON or OFF devices directly as shown in Figure-6.

**Figure 5: Authentication web page.**

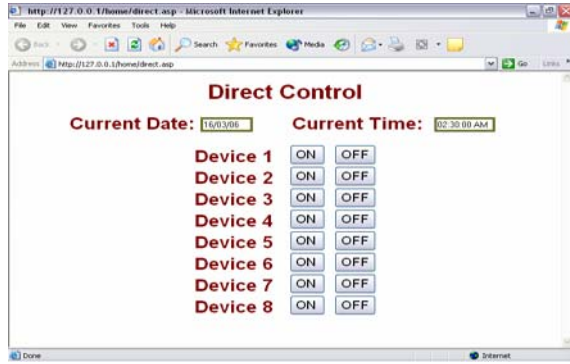


Figure 6: Direct control page.

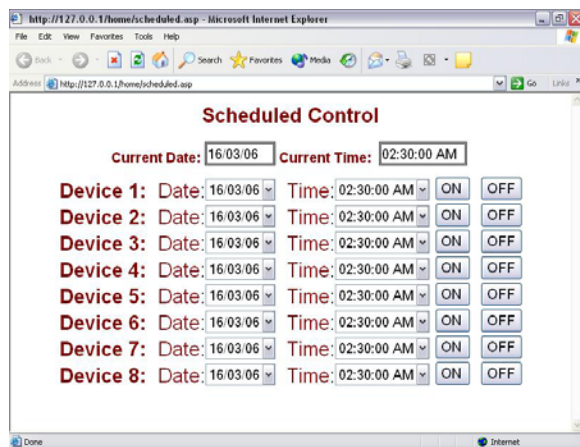


Figure 7: Schedule control page.

The schedule control page provides the facilities to set date and time as well as the status of device operation (i.e. ON or OFF) to turn ON or OFF the device according to the given date and time as shown in figure-7.

The schedule information will be stored in the server database, which will be checked with the system date and time repeatedly after specific small time intervals to control the status of specific device. The operation of the developed system is illustrated in the flow chart in figure-8.

6. Limitation

The only drawback associated with our system may be the fact that since we currently have no methodology to start up a computer on demand, server computer linked to our system have to be in stand by mode so the system can respond to incoming request.

7. Discussion

The cost of the Internet connection to the server computer and the development of the interface box

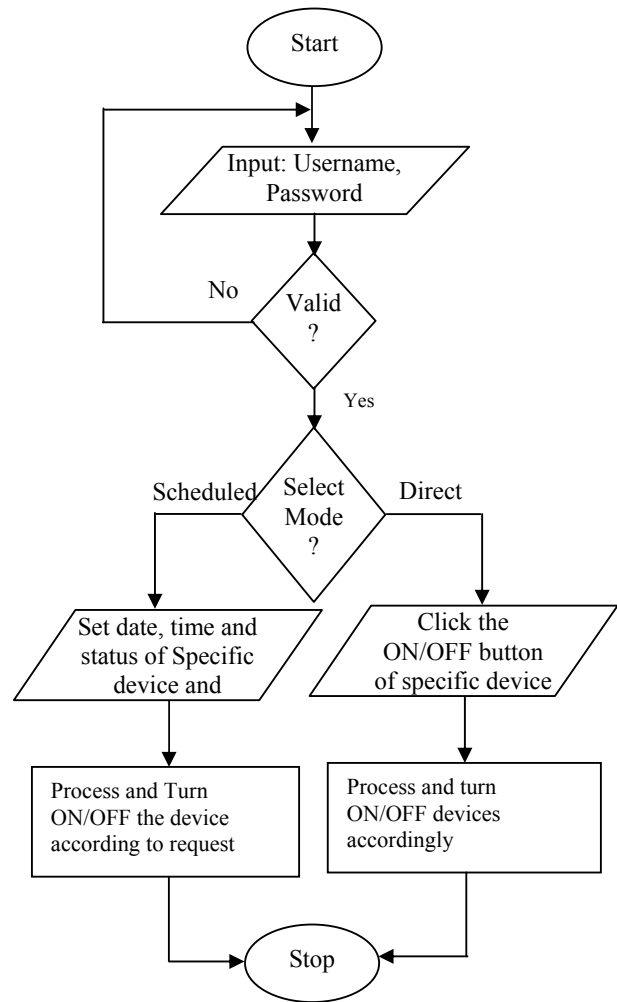


Figure 8: Executing clients' request through web server.

are estimated roughly at this time. But a comparison to the commercial products shows that Nevertheless, the proposed system is able to serve 256 devices in a large organization or industry by upgrading the interface box and little modification in the program, which will also decrease the cost per device.

8. Conclusion

Now the proposed system is able to control home appliances by using a remote desktop computer, laptop computer or PDA through Internet. In future, we will develop a remote home appliances control system, which is able to control multiple user agents. The future approach makes possible a connection through the Public Switched Telephone Network (PSTN) and Global System for Mobile (GSM) communication network as well as the Internet.

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