AIU

ARAB INTERNATIONAL UNIVERSITY

Faculty of Informatics & Communication Engineering

Junior Project Report
On
Smart Controller Through Voice

Submitted to
Department of Communication and Computer Engineering

Smart Controller Through Voice

A junior project submitted in partial fulfillment of the requirement for the Degree of Bachelor in

Informatics Engineering

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ABSTRACT

Since ever humans were obsessed to make their life easier and more efficient. Moreover, with all the technology that we had and with the internet exist. Humans need to move to the next step, which is to be related to their inventions more likely, starting with lights and ending with all kinds of devices, we called this next step Internet of Things (IoT). With all the technology that we have in our hands, we can say that this SCtV can help us to be more interactive with our devices and use it to achieve the sake of life that we look forward. Not only humans want to be comforting in their houses, but in their workplaces, restaurants, schools, and every place. Our vision is to create an interactive world that can achieve the best from all available devices around us. That kind of life that we are looking for in our project.

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Chapter 1

INTRODUCTION

1. Introduction

In this world, everyone should be comfortable in life. Contemporary man invented a different technique for his life. In today's world, people should be in touch and ready to access information easily. Be it on TV or the Internet, people need to improve their quality of life so that their life becomes easier and simpler. There has been a steady and significant growth in the use of smart devices in the past decade. This is the result of the growth of the Internet of Things (IoT) industry. Devices connected to the Internet have become more intelligent. Each day there are more and more smart devices, vehicles, buildings, and other objects, which consist of software and electronics, that are interconnected either by some network or to the Internet. These smart things have the main purpose of collecting and exchanging data. The constantly increasing usage of smart interconnected devices on a global level led to a growth of smart homes as smart technology ecosystems, whose purpose is to coordinate and optimize our daily activities. The vision of Ambient Intelligence (AMI) has brought a new twist to decade-old research initiatives in the industry realizing smart environments. The AMI vision, as proposed by the European Consortium, promotes a paradigm in which humans are surrounded by intelligent and natural interfaces offered by heterogeneous computing devices that are connected to everyday objects. The resulting environment is able to identify and react to actions. Thus, AMI can be seen as the driving force for a more user-friendly environment that enables effective support for human interactions.

1.1Background

For a world and everything around us is constantly changing. As science and technology progress, we are moving towards a more automated lifestyle. We have smart cities, smart homes, smartphones, smart cars, etc. This quick way of life requires further development of daily automation projects. The benefit of any system is mainly built with IoT devices. The Internet of Things is a system of interconnected computing devices, machines, mechanical or digital objects, or objects or animals that are provided with unique identifiers (UID) and the ability to transmit data over a network without the need for a human-person or human-computer interaction. IoT technology is most synonymous with products pertaining to the concept of the "smart home", covering devices (such as lighting fixtures, thermostats, home security systems and cameras, and other home

appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers. This paper presents a smart system implementation using the Internet of Things with the help of Raspberry Pi. The home is the most comfortable place for a person and is a refuge after a workday tiring. What if we could heat the water before arriving? What if we forget the lighting, and we can turn it off once I say turn off the light? Or we forgot to turn off purpose, we offer you an interactive smart system.

1.2 Objective

The main objective of this project is to develop a smart device. The device was a small palm-sized piece and we would be able to interact with it using voice commands.
These are the main features that this system will provide in the implementation of the voice commands we are talking like turning off the lighting, and the ability to turn on and off any electrical device at a specific time without remembering in advance.
We will also be able to control electrical appliances while we are outside the home. The software should be designed to be modular and responsive in order to accommodate different devices.

1.3 Problem Statement and Proposed Solution

The world in which we live has become a place for the most intense competition in various fields to reach the best. One needs to work hard to achieve his goals, and there must be ways to make his life easier and more comfortable. The advent of information technology tends to act like a double-edged sword when it comes to working productivity, and sometimes one can use the ease of information to help them complete the task, but it can also provide a great distraction. Ultimately, one strives to be his or her best, but failure to provide rest times makes one's days tired. All people the elderly, the youth, and the disabled find their homes a better place to rest. But because of the pressures of work and life, one sometimes wastes his time, and at other times he forgets...

It will be very useful, for example, when you get home, we find the water hot, or when we get tired, we can turn off the lighting once we say turn off the light. One needs a product to do these things the easy way. This smart device helps people in their daily life. Through the processed and translated voice commands in Raspberry Pi and their application on the required devices, as well as we outside the home we can control the devices once connected to the Internet through the Android application so you can know its status and change it. With this device, one can, be outside or inside the home to be comfortable.

Chapter 2

ANALYSIS

The following requirements define the goals of the project outlined in the introduction. The functional requirements define features that must be done for the project to be considered a success, while the nonfunctional requirements define how the functional requirements are achieved. Requirements are categorized into critical, recommended, and suggested. Critical requirements are absolutely necessary, recommended are highly desirable, and suggested requirements are not necessary but would be very nice to add.
Design constraints are criteria that the solution must adhere to. The constraints are set by the client and are non-negotiable.

2.1 Functional Requirements

Critical
1. Must be able to receive and process sound.
2. It is not necessary is connected to the Internet when receiving audio directly from the Raspberry Pi.
3. The Android app should be able to expand to multiple sizes.
4. You must be online to receive information from the Android app.
5. System defaults in low power sleep mode.

Recommended:
1. Controlled by alternative input methods in android application.
2. Sleeps when certain time has passed.

2.2 Non-Functional Requirements

Critical:
1. The Android application is easy to use.
2. The system has good performance for users.
3. The system maintains good reliability for users

Recommended:
1. This system is user friendly

Suggested:
1. The ability to perform more than one command in a single voice recording.

2.3 Design Constraints

Constraint
1. Solution must be open-source
2. System must be accessible for hobbyists
3. System must be scale-able, extensible

2.4 Current Model

The overall system has two main components - the hardware component and the software component. The hardware model is The ReSpeaker 4 Mic Array for Raspberry Pi is a Pi Hat with a ring of 12 RGB LEDs. It is designed to build voice-supporting applications such as Google Assistant and Alexa.

This proposed system contains various functions and was implemented, designed and developed using the architectural block. Thus, this is expandable in the future because it can support home automation. This means that through this system, in the future, IoT home automation can be controlled by external factors surrounding it. ReSpeaker that allows you to interact with your home, factory, office, internet devices or other things in your daily life is used by voice and is powered by Raspberry Pi, thus supporting the voice control program.

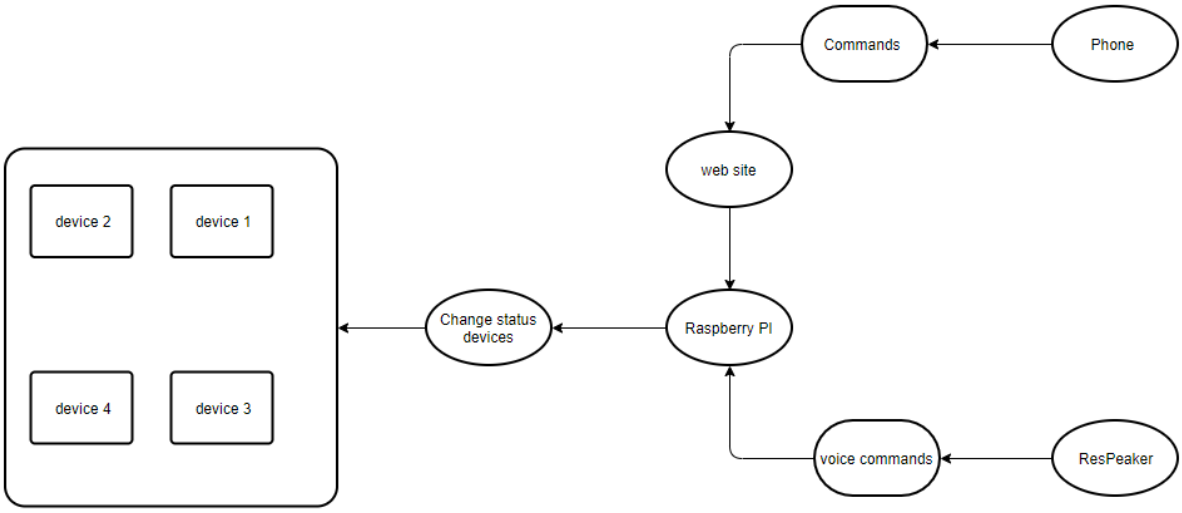


Figure 1: Data flow in the Smart Controller through Voice

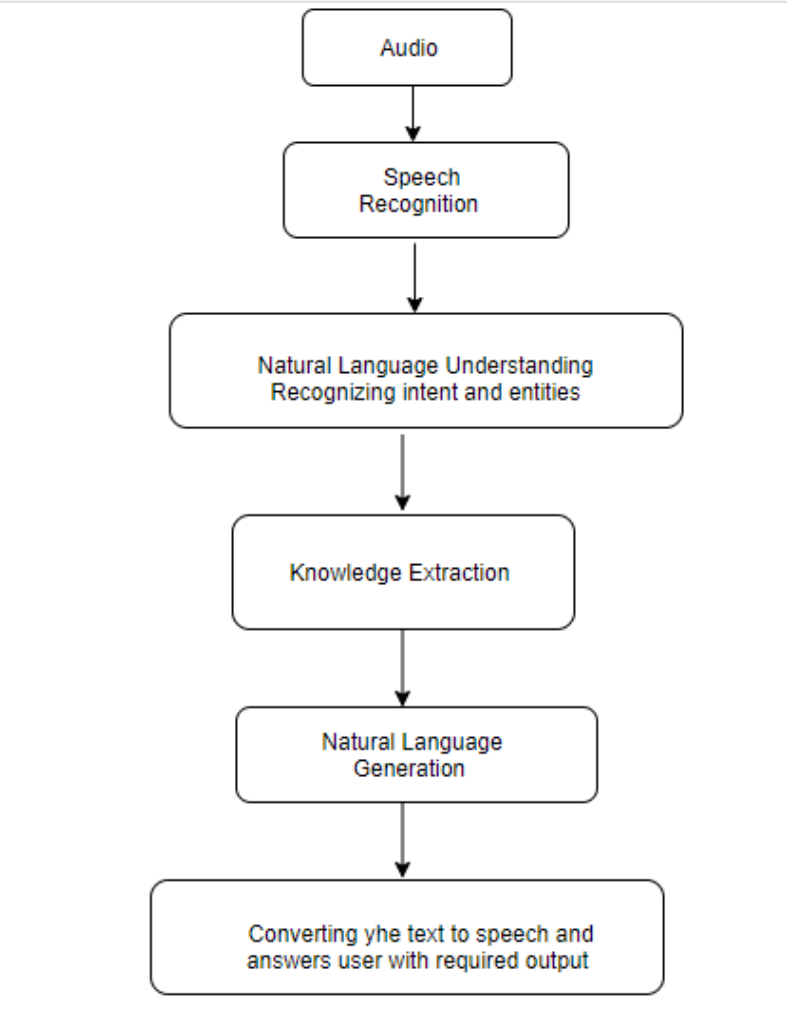


Figure 2: Data structure for voice control

Chapter3

SYSTEM DESIGN

3.1 Hardware Design

The hardware in this project is very simple, which we used Raspberry PI 4 because it helps us fulfill our requirements and Respeaker (which allows us to interact with our home or internet devices or any other things in our daily life) to be installed on the Raspberry

Raspberry Pi 4

Raspberry Pi is a small computer the size of a credit card that works to run everything so that it can integrate with its technology between Linux systems, programming science, electronics, and smart control systems at the same time, we can use the Raspberry like any traditional computer and we can do electronic projects such as designing home control systems Smart. Raspberry Pi 4 is a single-board computer with it a more powerful Broadcom BCM2711B0 quad-core ARM processor and the 4K-capable Broadcom VideoCore VI video processor, with the ability to run on Linux operating systems. Raspberry Pi 4 has an integrated LAN port that can be used to connect to the Internet. The list of ports on the Pi 4 also works as a backdrop for the few physical features available on the microcomputer, with four USB ports, a pair of HDMI 2.0 mini ports and a USB Type-C power jack.

Figure 3: raspberry pi 4

ReSpeaker 4-Mic Array

ReSpeaker is an open modular voice interface to hack things around you. Let you interact with your home appliances, your plant, your office, your internet-equipped devices or any other things in your daily life, all by your voice. The ReSpeaker project provides hardware components and software libraries to build a voice-enabled device.

ReSpeaker 4-Mic Array for Raspberry Pi is a quad-microphone expansion board for Raspberry Pi designed for AI and voice applications. This means that we can build a more powerful and flexible voice product that integrates Amazon Alexa Voice Service, Google Assistant, and so on. allows the device to pick up sounds in a 3 meters radius. Besides, this 4-Mics version provides a super cool LED ring, which contains 12 APA102 programmable LEDs. With that 4 microphones and the LED ring, Raspberry Pi would have the ability to do VAD (Voice Activity Detection), estimate DOA (Direction of Arrival), do KWS (Keyword Search) and show the direction via LED ring, just like Amazon Echo or Google Home.

Figure 4: ReSpeaker 4-Mic Array

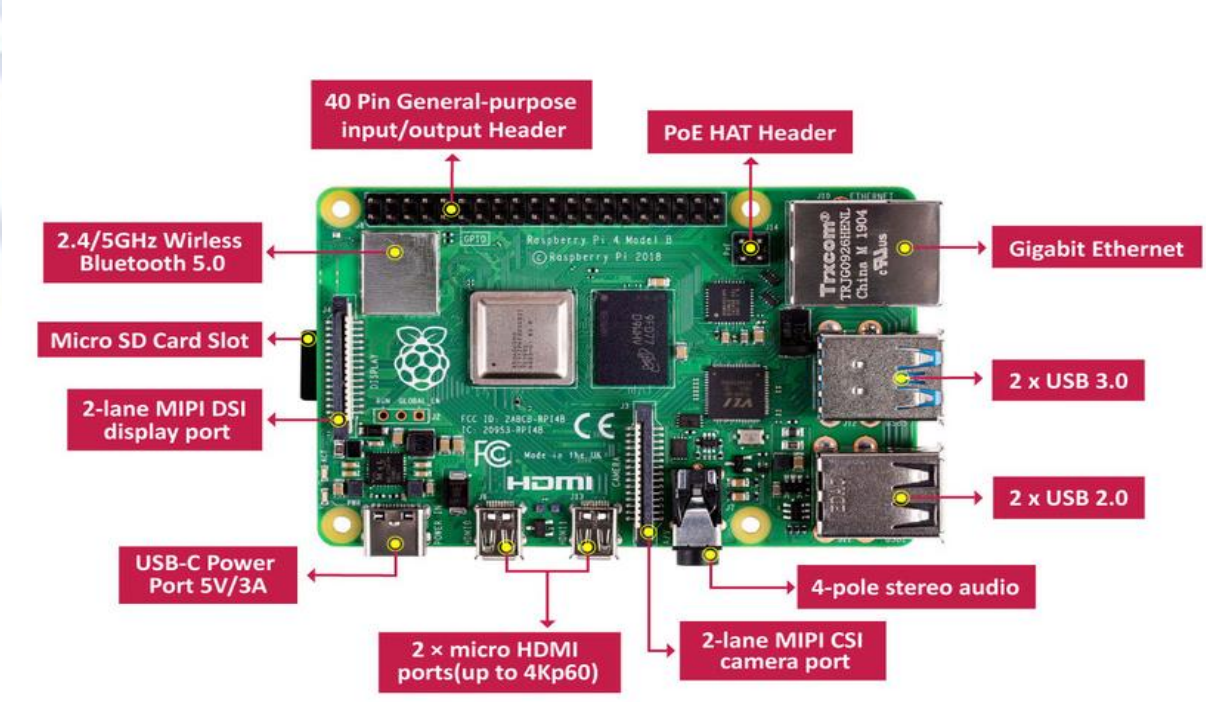


Figure 5: Interior design of raspberry pi 4

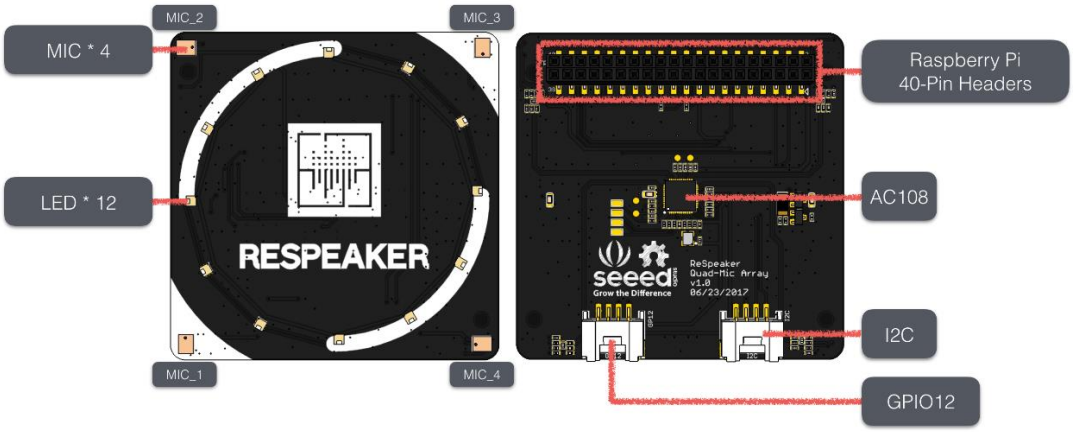


Figure 6: Interior design of ReSpeaker 4-Mic Array

3.2 Software Design

The goal of our project is to create an open platform for development, and all software components must fit to that goal. The software is designed to run on many platforms.

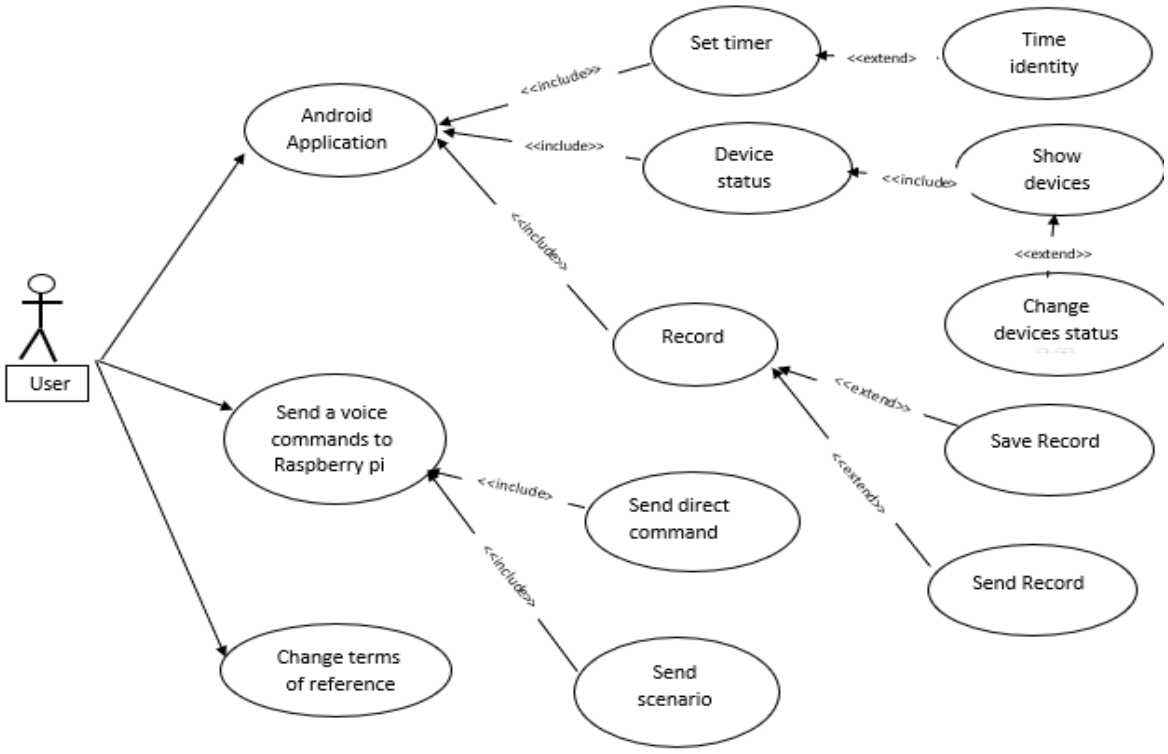


Figure 7: Use Case

3.3 Application Structure

The application of the Respeaker after it get the voice command from a user will do the command and then change the database using the Python programming language which allows access to the database and modify it according to the order passed. Another way to do this is by using the android application, where you will get a list of devices from the web API that builds using PHP on the Raspberry PI server, then make the change to the database that is built using the MySQL. To access the database from the Android application through the Internet, a free website was used to upload PHP files, but this service does not allow us to access the database or modify it, so the database was raised on RemoteMySQL.

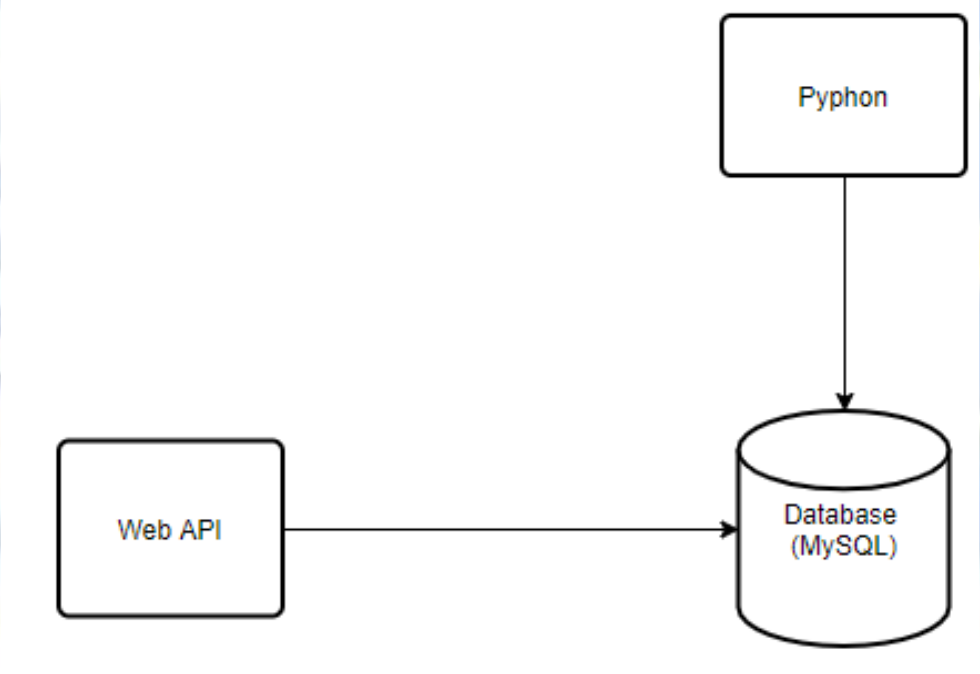


Figure 8: Application Structure

3.4 System architecture

This architecture of the above figure is simulated the interaction between user and SCtV. The SCtV consist of Raspberry PI, ReSpeaker, phone, router, and controlled devices. The user can control the devices with two ways, First by speaking to the ReSpeaker and it will pass the voice to get recognized by the Raspberry, after recognizing the voice the Raspberry will send using Python them to the matching IP of

the selected device to the router which will by its turn will pass it to the selected device. The Raspberry PI will be switched on using a voice command such as "Snowboy " or any other keyword. The second is by phone, where the user can control the devices through an interface that shows us a list of devices that allow us to change the status of the device through the Internet.

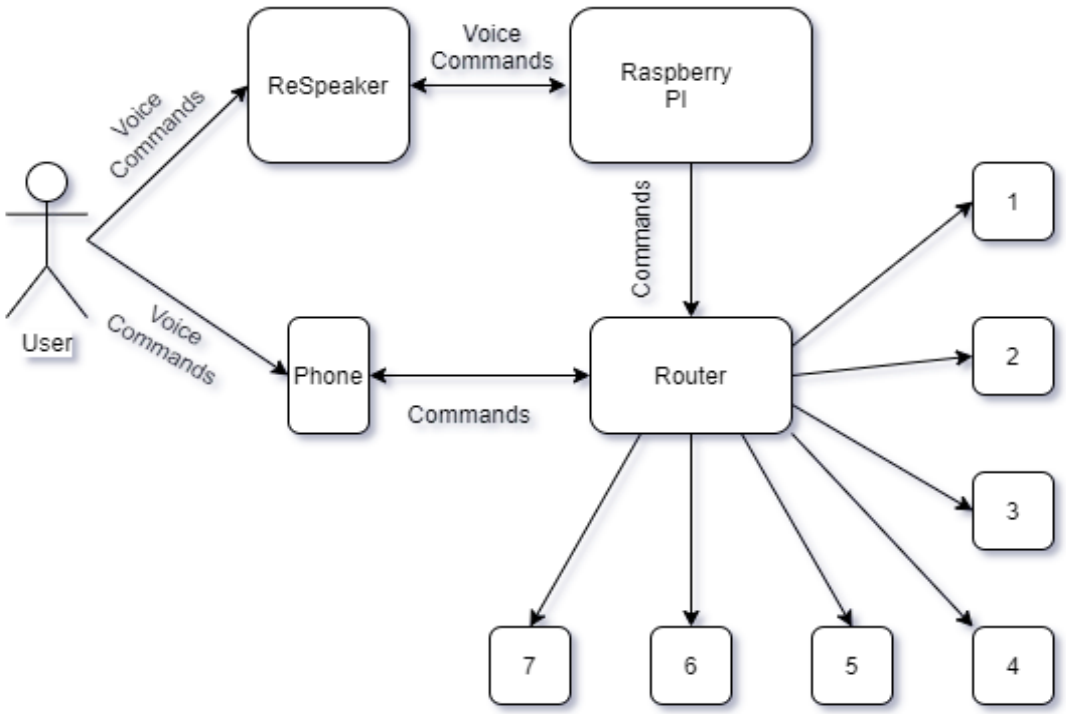


Figure 9: System architecture

Chapter 4

4.1Technologies Used

Below is a list of technologies we plan to use for our project. Being a webserver-based application and android application
we used a variety of tools that meet the requirements:
-Python programming
-000WebHost
-Remote MySQL
-PHP
-Java
-xml
-MySQL
-ReSpeaker 4-Mic Array
-Raspberry Pi

The main hardware component of our system is Raspberry Pi. In particular, we use Raspberry Pi 4 because it maintains the same price point but overcomes additional processing power, more RAM, and large sums onboard Bluetooth and Wi-Fi for calling. Raspberry Pi was chosen for ease of use and availability for the amateur community.
Raspberry Pi is capable of running many Linux flavors, all of which must be able to run our main program. And to receive audio, we used a Respeaker for its ability to build a more robust and flexible product and allowed the device to capture sounds in a 3-meter radius. The Respeaker acts as a standard open audio interface for penetrating things around you. Using the Python programming language, the commands are transferred to the MySQL database and modified. MySQL runs on many system platforms, including Linux, Microsoft, macOS, etc. For the Android application, XML and java were used, where commands are sent from the application to the database (MySQL) through a web application programming interface that is built using PHP uploaded to free site.
000webHosting has been chosen to allow us free hosting in order to access devices over the internet. RemoteMySQL was also used to allow us to connect to the database as 000webHost does not support access to the database. Using unfamiliar technologies and programming languages would increase the barrier for entry and deter potential users who may not have as much of technological background.

4.2 Python programming

Our programming language is python and our building area is PyCharm. Python is a widely used high-level general-purpose language. Its design highlights the code readability and the syntax that allows exposing concepts in fewer lines of code than would be possible in languages. Python carries an easy abstract. It features a dynamic system and automatic memory management, has a large and comprehensive standard library. Python interpreters are available for the installation for many operating systems also allowing Python code execution to a wide variety of systems. Python code can be packaged into executable programs for some operating systems, allowing the action of Python-based software to use on those environments without having to install Python interpreter.

4.3 000WebHost

Free hosting allows you to host a limited number of websites and comes with disk space and bandwidth coverage. The variety of things you can do with free web hosting is enormous. In essence, you can use it to create a website about anything, starting with:

Blog Wordpress
Website review
Personal sites
Small business
Schools and universities projects
Small e-commerce stores

Free web hosting is also an amazing platform to start and learn to code, as it supports the most popular programming languages like PHP, MySQL, HTML, JavaScript, CSS and more! All 000webhost servers use advanced firewalls and include DDoS protection. A free web hosting account can have up to two active sites simultaneously. Each will have their resources, separate FTP details, and can use any tool available in the control panel. A free web hosting account can hold up to two active websites at a time. Both will have their own dedicated resources, separate FTP details, and can use any tool provided within the control panel.

4.4 Remote MySQL

When we're working with MySQL, there comes a time when we need to take our work beyond the localhost and check for its reliability, connectivity, and functionality. Connecting to the Hosted Database. The Remote MySQL feature is used when the user wants to connect to their database using third-party software that does not run on the server. The user has to first allow the connection from within cPanel for the IP address they are connecting from. This feature primarily permits remote hosts or servers to access the MySQL databases on the user's account. Often developers need to connect to their databases from remote locations. The remote MySQL feature allows the user to access the client program running in the remote computers to access the hosted database in the sever.

Chapter 5

IMPLEMENTATION

Smart controller through voice is implemented in a way that the orders that were received from the user through the Respeaker are executed directly, processed and implemented without the need to connect to the Internet, and is also through the Android application that is sending the orders through the Internet to the Raspberry. The procedure for Smart Smart Controller through Voice checks in the following steps:

1. The idea
2. Respeaker
3. Audio receiver
4. Android application

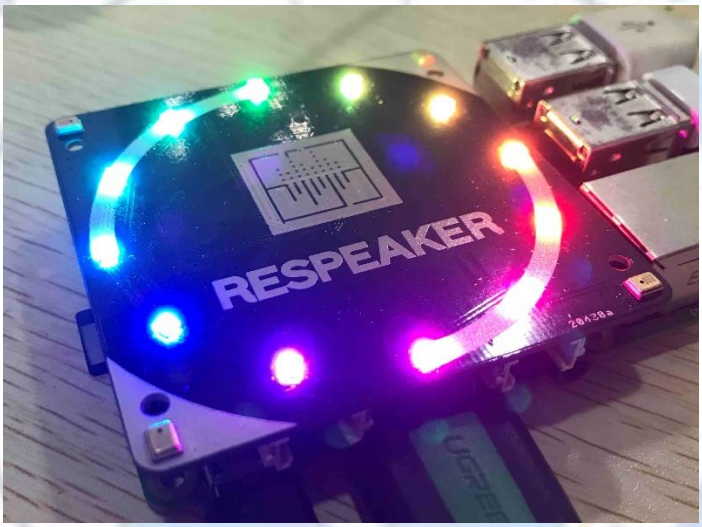


Figure 10: Final form of implementation

5.1 The idea

Regular devices do not operate without anyone turning them on or off. This smart system will allow us, with voice commands, to control devices very easily without the need for manual intervention by humans

5.2 Respeaker 4-Mic Array

After a prolonged search for speakers to receive sound, Respeaker 4-Mic Array was chosen so that devices could have interacted more forcefully and flexibly. which allows the device to pick up sounds in a 3 meters radius.

5.3 Audio receiver

By speaking to ReSpeaker, the voice will be passed to identify it via Raspberry, where Hotword is heard for the specific keywords chosen to activate the voice interface "Snowboy" where the program is then read for voice search and commands. Voice interfaces use speech recognition technologies to allow user input through spoken commands. The software identifies spoken words and phrases and converts them to a machine-readable format for interaction.

Snowboy is a highly customizable hotword detection engine that is embedded in real-time and is always listening (even when off-line) compatible with Raspberry Pi, (Ubuntu) Linux, and Mac OS X.

A hotword (also known as wake word or trigger word) is a keyword or phrase that the computer constantly listens for as a signal to trigger other actions.

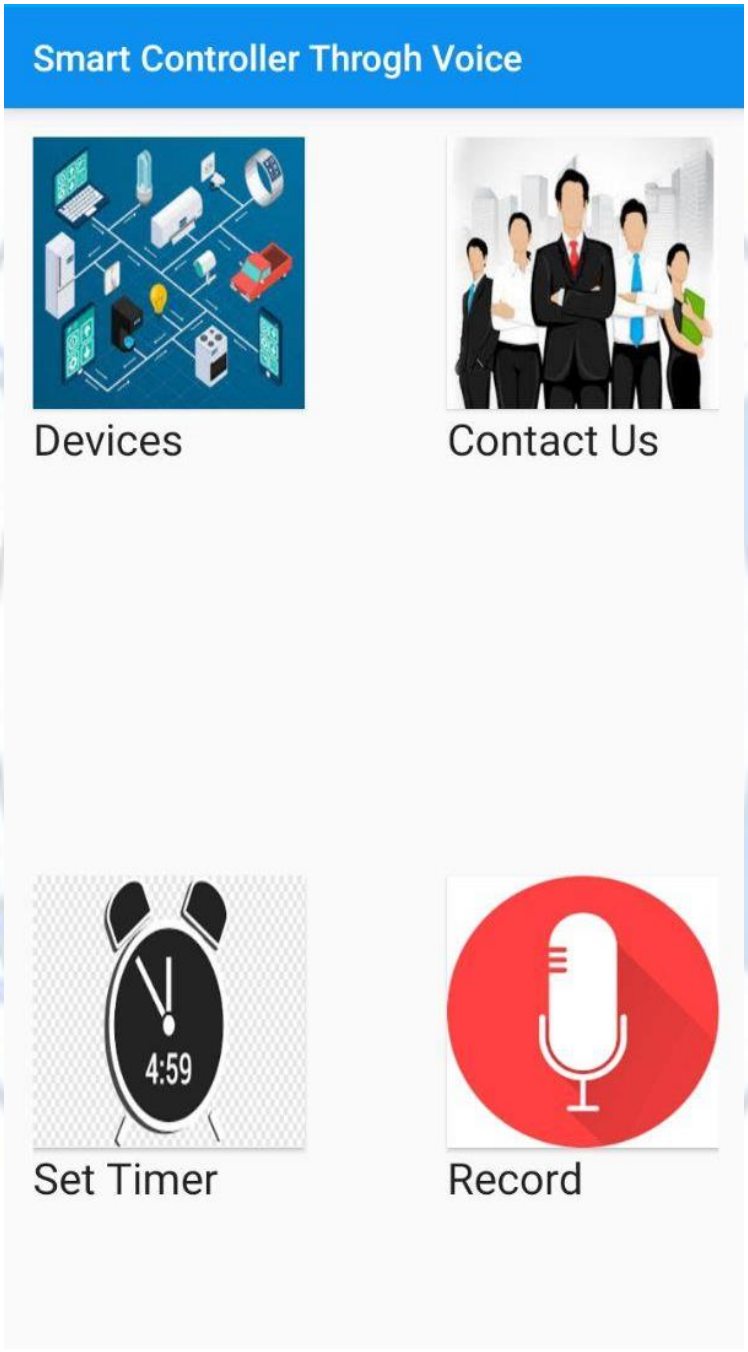
5.4 Android application

The Android app was created to give us access to devices at home while we are abroad, to make our lives safer and more secure. This app contains:

1. The main interface
2. Voice recording interface
3. Interface to display existing hardware and its condition
4. Timer interface

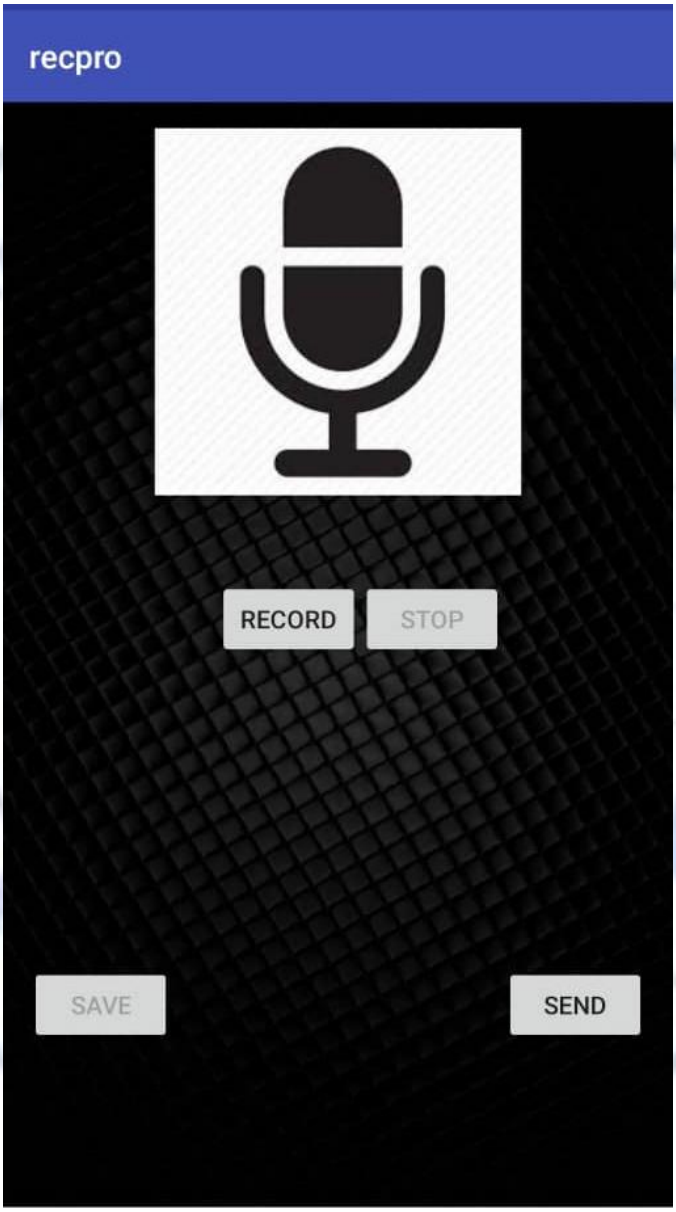
5.4.1 The main interface:

This main interface shows us the existing interfaces and through it, we move to other interfaces. It contains an audio recording interface and an interface to display the list of existing devices and their status.



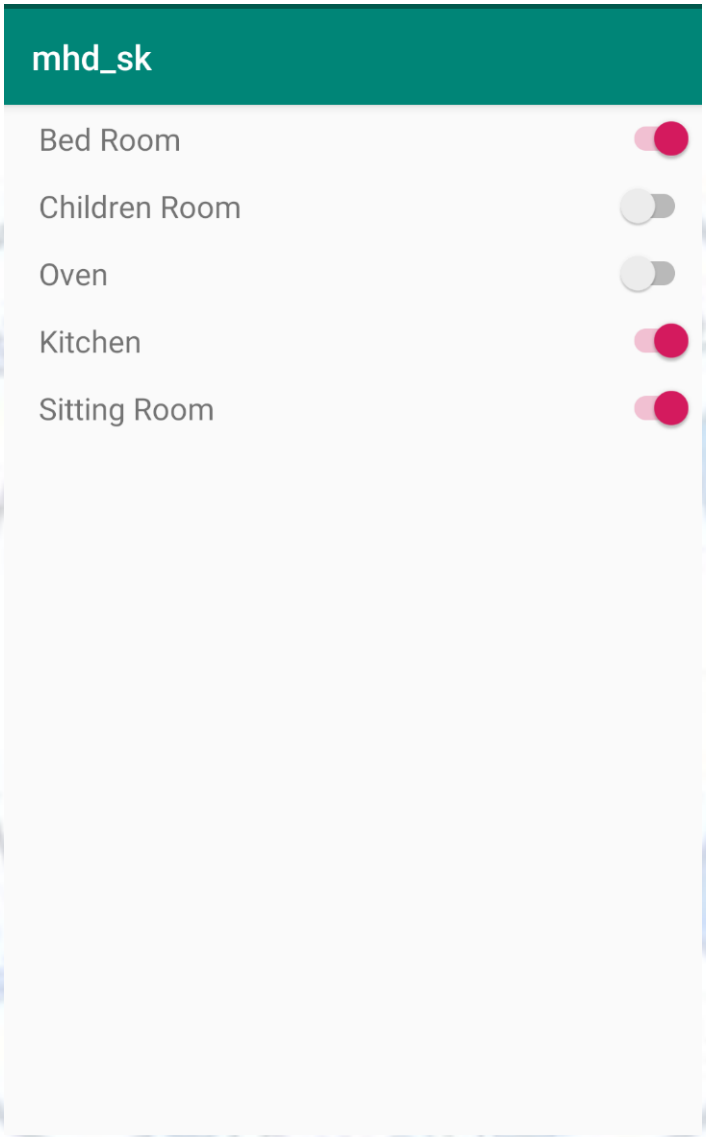
5.4.2 Voice recording interface:

This interface is to record the command that we want to execute, by pressing the record button starts recording the sound and saying the command we want and on completion, we press the stop button to stop recording. Then we press the send button to send the required command. And we can save it by pressing the save button to use it again without record the sound.



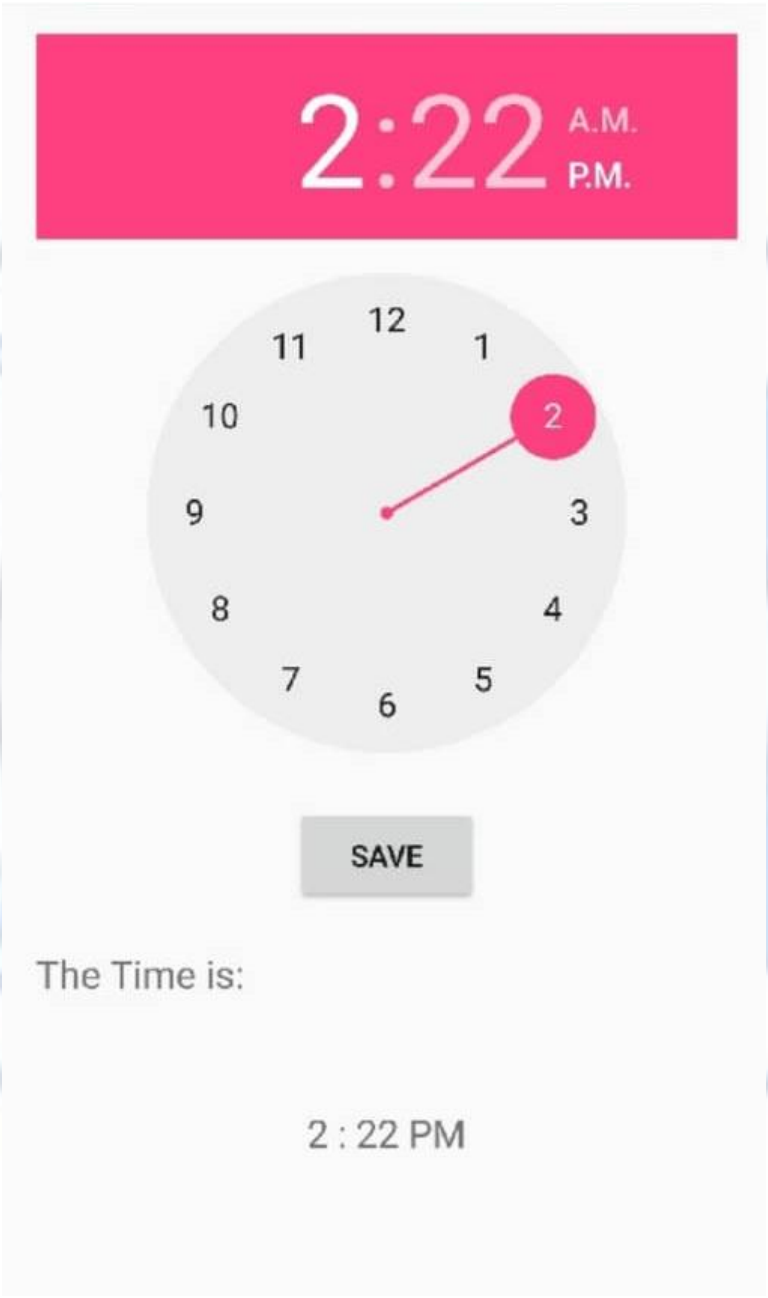
5.4.3 Interface to display existing hardware and its condition

And in this interface, it shows us a list of the existing devices and shows us its status. And it allows us to change her condition.



5.4.4 Timer interface:

Through this interface, we can set a specific time to execute the required command, by setting the time and pressing the save button.



CONCLUSIONS

Our system made the concept of daily life easier and simpler than usual. It is a new app for creating a smart interactive system. The system is reliable and easy to use, in this interactive system; the focus is on an interactive home system. There are many benefits to Smart Controller through Voice. A structure geared towards serving the user and facilitating his life has been adapted so that it saves effort and time by making home appliances more intelligent, controlled by voice command or making them perform a specific function at a specific time. Also, we can control devices while we are outside the home, by voice or written instructions, and this helps us make our lives safer and makes us feel more secure.

SCOPE FOR FURTHER DEVELOPMENT

Based on the encouraging results from the Smart Controller through Voice project and its benefits. We gather information about other services needed for the user. We gather the required information from users and try to many more modules to the project in the future. It can implement specific orders by identifying the user's face. Also, through temperature sensors, room fans can be controlled, as well as room lighting can be controlled through external lighting. There is also room for another type of entertainment unit that can play music, for example. There is no limit to creativity and advancement in technology. The sky is the limit of the Internet of Things.

Project difficulties

We faced many difficulties including:
1-The difficulty of finding devices that fit with the circuit is rare in Syria, we have been searching a lot to find some of the evidence that Raspberry can correspond with most of the model needs a proxy and most sites are banned.
2- The difficulty of having the necessary devices in Syria.
3- There are problems with some technologies from their source and no solution, and because of that they have been changed.

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