

SPEECH BASED HOME AUTOMATION SYSTEM WITH USER AUTHENTICATION

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Abstract: - Generally, most of the home appliances nowadays, are controlled by switches and remotes. Also, one need to be near the switchboard to access those appliances. Not only this, it is tough for the handicapped, especially abled or elderly people to access the switchboards which are at some height. So, in order to solve all these issues, we have implemented a home automation system based on human speech using IOT (Internet of Things). Also, Desktop application is provided for registering new user with multiple voice samples and removing the existing user and to access the devices in case the user is not in system's range.

Index Terms - IOT, Voice Automation, Speech Recognition, Speaker recognition

I. INTRODUCTION

Nowadays, most home appliances such as TV, light bulbs, and air-conditioners are controlled by switches or remote controllers manually. In order to control switch-based appliances, a user must be near the switches. To overcome this inconvenience, there have been many researches to use human speech to control home appliances [5]-[6]. One need to go near the switchboard, press the switch to Switch ON/OFF the desired appliance. Now, imagine a house with elderly/handicapped people who are not able to reach to the switch easily. In such cases, this switch or remote technique becomes a burden for them. So, in order to help such people and to make their life even easier, we implemented a home automation technique which is based on the person's voice. The person must speak out the command switch ON/OFF. Along with voice technology, a Desktop Application is provided using which the house owner can add/remove the access of any person to these appliances. This application also provides the user some manual switch buttons by which he/she can access the appliances when he/she is out of the system's range. In order to achieve this, we are making use of a very commonly used technology called IOT (Internet of Things). It is an internetwork of physical devices which communicates with each other and process according to the information being shared. There are various ways to interact with the home automation system like: using sensors, various body gestures or by using a person's biometrics like retina scanning, fingerprint or by human voice.

In this system, we are using human voice to control the home appliances. The entire voice control system is divided into 4 modules: Speech Detection, Speaker Verification, Voice Recognition & Command Execution. Along with voice control, we are also providing a desktop application to add/remove the authenticated users who can access the voice command.

Home automation means controlling of home functions and features automatically and controlling the home appliances using voice commands provides accessibility, comfort, energy efficiency, security by providing control and monitoring of appliances, security surveillance.

II. LITERATURE SURVEY

This paper provides a simple introduction to the IoT, its application and potential benefits to the society [1]. IoT has received much attention from scientists, industry and government all over the world for its potential in changing modern day living. IoT is envisioned as billions of sensors connected to the internet through wireless and other communication technologies. The sensors would generate large amount of data which needs to be analysed, interpreted and utilized [2]. Internet of Things is a concept where each device is assign to an IP address and through that IP address anyone makes that device identifiable on internet [3]. Gadget controlling by switch or remote is old idea now. We can control any home apparatuses by utilizing our voice. The fundamental point of this venture is to control light, fan, AC and so forth utilizing human voice. The benefits of utilizing a voice interface as a medium are perpetual. As a matter of first importance we would get rid of or altogether lessen the requirement for preparing in working the innovation. Also, the appropriation of innovation administrations for disentanglement would prompt to a more extensive and more fluctuated access to a similar innovation would help individuals with incapacities. [4]

III. PROPOSED SYSTEM

3.1 Block Diagram of Proposed System

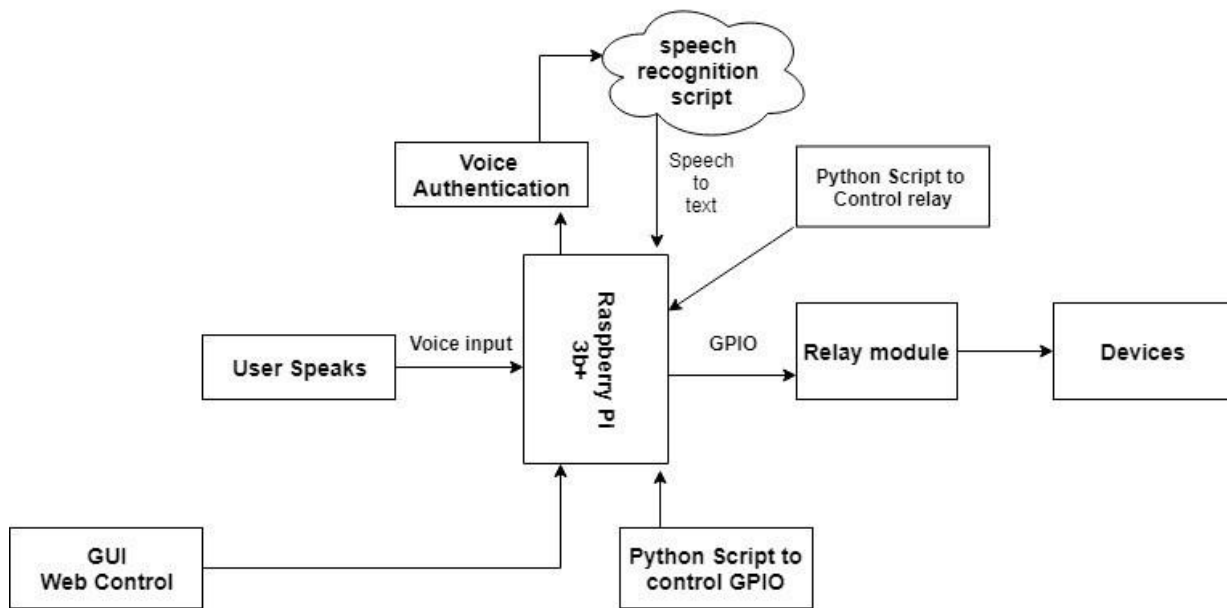


Fig 3.1: Block diagram of proposed method

As shown in the figure the circuit is designed around microcontroller unit. Here the Heart beat sensor is used to sense heart rate if above normal rate 75. The user can press the panic button in case of emergency situation then the GPS collects the data and uses GSM to send the messages to saved phone numbers of relative and police. We have another defense like Shock, it gets activated by pressing shock button.

3.2 Implementation (Hardware)

1. Raspberry pi 3 b+: A Raspberry pi is a small credit-card sized single-board computer which was developed in United Kingdom during by the Raspberry pi foundation. It features a Broadcom SoC (system on a chip) with an integrated ARM-Compatible Central processing unit and an on-chip graphics processing unit. The speed of the processor ranges from 700 MHz to 1.4 GHz and the on-board memory ranges from 256 MB to 1 GB RAM. This small credit-card sized minicomputer contains various i/o ports, 4 usb ports. For video output, HDMI and Composite video are supported, with a standard 3.5 mm jack for audio output. It also contains an 8P8C Ethernet port with an on-board 802.11n wi-fi and a Bluetooth modal for the internet connectivity. The whole system works on a Raspbian OS which must be mounted on this system using a Sd-Card.



Fig 3.2.1: Raspberry Pi 3b+

2. 5V Relay: A Relay is an electrically operated switch being used for remote access devices. It is a separate device which will be connected to the raspberry through short wires to access the required devices. It either works electro-mechanically or electrically. It is basically a switching device which change the state of a circuit when required on the passage of voltage. In simpler words, relay is used to connect the raspberry pi to the home appliances as it acts like a switch. One relay can connect to one device at a time.



Fig 3.2.2: A Relay Module with four 5V Relays

3. 3D Sound Card Adaptor: In our project, we are using a Quantum QHM623 sound card is used. It is an external sound card used to generate audio files for the computer or record outside voice and convert it into the streams of 0's and 1's. This sound card contains two 3.55mm jack out of which, one is for microphone and other is for any output audio device. The microphone is used to take the voice from the outside world and change it into the bits form. Basically, every computer has an inbuilt sound card in it so that we can hear the videos or to record the voice samples.



Fig 3.2.3: USB Sound Card

3.3 Implementation (Software)

- Tkinter:** Tkinter is a python binding for the Tk GUI i.e. it is a python module for the Tk GUI toolkit. It is an inbuilt GUI library in the various versions of python. Also, it is one of the most powerful GUI building options provided by python. The main reason for Tkinter being so much powerful is that it provides a fast, easy and object-oriented way to create a GUI.
- Sqlite3:** Sqlite3 is a Relational database management system (RDBMS) which mainly uses PostgreSQL syntax. It is also one of the most widely deployed database engines. The reason behind SQLite being so widely used is its ability to get directly attached with the application programming. Due to its, serverless design, it works faster and provides multiple writes at a single time hence, maintaining the integrity of the database. It is used to create a database for the various users who can access the system and to add/remove any user's accessibility as per the requirement.

IV. METHODOLOGY:

A home automation system integrates electrical devices in a house with each other. This system consists of 2 Methods.

- Voice Control**
- GUI Control**

Voice Control: As the name suggests, this module is completely related to the voice control of the system. This module is again divided into 4 phases: Speech detection, Speaker authentication, Speaker recognition & Command execution. The first phase is related to the detection and catching the voice of the person via microphone. The second phase is related to the speaker's identity i.e. whether the authenticated person is speaking or not. The system will work only if the detected voice is of an authenticated person or not. The third phase is about the conversion of the spoken words into text and match those words with the ones in the database. Again, the system will go to the last phase only if the spoken word is correct and matches with the ones in the database. The fourth and final phase is about the command execution i.e. the system will now perform the task asked by the user (switch ON/OFF the device).

- Speech Detection:** The term speech detection also known as voice activity detection (VAD) is a technique used in speech processing where the presence of human speech is detected. The main uses of speech detection are speech coding and speech recognition. For speech detection the raspberry pi requires a sound card which takes human voice as a input.

- **Speaker Authentication:** The identification of a person from characteristics of voices is known as speaker recognition or speaker authentication. Speaker recognition is used to identify who's speaking. Speaker authentication uses feature extraction algorithm to identify the voice features.

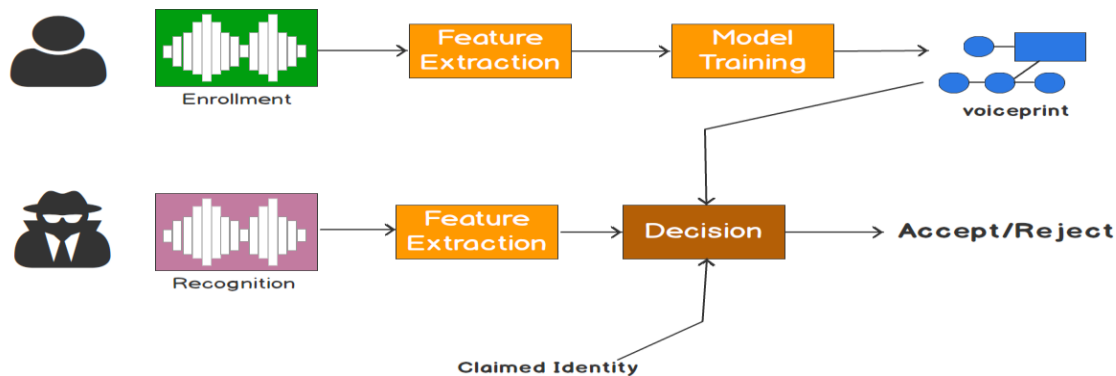


Fig 4.1: how Speaker Recognition Works? [7]

Recognizing the speaker can simplify the task of translating speech in systems that have been trained on specific voices or it can be used to authenticate or verify the identity of a speaker as part of a security process.

- **Speech Recognition:** Speech recognition develops methodologies and technologies that enables the recognition and translation of spoken language into text where the system captures the voice of an identified (Authenticated) user. There are two types of speech recognition system:
 - Some systems which requires pre-model training are called as speaker dependent systems.
 - Systems which does not requires pre-model training are called as speaker independent systems. The system analyzes the person's specific voice and uses it to fine-tune the recognition of that person's speech, resulting in increased accuracy.
- **Command Execution:** The term command execution specifies that the Raspberry pi has taken the input as a command and is ready to accomplish the expected task.

GUI Control: Graphical user interface (GUI) controlling is a very straightforward controlling approach which provides a desktop application to the user. A user can log in to the web application by entering an authenticated user-id and password. Admin can create a new user by generating a unique user id and password. User can give a command by clicking on the ON/OFF button which will trigger the relay unit that will control the home appliances

V. RESULTS & CONCLUSION

In this paper, we have designed a speech-based home automation system which will help the user to access the home appliances like light, fan, air conditioner etc. only using the voice commands. The system provides an alternative to the switch or remote based access to the home applications. Using this system, the people who are not able to reach the switchboard can access the home appliances. All user needs to do is give commands to switch on/off and the device will get switched on/off. Also, during severe cold weather, when the voice of the users gets changed, they can access the appliances using the desktop application.

VI. FUTURE SCOPE and APPLICATIONS

- In the coming future, we can replace the desktop application with a web application or android application so that the user can access their home appliances even from distant places using their mobile devices.
- We can add some sensors to the network which will notify the user about the connected device's state (On/Off) remotely, so that the user can get the live update about their home appliances working state.

VII. ACKNOWLEDGEMENT

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