



VOICE ENABLED DEVICE SWITCHING FOR PHYSICALLY CHALLENGED AND EMERGENCY ALERTS THROUGH SMS

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ABSTRACT

The project develops device switching via voice commands. Therefore, the focus is on device switching and controlling GSM modem to send SMS in case of emergency, all controlled by voice commands. To be specific, there are three main objectives in this project. First of all, to design and construct a voice enabled device switching system to assist physically challenged and elderly people. Secondly, to control the electrical devices like light, fan, etc. with the help of voice recognition system. Finally, to provide a communication mechanism between the user and the predefined number through SMS messages via GSM modem in case of emergencies. The method used during the development of the system involves use of Visual Basic 6.0 (V.B.6.0) and Microsoft Speech API to detect commands, RS232 serial port to receive and transmit data from a computer, and PIC16F877A to control relays. As a result, there are four sets of coding involved, i.e C coding, V.B.6.0 coding to create GUI, coding for GSM and HTML in V.B. 6.0. Although many systems have been developed that use voice recognition such as voice enabled wheelchairs, voice enabled home loads and many more, they do not provide monitoring ability. In this project the user has the ability to monitor the loads and security system through HTML from anywhere, using any device, as long as they are connected to the same network, which will be explained in more details.

Keywords: voice command recognition, home device switching.

INTRODUCTION

This paper includes details of Voice Enabled Device Switching system. The project focuses on device switching and controlling GSM modem all by voice commands, which is a great help to those with disabilities and elderly people. The project also provides monitoring abilities through HTML files. Throughout the paper there will be discussions over technical preparations, system design, system's accuracy, as well as limitation of the system. Therefore, there will be short explanations about main blocks of the system such as GSM modem, Windows Speech API, HTML file and etc. and then the systems overall function will be reviewed.

PROJECT DEVELOPMENT

Project background

Speech recognition, which is also used in domestic automations, was first predicted in 1976 by Reddy Boldly. He predicted that in 10 years from 1976, connected speech systems will be built with the cost of \$20,000. Although the system was eventually built, it was not built within the expected time frame and its costs were much lesser than predicted. This technology has been improving every day, and the costs of it have been decreasing in turn, up-to the point that in today's life speech recognitions can be used in most smart phones and even laptops, with no extra charges. Speech recognition is one of the best advancements that will be center of attention in any field imagined due to its simplicity to use and affordable cost. Since speech recognition is the most natural way of interaction, it can be used in any system. We might witness a lot of machines, home appliances, robots and etc. fully functioning with voice commands, in

the near future. Although a lot of advancements are achieved, there is still a lot more that can be done in this area (Baker, J., Reddy, R., and Huang, X., 2014).

Many systems have been developed through years, that use voice recognition such as voice enabled wheelchairs, which focuses on implementing smooth control for computerized systems through humming (Peixoto, N., Ghaffari Nik, H., and Charkhkar, H., 2013). But non of these systems provide monitoring ability that this project has.

This project focuses on device switching by voice commands, which is a great help to those with disabilities and elderly people. This system will give them an opportunity to live as autonomously as possible in their own house. They will have the ability to switch ON or OFF all their home appliances from anywhere in the house by voice commands while monitoring them and even send Short Message Service (SMS) messages in case there is an emergency, to predefined numbers, also controlled by voice commands.

The project consists of several main blocks that do essential tasks in the project. Voice recognition, Automatic Speech Recognition engine (ASR), Text To Speech engine (TTS), Global System for Mobile communication (GSM modem), voice activated Graphical User Interface (GUI), and Hyper Text Markup Language (HTML) are the most important ones.

Speech recognition

Speech recognition is basically translation of spoken words into text, in computer science point of view. The main two engines running speech recognition in Microsoft speech are automatic speech recognition (ASR) and Text To Speech (TTS) (Alshueili, H., Sen Gupta, G.,



and Mukhopadhyay, 2011). There are two types of speech recognition: 1- Speaker dependent 2- speaker independent. In the first type the system only responds well to the individual who trained the system and there is a wide range of words that can be detected. This type of recognition can be used for security systems and personal computers that work with voice recognition. The second type works based on the words detected and does not depend on the individual who gives the commands. Although in this type the number of words that can be recognized is less, it can still be as accurate as the speaker dependent systems. Speaker independent systems are mostly used in industrial requirements such as AT & T system in telephone system (Ayres, T. and Nolan, 2005), (Dua, 2010).

GSM modem

A Global System for Mobile communication (GSM modem) is a type of specialized modem, which you can insert a SIM card in it to operate over a subscription to a mobile operator. In other words, it is a digital cellular that has the ability to send SMS messages just like a mobile phone. It can also be connected to the computer to communicate over mobile network by the control of the computer. Consequently the user can send SMS and Multimedia Messaging System (MMS) using their computer over a mobile network. GSM modem can be used in many applications and projects to remote control the system or to send SMS messages (Xuemei, L., Qiuchen, Y., Wuchen, W., Xiaohong, P., and Ligang, 2010), (Jin, S., Jingling, S., Qiuyan, H., Shengde, W., and Yan, 2007).

HTML file

Using Hyper Terminal Markup Language (HTML), gives the user the ability to insert multimedia contents such as pictures, sound, animation, and etc. with a high quality user interface (Andric, A., Devedzic, V., and Andrejic, 2005).

One of the most common approaches to deploy a Web-enabled ES is the HTML-CGI architecture. In this architecture the user interacts with HTML entry forms in a Web browser, meaning the information entered by the user is sent to the Web server, which forwards them to the Common Gateway Interface (CGI) program that replies with new HTML pages. In other words the user only interacts with it using a standard Web browser and all the expert functionalities reside on the server side (Andric, A., Devedzic, V., and Andrejic, 2005).

SYSTEM OVERVIEW

The main actuator of the system is firstly Visual Basic and then PIC16F877A. V.B controls most of the software and PIC16F877A controls most of the hardware. These two are equally important to the system.

V.B.6.0 output is the input to the PCB circuit, which is controlled by the PIC16F877A. Fig. 1 shows the block diagram of the software part of the project and Fig. 2 presents the hardware part of the project.

As presented in Figure-1 and Figure-2, the command is given to the personal computer using microphone, it is processed by the help of Microsoft Speech API and Visual Basic and transferred to the PIC16F877A via RS232 and MAX232 to control the relays. There are four loads, two inputs (magnetic switch and temperature sensor), and a LCD connected to the PIC16F877A. HTML and GSM module are also controlled by V.B.6 to do specific tasks assigned to them.

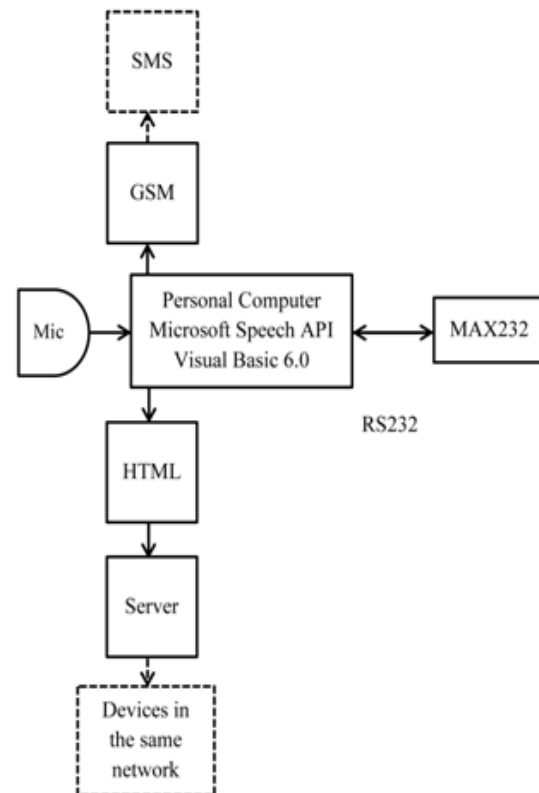


Figure-1. Block diagram of the input system.

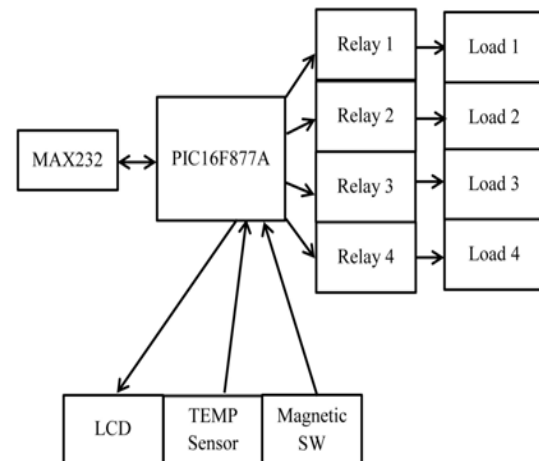


Figure-2. Block diagram of the output system.



SOFTWARE DESIGN

Software development of the project is done using two softwares, Visual Basic 6.0 software and MikroC software. V.B.6.0 consists of coding related to GUI, HTML, and GSM, while MikroC is used for C programming of the microcontroller.

Visual basic 6.0

One of the vital capabilities of V.B.6.0, which is used in the project, is the use of Windows API, which consists of two main engines, Automatic Speech Recognition engine (ASR) and Text To Speech engine (TTS) (Gnanasekar, A.K., Jayavelu, P., and Nagarajan, 2012). To use Windows API, the user has to have external function declarations. In addition, coding of HTML file and GSM module is also in V.B.6.

GSM

The GSM system, which is also controlled by voice commands, has two buttons in GUI: 1- Alert Fire. 2- Alert Police. After the commands are given to the personal computer via microphone and detected, V.B.6 sends the particular coding (AT commands) including predefined number and the message through COMPORT of the personal computer to the GSM and the message will be sent out from GSM side. Below is the AT command example to alert fire.

```
Private Sub Command10_Click() 'Alert Fire
If Check3.Value = 1 Then
MSComm2.Output = "AT+CMGF=1" 'Initialization
For Y = 0 To 30000000 'Delay
Next Y
MSComm2.Output = Chr$(13) 'Reset device's position
For Y = 0 To 30000000
Next Y
MSComm2.Output = "AT+CMGS=" 'Send number
MSComm2.Output = Chr$(34) ""

MSComm2.Output = "0178768940"
MSComm2.Output = Chr$(34) ""

For Y = 0 To 30000000
Next Y
MSComm2.Output = Chr$(13)
For Y = 0 To 30000000
Next Y
MSComm2.Output = "Alert Fire" 'Send message
For Y = 0 To 30000000
Next Y
MSComm2.Output = Chr$(26)
End If
End Sub
```

HTML file

HTML file is generated and updated by V.B.6. It presents the status of all the loads, temperature, intruder status, date, and time. These can be checked using any device as long as the particular device has the same network as the server. The server basically makes the

HTML file generated by V.B.6 available for view through internet.

Hardware design

The PCB basically receives inputs from V.B.6 to control the relays accordingly. It also sends the values of magnetic sensor and temperature sensor to the personal computer to be displayed in GUI and HTML. Its final function is to update the status of loads and temperature on the LCD screen.

RECOGNITION ANALYSIS

An analysis over number of correct recognitions for each command being said was done. 10 people from 5 different countries said each of the 8 commands 10 times and the number of correct recognitions by system was recorded. Therefore, each person in total gave 80 commands to the system, which means a total of 800 commands were given to the system. The number of correct recognitions was 618, which is equal to 77.25 %.

Figure-3 shows the percentage of correct recognition versus commands. By looking at the graph, it can be observed that as the commands are being given to the system, the percentage of correct recognition is improving. So we can see that the first commands given to the system have the lowest overall percentage of accuracy. From the other side, the final commands have the highest percentage of accuracy. Although there is a fall in the correct recognition of the system at the two commands before the last command, the system's accuracy is still improving. This proves that, as the commands are being given to the system, the system keeps on updating itself and adapting to the accent of the users no matter the accent. As a result by saying a command for approximately 10 times, the system can recognize the command much better.

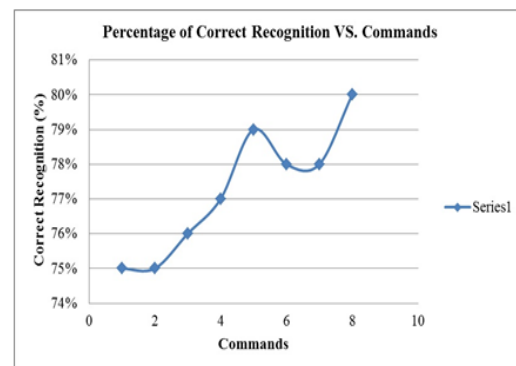


Figure-3. Percentage of correct recognition.

Other results gained from the analysis are, firstly, the system's respond to the person who has trained the system is approximately 10% to 18.75% higher than someone else with a new accent and second, system can be affected by factors such as accent, but as mentioned earlier it still improves its accuracy by adapting to the accents after the commands have been repeated a few times.



LIMITATION

The system has limited ability to function perfectly in noisy places, as the noises can interrupt the functionality of the voice recognition. Consequently the system might detect wrong commands. Although in such cases the microphone can be turned off during the time that the system is not being used to avoid issues, it can still be consider as a limitation.

RESULTS AND DISCUSSION

The outputs are generated with respect to the voice command given to the personal computer with a relatively high accuracy. The status of loads are correctly displayed on the LCD, HTML file read by the browser, and GUI itself. The GSM modem sends SMS to the provided numbers in case of emergency commands. The temperature sensor's value is correctly displayed on LCD, GUI, and HTML file. And finally, the intruder sensor status is correctly shown in GUI and HTML file

What is more, recognition analysis was taken place to analyze the effects of factors such as accent on the system's accuracy. It also evaluates the systems overall percentage of correct recognition as the system is trained. The overall accuracy achieved is approximately 77.25%.

Figure-4 presents the GUI designed for the project to provide a man-machine interaction and Figure-5 presents the HTML file read by web browser.



Figure-4. GUI of the system.

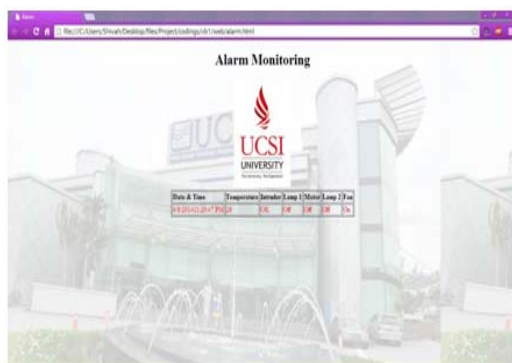


Figure-5. HTML file read by the web browser.

CONCLUSION AND FUTURE WORKS

Voice enabled device switching system was designed and satisfactory results and outputs were achieved. The project is a user friendly and cost effective system to help physically challenged, elderly, and disabled people.

There are a few upgrades that the system can have. Firstly is to use a System on Chip (SOC) Integrated Circuit instead of personal computer. Secondly is to connect the loads to the controller circuit and to the personal computer wirelessly. Lastly is to program the system to control the loads using any device that is allowed such as smartphones.

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