



Mobile Voice Recognition Based for Smart Home Automation Control

Mohammed Akour¹, Khalid Al Radaideh², Ahmed Shadaideh³, Osama Okour⁴

¹Al Yamamah University, Saudi Arabia, m_akour@yu.edu.sa, mohammed.akour@yu.edu.jo

²Qassim University, Saudi Arabia, kh_radaideh@yahoo.com

^{3,4}Yarmouk University, Jordan, osama.okour9117@gmail.com

ABSTRACT

Home automation is a technology that can help normal, elderly, or even disabled users in controlling electrical appliances in a house by utilizing his/her voice. Home automation could facilitate their life especially if they need caregivers and continuous attention. This research designs an entirely useful system that has the ability to recognize the human voice and differentiate between his/her commands. This research also seeks to design and implement a voice based system that helps users to operate the electrical appliances at home via utilizing android mobile phones. Using android mobile phone in controlling the electrical appliances could provide several benefits to divers users such as system security where the system can validate specific voice that belongs to the system owner, accessibility where the system can be used by people that have disabilities as (blinded, deaf, dumb). To demonstrate our approach, we have developed a prototype where an Android smart phone is used as speech based remote control that allow customers to control doors, light, and subwoofer remotely.

Key words: Smart Home Automation; Android OS; Raspberry pi

1. INTRODUCTION

Smart home automation is getting pervasive gratitude due to the expediency it provides to the community. Smart home automation allows centralizing the process of managing and controlling several home parts such as lighting, heating, ventilation and air conditioning, appliances, etc.

Smart home voice based control systems allow home residents to wirelessly control any electrical appliances that can be configured to operate virtually. As real example, the home light system can be controlled by using voice command recognition where then can be translated to turn on, turn off, or set the levels of different rooms lights. Moreover, the smart home security system can configure to be controlled based on voice recognition system to activate

and deactivate the alarm system. Even the TV channel can be changed using the voice based system in the smart home.

The proposed project attempt to implement a system that will overcome the disadvantages of traditional system in speech recognition based in controlling houses. In our project, it will be possible to run any system from any place using a single voice command. The use of voice recognition provides a significant increase in security, emulating an individual's voice is much more challenging, and need the use of modern communication technology.

Designing and building smart home automation embedded advanced technologies [9]. The new technologies create homeowners or smart company owners convenient relaxing or working environments that provides remote or automatic control of home and company devices and appliances [4]. Different users could add new challenges of building automation control of the targeted products [3]. Akour et al. [15] in order to build smart museum system to control the lights in the museum, they utilize set of thermal sensors that detect the presence of humans, DC LED spotlights, Arduino boards and Zigbee modules for a wireless communication to send data to a server. The proposed system was able to achieve the targeted goal behind this smart system.

Most of the current research aims to introduce robust and effective systems that would be much more capable to deal with the variance of language, speakers, and environment. Android is a software stack for mobile devices that includes an operating system, middleware and key applications. Android boasts a healthy array of connectivity options, including Wi-Fi, Bluetooth, and wireless data over a cellular connection (for example, GPRS, EDGE (Enhanced Data rates for GSM Evolution), and 3G) [8].

Android provides access to a wide range of useful libraries and tools that can be used to build rich applications. In addition, Android includes a full set of tools that have been built from the ground up alongside the platform providing developers with high productivity and deep insight into their applications [8].

We conducted an initial investigation and noticed while this new architecture is growing in both research and industry in the modern world, little knowledge or progress is shown in our area (Middle East). We hope that we can take the lead in establishing the first (to the best of our knowledge) Smart Home voice automation application. The main objective of our project is to design and implement an automation operator system, which will receive voice commands (such as "open", "close", "running light "...etc.) through a mobile application, and the corresponding action is carried out. The mobile application will transform the voice command into written command, and then transmit it to the raspberry pi which will understand this command and execute the specific order.

The proposed project could provide the following benefits to the community

- System security: the system can validate specific voice that belongs to the system owner.
- Ease of use: the system can respond to single voice command.
- Accessibility: the system can be used by peoples that have disabilities as (blinded, deaf, dumb).
- Replacing human's operators in tasks: that involves hard physical or monotonous work.
- Replacing humans in tasks can be performed in risky domains (i.e., fire, space, volcanoes, nuclear facilities, etc.).
- Executing missions that need excessive human capabilities of size, speed, endurance, etc.

2. RELATED WORKS

Michel Vacher *et al.* [14], system, presented an audio processing module called PATCH. The proposed approach allows real-time reorganization of voice instructions to control what they called it SWEET-HOME. They evaluated their approach in a realistic Smart Home with three user groups: seniors, visually impaired people, and people with no special needs. Results showed how PATCH approach worked properly for people with special needs.

Arthi *et al.* [1], utilized LabVIEW software in speech recognition for home automation to switch lights ON/OFF. Their simulation experiments measured the speed of any appliances respond. The result demonstrated how their system recognizes the input commands and responses achieved with a voice recognition accuracy of 95%. Based on this result, they inferred that their system can be employed in electrical appliances like fan, fridge, air conditioner, television, etc.

Faisal *et al.* [5] developed mobile application that allows controlling home appliances through voice instructions. The application tries to transform the user voice orders into SMS and send them via GSM network which increases the software complexity.

Thoraya *et al.* [13] illustrated a home automation system for elderly and disabled people. To recognizing the voice command LabView software is utilized and in order to develop the wireless system ZigBee wireless modules is utilized. The proposed system has been tested with three home appliances.

Y.Usha *et al.* [2, 7] developed Wireless Home Automation System to control all electrical appliances at home. After recognizing the human voice instructions, they utilized low- power Zigbee wireless communication modules to control the home appliances. Anamul Haque *et al.* [6] employed microcomputer PC to control home appliances. They articulate two approaches to control the home appliances i.e., timer option and voice command. Moreover, many researches that addressed developing smart systems utilize Arduino, Zigbee, and raspberry pi devices to read inputs - light on a sensor, a finger on a button, or a Twitter message or in building facial and voice recognition model [16, 17, 18].

3. RESEARCH METHODOLOGY

Smart Home voice based controlling system aims to provide home automation and housework daily activities. These activities might include controlling home lighting, home theater system, and other systems, in order to enhance the convenience, comfort, energy efficiency and security. Further, elderly and people with disabilities will get benefits from the home automation system by enriching quality of their life; otherwise they might require caregivers in institutional care.

The product we are going to build will not be costly in comparison with benefits that are going to provide to the home building industry. Initially, as a commercial product, the proposed project would introduce a system that could allow customers to control the following remotely:

- Doors: open or close the door via single voice command.
- Lights: turn on or off the lights.
- Subwoofer: connect subwoofer and control it using raspberry pi through 220V.

2.1 System Design

Figure 1 shows the system design overview. From the top left in the User speech input phase; the user speaks a command into the mobile application, then, the mobile receives the command as an analog signal and transmit it to digital one to understand it. Microcontroller Raspberry pi receives a digital input from the mobile application, and uses the information to determine the course of action. In

the case of “turn on” or “open the door”. etc., the raspberry pi activate the sub systems via digital signal (to allow the system to powered) only. Otherwise, the raspberry pi sends a digital signal to the any system we want to control, other systems can control also by using raspberry pi.

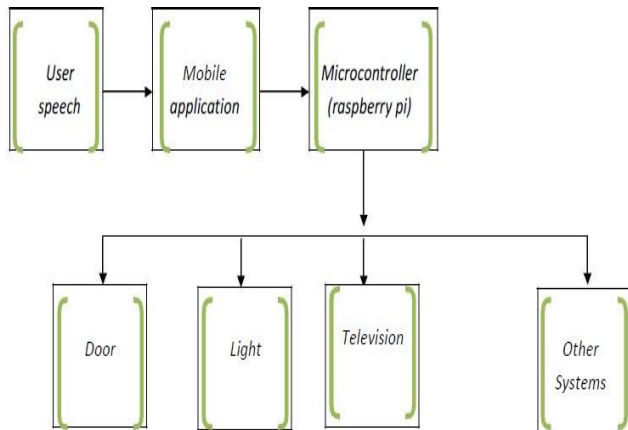


Figure 1: System Design Overview

Voice Recognition demonstrates the ability of a device or program to determine a voice tag of specific person and turn them into machine-readable form. Voice recognition technology is used for audio input to complete a specific task, rather than using buttons or keyboard, it’s talking through a mobile.

The terms “speech recognition” and “voice recognition” are sometimes used interchangeably. However, the two terms mean different things; speech recognition is used to identify words in spoken language, while voice recognition is biometric technology used to identify a particular individual’s voice.

First, the mobile will receive an analog signal and convert it to digital one using Digital Signal Processing (DSP). The goal of DSP is to measure, filter, and/or compress continuous real – world analog signals. It converts the signal from analog to a digital form, by sampling it using an analog-to-digital converter (ADC), which turns the analog signal into stream of numbers. The applications of computational power to digital signal processing have many advantages over analog processing in many applications, such as error detection and correction in transmission as well as data compression. [11]

The mobile application used to exchange data from digital signal to written words which can be used to understand the command and do it. Raspberry pi is a small computer sized as a credit card “measures 85.60mm x 56mm x 21mm, and it weigh 45g”. It was developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching methods of basic computer science in schools. Figure 2 shows the Raspberry Pi.



Figure 2: Raspberry Pi

2.2 System Configuration and Operation

Figure 3 reveals the most required hardware and software for developing the proposed system.

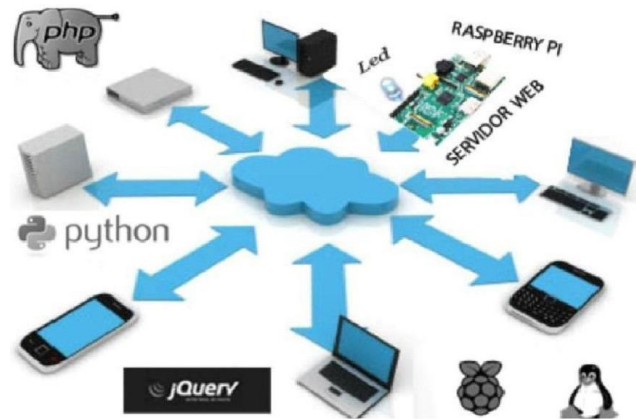


Figure 3: System Hardware and Software Requirements

The Raspberry Pi will be a server, while all other devices connected to the Internet cloud are what run the client-side application.

We used Python as powerful programming language to implement our system. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python’s elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms [10].

Figure 4 shows the physical configuring of the Raspberry after installing RASPBERRY PI RASPBIAN supported operating system on the memory. After placing in Raspberry PI, the Raspberry Pi could be connected by using HDMI to a TV or monitor, also connect a keyboard and mouse USB, the source voltage 5 Volt - 2 Amps, and finally connect the Ethernet cable.

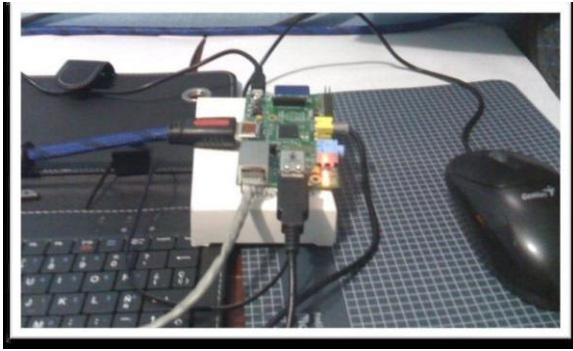


Figure 4: Raspberry physical Connection

In order to control the Raspberry Pi through SSH without having connected TV or monitor with HDMI input, we have to identify local IP, assigned to the Raspberry Pi, by utilizing this a program called Advance IP. The PUTTY program will be used to establish a connection with the Raspberry Pi via SSH. Figure 5 shows how it will work on Raspbian without being connected to a TV.

- 1- Checking phase: if the order is asking for something is already done (i.e., if the order is to open the home door) the system will double check if the door is already opened.
- 2- Action phase: If the door is already opened; another script will run a recorded voice “ the door is already opened “, but if the door is closed the answer will be “ the door is opening “ along with performing the action.
- 3- The previous phases are applied for lighting home orders.

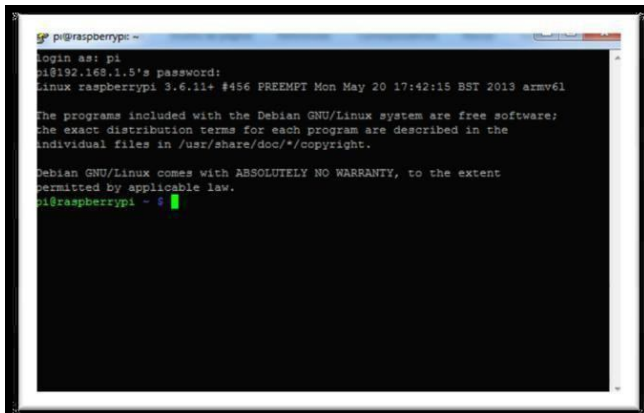


Figure 5: Raspberry Pi via SSH

We perform several experiments on lights and doors, our prototype provide promising result in the area of voice home automation.

As a forward step the APACHE server with PHP and MSQL should be installed and configured, this done by SSH connection throw port 22.

Directories typically used by a web server in linux are located in / Var / www, and the typical user for this environment is often www-data. We create the group and standard user to our server, at the same time grant the necessary permits and add it to the default user. Python provides a library that’s allowing us to interact with the GPIO pins.

4. RESULT AND DISCUSSION

The result of this research is the creation of a fully functional voice recognition home automation system that receives voice commands (such as "open", "close", "running light "...etc.) through a mobile application, and the corresponding action is then carried out.

Converting the voice command to text command is done by utilizing Voice to text Google Api which is a plug-in with Tasker application [12].

Tasker [12] passes the converted text command into similarity matching mechanism, the technique based upon finding key words in the statement such as (light on, light off, door close etc.). Then Tasker creates an order to take desired action in which HTTP passes the request to the Raspberry Pi server.

Depending on the HTTP carried requests from the Tasker, the Raspberry Pi will run specific scripts. These scripts are implemented using Perl language, the android system and the Raspberry Pi must be connected by the same Network.

5. CONCLUSION

We introduce a new contribution in the area of home automation. There are several works as mentioned in the related works section in the area of voice home automation and speech recognition. From the efficiency side, we produce system that is able to recognize human speech with high accuracy, and respond to the voice order in a properly manner. From the commercial side, we expect that the proposed system will not be expensive in comparison with the commercial product in the market. The proposed system could be extended to serve elderly and disabled people; so that they can monitor and control the home appliances.

REFERENCES

1. Arthi.J.E, M.Jagadeeswari, Control of Electrical Appliances through Voice Commands, IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 9, Issue 1 Ver. PP 13-18, Feb. 2014
<https://doi.org/10.9790/1676-09151318>
2. Arul, S. Benjamin. "Wireless home automation system using zigbee." International Journal of Scientific & Engineering Research 5.12 (2014): 133-138.

3. Dhananjay V. Gadre, Programming and Customizing the AVR Microcontroller, TMH Edition-2003.
4. Dutta, Kailash Pati, Pankaj Rai, and Vineet Shekher. "Microcontroller based voice activated wireless automation system." VSRD International Journal of Electrocal, Electronics & Communication Engineering 2, pp. 642-649, 2012.
5. Faisal Baig, Saira Beg and Muhammad Fahad Khan, "Zigbee Based Home Appliances Controlling Through Spoken Commands Using Handheld Devices", International Journal of Smart Home Vol. 7, No. 1, pp. 19-26, Jan 2013.
6. Haque, S. M., S. M. Kamruzzaman, and Md Islam. "A system for Smart Home Control of Appliances based on timer and Speech Interaction." arXiv preprint arXiv:1009.4992 (2010).
7. Hwang, Il-kyu, Dae-sung Lee, and Jin-wook Baek. "Home network configuring scheme for all electric appliances using ZigBee-based integrated remote controller." IEEE Transactions on Consumer Electronics 55.3 (2009): 1300-1307.
<https://doi.org/10.1109/TCE.2009.5277992>
8. Jakhete, Mayur D., and Piyush C. Mankar. "Implementation of Smart Restaurant with e-menu Card." International Journal of Computer Applications 119.21, 2015.
<https://doi.org/10.5120/21361-4374>
9. Park, Sang Hyun, et al. "Smart home—digitally engineered domestic life." Personal and Ubiquitous Computing 7.3-4 (2003): 189-196..
10. Python, <https://www.python.org/doc/>, Access on April 2019.
11. Sophocles J. Orfanidis, Introduction to Signal Processing, Prentice Hall, Inc., Upper Saddle River, New Jersey, 1996.
12. Tasker, <http://tasker.dinglich.net/> Access on April 2019.
13. Thoraya Obaid, Haliemah Rashed, Ali Abu El Nour, Muhammad Rehan, Mussab Muhammad Saleh, and Mohammed Tarique, ZIGBEE BASED VOICE CONTROLLED WIRELESS SMART HOME SYSTEM, International Journal of Wireless & Mobile Networks (IJWMN) Vol. 6, No. 1, Febr. 2014.
14. Vacher, Michel, et al. "Experimental evaluation of speech recognition technologies for voice-based home automation control in a smart home." 4th Workshop on Speech and Language Processing for Assistive Technologies. 2013.
15. Akour, Mohammed, et al. "Smart Lighting Controlling System: Case Study of Yarmouk University Museum." Information Technology-New Generations. Springer, Cham, 2018. 667-673.
https://doi.org/10.1007/978-3-319-77028-4_85
16. Victor Osamor, Onyeka Emebo, Barka Fori, Moses Adewale,, Engineering and Deploying a Cheap Recognition Security System on a Raspberry Pi Platform for a rural Settlement, International Journal of Advanced Trends in Computer Science and Engineering Volume 8, No.6, November – December 2019
<https://doi.org/10.30534/ijatcse/2019/36862019>
17. Olatunji K. A., Oguntimilehin A., Adeyemo O. A., A Mobile Phone Controllable Smart Irrigation System, International Journal of Advanced Trends in Computer Science and Engineering, Volume 9, No.1, January – February 2020
<https://doi.org/10.30534/ijatcse/2020/42912020>
18. Khalid Jamal Jadaa, Latifah Munirah Kamarudin, R. Badlishah Ahmad, Waleed Noori Hussein, Multi Objects Detection and Tracking System for Smart Home using Wireless Sensor Network , International Journal of Advanced Trends in Computer Science and Engineering, Volume 8, No.5, September - October 2019