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Research Article

Voice Activated Electronic Devices Control System For Home Appliances

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Abstract: Peripheral is the electronic equipment connected by cable to the CPU of a computer. Today the art of computer science lies in connecting computers with peripherals. In many circumstances, it looks more like magic than art. Due to the rapid technological development in computer, the speed and capacity of computer system have increased very much. So, it is possible to connect many peripherals with computer system and can satisfy the most computing needs. Now-a-days Computers are widely used in home, offices, institutions and many other different places. People have started to use computer to control their home appliances like television, fan, refrigerator etc. One can also view the status of these devices from remote places with the help of computer system. It is possible to design many methodologies to control the home appliances for comfortable use of these electronics. In this paper, we have designed and implemented an idea of controlling home appliances using voice command. We developed a control system by means of natural voice technology for advanced electrical and other household electronic instruments such as safety and comfort systems (light, fan), entertainment and leisure items (television) and the services associated with them.
Keywords: Home appliance, Voice command, Computer controlled electronic device, Peripheral..

INTRODUCTION

Imagination is the greatest gift man is blessed with. We imagined long to implement a system that will receive voice command and then behave accordingly. As we always want to get comfort in our day to day life, we wish that it will be a great achievement if we can control the daily used electronic devices just by giving voice commands sitting in an easy chair or lying in the bed. As this is the age of Computer Science, this gives us a boost to think a lot if we really can implement this. Since we have to control home appliances from computer using voice command, we implement software to recognize every voice command of every person. The voice command is taken into the computer using microphone which can be wired or wireless. From the voice command we generate some control signals to be passed through the parallel port to a control circuit and control the electronic devices according to the received signals. But developing such a circuit practically was a Herculean task in comparison to theory. We focused on combining these two separate parts namely hardware and software parts. Another complexity with this project is that working with AC devices with the help of computer is always a risky and tough job. Our designed system transformed the theoretical project into reality. We designed the system to control sixteen electronic devices and one TV, but it is possible to extend our system to manage many devices as per the user requirements.

LITERATURE REVIEW

Due to the ever-increasing complexity of home appliances and services, the next generation is expected to be surrounded by connected products by developing intuitive human interaction capabilities. In order to keep up the living standards of the advanced civilization, the world demands the initiation of intuitive, intelligent and flexible interfaces that facilitate human-machine interaction. As humans mostly communicate by verbal language, voice is one of the key natural interfaces to them. Voice activated electronic devices allow the users to transmit a remote control signal in response to a voice command and control devices with minimum efforts and complication. Particularly, it has much to offer elderly and disabled people with motor control deficiency or visual impairment. Their difficulties in moving independently require the means to control devices remotely in the living area. Voice activated electronic devices may come in handy to these handicapped people by allowing them not only to handle home appliances by distance and but also to move freely applying voice activated powered wheelchair.

Electronic Devices operated by voice commands facilitate our day-to-day activities allowing us to automate almost every necessary appliance including lights, fans, air-conditioner, television sets, electronic doors, security cameras, audio/visual equipments, computer systems and so on. It decreases the adoption and learning curve for the end users and at the same time establishes an exclusive connection between the owner and product. We can turn on or off any device connected to a wall outlet or can get the status of different sensors like room temperature, weather report etc just by uttering few words. It may tell the user whether the printer is out of link or the milk has expired. The devices can also be enabled to respond to questions guided by voice commands, suggest based on logs of users view, access or save about movies, music or restaurants or take decision accordingly. Such devices can contribute to the facts regarding security issues too by reporting intruders or identifying irregular voice activity. In addition, the proportion of employment to population has significantly increased due to improved lifestyle. Voice activated electronic devices will broaden the area of employment opportunities to some extent in order to meet up the growing demand of sophisticated living manners. This paper focuses on voice enabled human interaction with intelligent devices to help build a secure and convenient environment.

The rapid growth of personal computers, internet, cellular phones and wireless technology makes it easy for us to remotely access and control home appliances. Lately people are thinking of running several electronic devices over voice commands such as television receiver, television monitor, stereo amplifier, cassette tape decks, video tape decks, compact disk players, laser vision disk players etc. The present era has witnessed a great deal of research and many solutions have evolved already. Few of them utilized internet or wireless technology to connect and handle home appliances. Other folks used Bluetooth as well as GSM technology.

Potamitis and his fellow co-authors [6] focuses on a speech-commanded electronic assistant installed in a personal computer which can control the interaction of a speaker and home appliances. As they selected a Generalized Sidelobe Canceller (GSC)-based adaptive beamformer, the assistant is supposed to receive commands and interact with the speaker in the presence of competing speaker, sound interference and stationary noises. The system is designed by studying the conversational attitude of people without applying voice separation techniques. Thus the paper is intended to construct a speech activated portal to complex devices to help users.

Anamul Haque [7] in his paper deals with controlling appliances based on timer and speech recognition. It demonstrated the design of an interface box that can be controlled by the computer by connecting to parallel port. The system architecture involves two units: a control unit and an interface unit. The author discussed timer option as well as voice control option to control the appliances. In the hardware design, they have shown how to interface a relay and AC load. This system can handle eight electric appliances. The software is implemented using Visual Basic 6.0 and Microsoft voice engine tools for speech recognition purpose.

Vytautas [8] presented a universal platform for the control of smart home environment designed for the people with physical impairment. It discusses about the possibility to develop a personal vocabulary to adjust the voice user interface to the voice of particular speaker. The major points of the proposed platform are scalability and universality. The author proposed a hybrid recognition approach which involves the idea of two recognizers: Microsoft Speech server with English engine and proprietary CD-HMM based voice command recognizer. These two recognizes work simultaneously and their outputs are combined to obtain the ultimate response of the system. Lithuanian recognizer is used to strengthen the decision of the adapted foreign language recognizer.

Faisal and his co-authors [9] described a system which controls the home appliances remotely. It talks about two ways of controlling home appliances: one is via voice to text SMS and another one is to use the mobile as a remote control. The system is developed to monitor the appliances by distance which simply requires running a mobile application in Android OS based mobile and providing voice command. The mobile application then transforms the voice command into text using android intent API 2.01 and transmits it to the GSM network. The system used Java for mobile, MPLAB for microchip family of controller and Bluetooth interface for wireless communication between home mobile and hardware control module. In the study they recommended a system that control electric appliance by means of voice commands when the user is in a distant area and it is also capable of handling appliances through home mobile.

Jia-Ren [10] suggested the control of home appliances applying Bluetooth technology. Author devised a remote control with a Keypad as an interface to a microcontroller. This is interfaced to Bluetooth module to give wireless interface for the remote to communicate with the appliances control module. If the key is pressed, the controller sends the signal regarding the pressed key via Bluetooth medium and the receiver receives the command on the receiver end and acts accordingly.

BLOCK DIAGRAM & ITS DESCRIPTION

The voice is the initiator in our system for all the further controls. The given voice commands will initiate the desired action. In our project we have employed only light, fan and TV, but theoretically any type and any number of electronic devices can be operated.

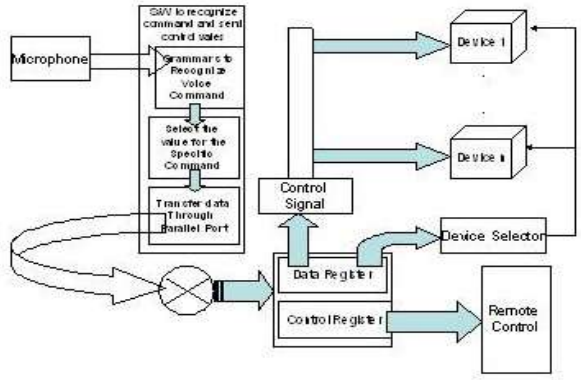

Fig-1: Block Diagram of Voice Activated Electronic Device Control System

So we can perfectly divide our system into two major portions, (i) Detection of the voice and (ii) Control the devices accordingly. In the first portion we receive the voice command in the computer with the help of microphone. Using Speech SDK [3] the command is detected. Then our software determines the value to be passed to the printer port to control the specific device. We can also control TV by changing the control register values. A remote control is used to control the television and we control the remote controller.

SHORT DESCRIPTIONS OF HARDWARE COMPONENTS

A. Opto-coupler: To separate the AC part of the circuit from the DC part, Opto-couplers are used.

B. ULN2003A: ULN2003A is the Darlington pair IC. It has 8 input-output pairs. A logic high input produces 0V output at the corresponding output line. It is used to supply the required high current in the control circuit.

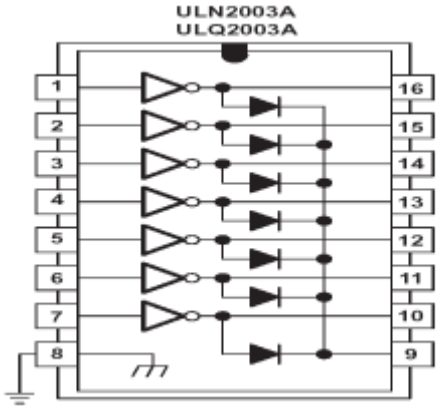

Fig. 2: ULN 2003

C. Solid State Relay: Relay is a kind of switch. It is commonly used in AC circuits and in many other circuits too. There are different types of relays like 6V, 12V etc. We used 6V relay. The relays have 5 pins, 3 at one side and 2 at the other. The middle pin of the 3 pin side is short with one of the pins at the 2 pin side. The logic is that, when the voltage difference between the other two pins of the 3 pin side is around 6V, the middle pin becomes short with the other pin (the one that was not previously short) of the 2 pin side, therefore the relay is on. The current rating of the relay we used was 7A at 240 VAC.

D. TV Control Circuit: We used the control pins (1, 14, 16 and 17) of the parallel port to control the remote control circuit. The 4 values were connected to the 4 selection pins of 74154 – the 4-to-16 decoder. Our motivation was to control 15 functionality of TV. So, that's why we used 74154. The outputs of the IC are connected to 6V relays.

E. Printer Cable: A printer cable is necessary to connect the computer parallel port [5] with the circuit.

F. 74244: 74244 is an octal buffer. It was used to increase the voltage level of the parallel port outputs, as they are very poor.

G. 74138: 74138 is a 3-to-8 decoder. Depending on the 3 selection bit value it outputs active low at one of the 8 output lines (0-7). The three selection bits were fed from the octal buffer a-output.

H. 74373: 74373 is an octal latch. Its property is that, when the enable pin is high, it passes the input data to output lines. Otherwise, it holds the previous value. A different 74373 was required for each device.

SOFTWARE IMPLEMENTATIONS

We have chosen C# to recognize voice command as well as passing data to port [4]. To accommodate this purpose we have also used (i) Microsoft Speech Software Development Kit, Version 5.1 [3], (ii) Interop.SpeechLib.dll [4] and (iii) inpout32.dll [1]

We have 3 C# Files in our project. The Main CS file uses a ListBox with commands for users to show and highlights the selected command. PortInterop CS File used to access the port using Inpout32.dll. Finally, SpeechListBox CS file implements a ListBox, builds grammar for command-text and handles events for the specific commands. We also used UserPort [2] to access parallel port in XP.

In the third CS file, most of the operations are done. Here the events are handled in a while loop. Depending on the command, particular case is selected. In each option the specific register is selected and the value is set to that register to perform the expected operation in the circuit. When the value is written to the port then we get our desired task performed in the circuit. When we need to operate television, we write in

the control register and when we need to operate other devices, we write in the data register. The register is differentiated with port number. Below we describe the pseudo code, values in data and control registers and a screen shot of the software.

Pseudo code: The steps that are used to control the home appliances using voice command are as follows:

1. Receive to the voice command.
2. Recognize the command.
3. Determine the register according to the command.
4. Write value to the data register if any of the 16 devices selected.
5. Write value to the control register if Television is selected.

Values in the Port:

Data register contains eight pins (D2-D9). We used four of them (D2-D5) for changing the status of the device. The status of the device is actually the intensity of the device. For fan status means speed and for light it is brightness. The more bits in D2-D5 are set, the more high status it will gain. The rest of the Data register (D6-D9) are used to select the devices. Suppose we want to select device0 with status level 2 then the value in data register will be 3 (00000011). We can actually use total 16 (2^4) status for each device.

Table -1: Values in the Data Register to operate any one of the 16 devices

Value	D7	D6	D5	D4	D3	D2	Task
	DeviceB	DeviceA	Status3	Status2	Status1	Status0	
							Device#1=Light
0	0	0	0	0	0	0	Level 0
1	0	0	0	0	0	1	Level 1
3	0	0	0	0	1	1	Level 2
7	0	0	0	1	1	1	Level 3
15	0	0	1	1	1	1	Level 4
Similarly using D9, D8, D7, D6 we controlled 2^4 devices. No of devices can be extended using more port pins							

Again, control register contains four pins. We used their combination, 2^4(=16) to control 15 operations since the 0 value in the control register is not used by us.

Table -2: Values in the Control Register to Operate television

		Value Supplied From S/W			
Value	A3	A2	A1	A0	Task
0	0	0	0	0	No Op
1	0	0	0	1	Channel Down
2	0	0	1	0	Volume Up
3	0	0	1	1	Future Use
4	0	1	0	0	Volume Down
5	0	1	0	1	Volume Off
6	0	1	1	0	TV On/Off
7	0	1	1	1	Channel Up
8-15	1	X	X	X	More Functions

Screen Shot of the Software:

Fig. 3 Screen Shot of Software

Specifications

1. The SI unit for magnetic field strength H is A/m. However, if you wish to use units of T, either refers to magnetic flux density B or magnetic field strength symbolized as $\mu_0 H$. Use the center dot to separate compound units, e.g., "$A \cdot m^2$." Parallel Port of the computer must be free to control the devices.
2. A microphone (wired/wireless) is a must. Wireless microphone will give more flexibility in giving commands.
3. Since the S/W is implemented using C# (MS .NET), so .NET framework is required

Challenges FACED AND ADOPTED SOLUTIONS

The difficulties we faced include the fluctuation of voltage. As we needed two DC voltage source, one is of 5V and another is of 6V, we used to work in the labs most of the time rather than home. We got the 6V from the variable voltage sources from trainer board to operate our 6V relays. But often it used to happen that, at the time of our working, the variable voltage was varying too much. Sometimes it used to go below 5V and was not sufficient to turn on the relays. So, we used to increase the voltage at 6V. A bit later, the variable voltage used to automatically increase and the relays were not getting off. Then we used to again check the voltage and often found it was above 7V. So, we decreased the voltage.

One of the major challenges the proposed method could face is natural language processing. Natural language processing (NLP) is a component of artificial intelligence (AI) which can be defined as the ability of a computer program to recognize human speech as it is spoken. The development of NLP applications throws up some interesting computational challenges because computers traditionally require humans to speak to them in a language that is precise, unambiguous and highly structured or perhaps through a limited number of clearly-enunciated voice commands. Spoken language, however, is not always precise. It is often ambiguous and the linguistic structure can depend on many complex variables, including slang, regional dialects and social context. Additionally, voice activated electronic devices may prove distracting. Sometimes it misunderstands words and commands which results into cursing the system out.

Another issue can be the effectiveness of the voice recognition software and embedded speech engine. It includes the risk whether it can possibly produce the appropriate sound levels to voice recognition software consistently, volume to achieve proper sound pressure levels without reflection or loss and clarity to provide the speech engine the intelligible dialog required in order to identify commands. One of the primary factors that put restrictions on the design of the system is the limitations of associated algorithms. If the speakers move while talking among many potential speakers, non-desired speakers or music produce non-stationary interference. Such interference displays similar statistical characteristics as the signal of the desired user does.

Privacy and security is another issue that we will have to wrestle with. For example, if voice recorded in a certain period by a microphone at home is stored somewhere in the cloud, the information may be accessed. It will be then difficult to specify the potential ramifications. Or someone may gain unauthorized access to home audio database to see whether the home is empty. Similar concerns have been raised regarding the proposals for devices with automatic content generation. Therefore, there are serious legal and technical aspects in the domain of personal data management problems. Thus the proposed method demands user's authorization and right to securely maintain or delete logs of conversations or contents added automatically to the database.

CONCLUSION

This is really a very interesting and useful project. It is suitable for internal use. But our software must be run before the appliances can be controlled. Therefore, the computer must remain on. We can make the computer voice activated also, so that one can turn on the computer, run any or at least some common programs like text editor, PowerPoint, browser and obviously our software of controlling home appliances. It would be the best if the project becomes microcontroller based. This is our future expansion plan of the project. It could then be a most popular commercial product.

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