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DESIGN AND FABRICATION OF A VOICE CONTROLLED SOCKET USING ANDROID PHONE AS AUTHENTICATOR

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Abstract

System automation plays an important role in our daily lives. The main importance of an automation system is the fact that it reduces human error and stress. With an aging population and the increasing acceptance of community-based care, there is a growing need for electronic assistive technology to support independent living, particularly among the elderly and persons with special needs. This study, Micro-controller based Voice Control Automation System using Android Smartphone aims to use simple voice commands in English to control the switching of devices. This project aims to implement a voice-controlled socket using android phone automation system for electrical appliances in the home which will receive simple voice commands such as 'on', 'Off', through a mobile-phone application. While there have been other ways to create automation systems that uses voice controls like using an external microphone connected to an Arduino or Raspberry pi or even using a PIC microcontroller, this particular system was developed with a smartphone – with an android OS (Snow Cone v2) in this case. The control circuit consists of an ESP 32 micro-controller, which processes the user commands using voice via an android smartphone. The relay controls the switching of devices while the Wi-Fi Module shares signal data having established a wireless connection between the microcontroller and the smartphone. The entire system is fast and efficient because of the ESP-32 microcontroller used, a PIC micro-controller could not have given the accuracy and speed required in this project. Most similar systems built use Arduino or Raspberrypi but this system was built around an ESP-32 controller because of its availability and low cost. Tests on accuracy, speed and range and thermal efficiency of project were carried and the results were positive and desirable for the design specifications. This project will be of great help to the elderly and disabled individuals as it will enable them to easily access basic electronics. The project is however limited to the use of other Operating systems such as iOS and Windows as its application can only function on android devices.

Keywords: Automation; Voice Control; Android Smartphone; ESP-32 microcontroller; Wi-Fi Module.

1. INTRODUCTION

We have had the Bronze Age, the iron-age, the industrial age, and now we are in the information age. The 21st century is the era of the fastest period of evolution in information technology, Chen et al, 2019. Every single day the concept behind the scene is getting more and more complex to provide humanity with the best level of comfort. And whenever the thinking goes, think of the most prominent technology which has completely altered the people's way of

The Seybold Report
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interaction with the normal World, Song et al, 2018. The need to be comfortable in our homes cannot be over-emphasized as we spent a relatively good amount of time at home after our everyday hustle of work to rest, sleep and even have fun with our family. No matter where we spend the day or a short while, we must return to a place called home.

Home automation refers to the building of an automation system for the home, these homes are now referred to as smart homes or smart houses, Gomez et al, 2019.

A home automation system will monitor and/or control home attributes such as lighting, climate, entertainment systems, and appliances. It may also include home security such as access control and alarm systems. When connected with the Internet, home devices are an important constituent of the Internet of Things ("IoT"), Liu et al, 2020.

This project also aims to design and implement a voice controlled socket using android phone that helps individuals to operate their electrical appliances at home via android mobile phones. An android mobile phone will be used in controlling the electrical appliances which could provide several benefits to diverse users.

This benefit would include 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).The benefits of using voice as an interfacing medium are multifold, Wu et al, 2021.

Firstly, it significantly decreases the need for training for operating technology.

Secondly, the simplification of services would entail a wider adoption of existing technology and would help people with varied disabilities access the same technology, Pu et al. 2020.

We have deployed an Android Application as the user front end primarily because of the ease at which the platform provides us with the means to use complex technology and due to the widespread adoption in the mobile industry, Xiong et al, 2019.

Various Tests were performed on the system, tests for range, accuracy, noise and security were performed and the results were desirable. The relevance of this project is not limited to home applications but can also be used in so many automation applications in the areas of transportation, healthcare and process control.

The home automation system by voice can understand thousands of voice commands and perform the required action to control various electrical devices. The voice recognition is a bit complex and challenging since each person has his accent. Voice control for a home automation system is proposed in this project. The system takes the human voice commands by its inbuilt microphone that converts the sound wave to an electrical wave. This system can perform different commands to control devices such as turn-on, turn-off at the same time. The voice commands are processed in real-time, using an offline server and a microcontroller (ESP 32) through USB serial communication. Performance evaluation is carried out with encouraging results of the voice commands through the Speech Recognition Engine and controlling various electrical devices.

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/85BCJ

Speech – and voice recognition Speech recognition defines the process of converting speech into digital data by translating acoustic signals to a set of words whilst voice recognition aims towards identifying the person speaking (Patel et al., 2013).

The history of speech recognition is far greater than most people might think, stretching back since the mid-'20s. The first speech recognition system, named Audrey, was created by Bell Laboratories in 1952. Audrey was rather rudimental and limited technology-wise, understanding only ten digits - spoken by particular people (Pieraccini, 2012). About 10 years later, IBM developed and demonstrated their Shoebox Machine. The device recognized and responded to 16 different spoken words, including all ten digits "0" to "9" as well as calculating commands such as "plus" or "minus" (IBM, 2018).

The first mass accessible voice command system was launched by Apple Inc. as they released the virtual assistant named Siri on the 4th of October 2011 (Bostic, 2013). It was due to the development of both hardware and technology innovation had developed enough for companies to make voice technology available on the mass market and with the number of smartphone users growing, Apple encouraged Google to release a voice assistant for the smartphone on May 18, of 2016 (Schalkwyk et al.,2010). The assistant made it possible for Google to crowd source data and thereby enhance its voice technology by using billions of received search queries. This led to better predictions of what the users were probably saying. Smartphones were the ultimate platform to test voice recognition and control. This is because a considerably high number of people in the modern world owned a smartphone, making the computation possible via the cloud (Schalkwyk et al., 2010).

It was not until recent years that voice command systems became marketed as the primary feature of a product. Voice control becomes more of an integrated component in most technologies at the moment due to it being the most intuitive and hands-free way of interaction between person and technology, Xiong et al, 2019.

A fully integrated component in most technology is most likely to be within the nearest future. The system can process voice commands in English with more than 90% accuracy, allowing the field of technology to progress at a fast rate (Vrinda, Shekhar, 2013).

A study, discussing speech recognition and AI, declares the fact that these technologies are not capable enough to compete with the accuracy of human listeners due to the lack of reliable software, thus 12 developing flawless and highly efficient speech recognition techniques remain a challenging task (Choudhary and Kshirsagar, 2012).

In terms of recognizing the patterns of speech, AI can be considered a great opportunity. It is because AI can transform the speech of well-structured algorithms by appropriately following all stages (Saon et al, 2012).

Representation of correct and appropriate inputs, demonstrating speech units, and designing of recognition algorithms are different activities where the approach of AI plays a vital role, stated by a study discussing software engineering using artificial intelligence techniques (Ammar, 2012).

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/85BCJ

A voice assistant is a software agent that can perform tasks or services for an individual, by using the technology of voice recognition. Following the voice, assistants are a few of which can be found on the market today, Anjana et al, 2017.

As explained, Apple's Siri was one of the first and most well-known voice command services, introduced to the general public through the iPhone. Initially released on the iPhone in 2011, it has quickly been implemented to almost every Apple product (Apple Inc, 2018).

Siri's main purpose is to make interaction within the device simpler and works well when it comes to sending text messages or executing basic commands.

Amazon's Alexa Alexa is one of the most popular voice assistants on today's market, developed by Amazon.com INC and initially released in 2014 (Amazon, 2018). Alexa's main purpose is to reach out to a wider platform by being non-restricted and used in various products within various areas (Van der Velde, 2018).

Microsoft's Cortana debuted in 2014 as part of Windows Phone 8.1, developed by Microsoft INC. Microsoft announced, in late 2017, that Cortana's conversational speech recognition system reached a 5.1% error rate, making it the lowest at that time. Cortana is based upon real, human personal assistants.

The Google Assistant was developed by Google LLC and was initially released in 2016. It is primarily available on mobile and smart home devices and can engage in two-way conversations. The assistant not only answers your questions correctly but also gives some additional context and cites the source website for given information, as expected since it's backed by Google's powerful search technology (Whitwam, 2016). Google Assistant has made great strides in catching up with Alexa in such a short time, boasting a 95%-word accuracy rate for U.S. English. This translates to a 4.9% error rate, making it the lowest of all the voice assistants currently out there (Van der Velde, 2018).

According to a study by Thompson et al, 2017, almost 60 % of today's smartphone users interact with their voice assistants to do online searches. While merely 16% use it to conduct home management tasks. The study explains that voice command can be divided into two different main types of questions; Tasks that are completed exclusively through voice and tasks that are initiated by voice and completed on screen.

A further advanced AI will provide more extensive usage, however, the interaction between the voice assistant and a screen is however most likely to remain even with more advanced machine learning (Thompson et al, 2017). The study by J. Walter Thompson, Kantar, and Mindshare furthermore shows that most users of voice assistants prefer to use voice commands in private spaces, such as the home or in the car. Several car manufactures have already implemented voice commands, such as Ford and Volkswagen. According to the study, 65% of regular voice users in the United States continue their habits in the car, while only 40% globally. Celtek et al. (2017) designed and implemented a low-cost, effective wireless home automation system with a general-purpose application. The web-based application integrates with existing homes to control temperature, humidity, motion, and luminosity sensors along with the signal

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/85BCJ

conditioning circuitry from user-inputted data. The home automation system consists of three key segments: the sensor nodes (SNs), the actuator nodes (ANs), and the center node (CN).

Bhatt et al, 2016 designed and implemented a scalable, cost-effective sensor wireless network for transforming the traditional home into a smart home. They deployed heterogeneous sensor and actuator nodes based on wireless networking technologies for a home. The system has a scalable architecture, and thus, any number of home appliances can be controlled and monitored on the system.

Due to fast steep growth in the usage and reliance on striking features of smart devices, Vikram et al, 2017 proposed a methodology to provide a low-cost home automation system using WiFi. It embodies the concept of the internetworking of smart devices. The experimental rig involved the use of the ESP8266 WiFi module, ATmega microcontrollers (μCs), Single-Pole Double-Throw (SPDT) relays, Transceiver NRF24l01+ RF, etc.

Gyory and Chuah in (Gyory and Chuah, 2017) proposed the design of an IoTOne solution that supports heterogeneous IoT devices and avoids both the security vulnerabilities and the limited device compatibility issues. The IoTOne solution supports heterogeneous IoT devices and provides security checking of IoTApp such that only IoTApp with robust codes would be hosted on the IoTOne App store.

Shinde et al, 2018 developed an IoT-based smart energy management system to intelligently control the appliances wirelessly rather than just switching devices on or off. In this paper, the power consumption of appliances was measured in intervals of 30 minutes and sent to the Raspberry Pi. The paper published by Sowah et al, 2018, provides a useful solution to the problem of the programmability and customizability of a modular home automation system.

2. METHODOLOGY

2.1 Description of the System

The project involves the use of voice control in combination with mobile phone fingerprint as authentication to control basic electronic devices like light, fan and television set. The project has a standalone mobile application that works with the hardware component.

The mobile app developed is installable by android devices. The app receives a command and sends a signal to the hardware component through the Wi-Fi. The app can only be accessed by authorized users through the use of the fingerprint authentication system. The key components of the system:

- Android-based mobile phone
- Esp32 Microprocessor
- Relay module
- Power distributing board

ISSN 1533-9211

DOI 10.17605/OSF.IO/85BCJ

2.1.1 Android-based mobile phone

Android is a mobile operating system (OS) based on the Linux kernel and currently developed by Google. With a user interface based on direct manipulation, the OS uses touch inputs that loosely correspond to real-world actions, like swiping, tapping, pinching, and reverse pinching to manipulate on-screen objects, and a virtual keyboard. We have used the Android platform because of its huge market globally and it's easy to use user interface.

The voice recognizer which is an in-built feature of Android phones is used to build an application which the user can operate to automate the appliances in his house. The user interface of the application is shown below:

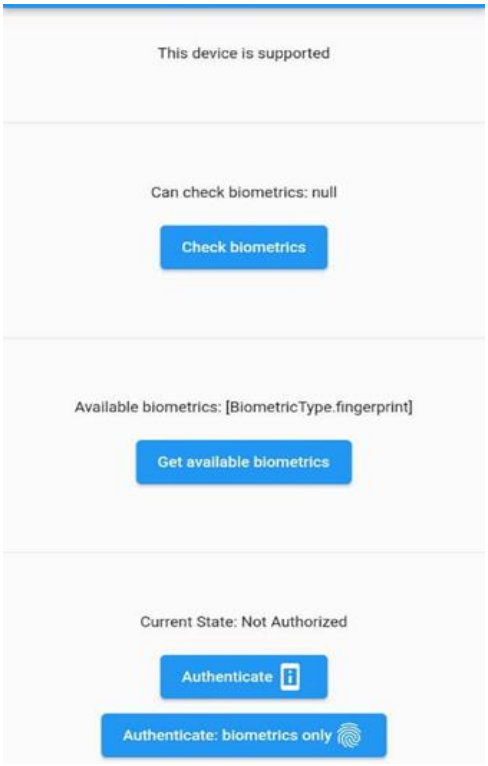

Figure 2.1: Android mobile interface

The microphone button is tapped and the voice command is given to switch the corresponding device on/off. The voice recognizer listens and converts what is said to the nearest matching words or text. The Wi-Fi adapter present in the phone is configured to send this text to the Wi-Fi module on the Esp32 microcontroller that would in turn control the electrical appliances through the relay boards.

Esp32 Microcontroller

ESP32 is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core

The Seybold Report
ISSN 1533-9211
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microprocessor and a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, and low-noise receive amplifier, filters, and power-management modules. It contains everything needed as a microcontroller. We either need to connect it to a computer using a USB cable or power it with an AC-to-DC adapter. The Wifi module transmits the text to the Esp32 microprocessor. The text is matched against the various combinations of predefined texts to switch the appliances on/off. The appliance name and a command for on/off are stored as predefined commands. For example, to switch on television the user needs to say "television on" and to switch it off he needs to say "television off". The appliances are connected via the relay boards to the Esp32 microprocessor. When the matching text is detected it is then given a high or low output signal to switch the appliance on and off respectively.

Figure 2.2: ESP32 Microcontroller

Relay Module

A relay is an electromagnetic switch. In other words, it is activated when a current is applied to it. Normally a relay is used in a circuit as a type of switch (as shown below). There are different types of relays and they operate at different voltages. When a circuit is built the voltage that will trigger it has to be considered. In this project, the relay circuit is used to turn the appliances on/off. The high/low signal is supplied from the Esp32 microcontroller. When a low voltage is given to the relay of an appliance it is turned off and when a high voltage is given it is turned on. The relay circuit to drive four appliances in the Voice-operated Android and Esp32 microcontroller Home automation system is shown below. The number of appliances can be modified according to the user's requirements.

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/85BCJ

Figure 2.3: A Relay Module

Power distribution board

A distribution board (also known as panelboard, breaker panel, electric panel, DB board or DB box) is a component of an electricity supply system that divides an electrical power feed into subsidiary circuits while providing a protective fuse or circuit breaker for each circuit in a common enclosure. Normally, a main switch, and in recent boards, one or more residual-current devices (RCDs) or residual current breakers with overcurrent protection (RCBOs) are also incorporated.

Structure of the system

For this project, two major sections will be incorporated. Firstly, there is the hardware section and secondly, the software section.

2.2.1 The hardware design section

The project consists of the above explained basic electronic components which form the core part of the project architecture and other components like:

a. 5 Volts charger
b. Socket
c. Lamp holder
d. JST Connectors
e. Female and male header
f. 13 amps plug

a. 5 volts Charger

Two 5 volts chargers of different amps were used. A 5-volt charger of 6 amps was used for the relay module and another 5 volts charger of 2 amps was used for the Microcontroller. A 12 volts charger was initially proposed but we had to make use of the two different chargers due to differences in the power consumption of the relay and Microcontroller.

ISSN 1533-9211

DOI 10.17605/OSF.IO/85BCJ

Figure 2.4: Type c USB charger

b. Socket

Sockets are also known as outlets, electrical sockets, plugs, and wall sockets. It allows electrical components to connect to the electrical grid. 3 Sockets were used for this project due to the fact that we don't want to connect our home appliance to the system directly. Each of the sockets serves its own purpose based on the needed appliance.

c. Lamp holder

A lamp holder is a device for holding a light bulb or lamp. One Lamp holder was used in the project to hold a bulb used to represent light.

d. JST Connectors

Japanese Solderless Terminal also referred to as JST, is manufactured by a Japanese company of the same name. The JST system is primarily designed to bridge electrical connections or carry an electrical signal.

Figure 2.5: JST Connector

ISSN 1533-9211

DOI 10.17605/OSF.IO/85BCJ

e. 13 amps Plug

A plug is a device for making an electrical connection between an appliance and the mains, consisting of an insulated casing with metal pins that fit into holes in a socket. It is used to connect the entire system to the main power source.

Block Diagram

The figure below shows the block diagram of the system, it shows the visual or graphical illustration of the block exploitation via connections of blocks one to another. Input signals were accepted from the mobile app through WI-FI of the smartphone. Speech to text is accustomed to extracting text from the speech. The extracted text is passed to the if/else statement which executes a block of code if a specified condition is true.

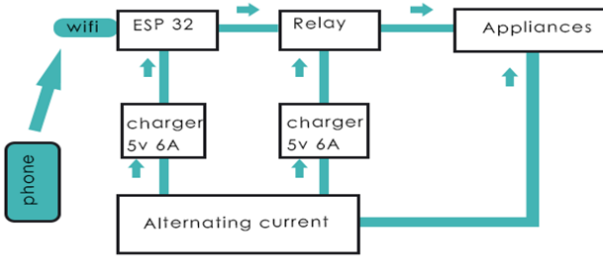

Figure 2.6: Block diagram of the system

Hardware Implementation

The positive terminal of the charger cable is cut into two and one of the switch terminals is connected to the charger likewise, the negative terminal of the electronic device is connected to the negative terminal of the switch is connected to the normally open (NO) pin of the relay module and the common (COM) pin of the relay module is connected to the positive terminal of the home appliance. The charger is connected to the DC input jacket of the breadboard power supply.

The charger is used to power the whole system while the switch is used to switch off/on the entire system. A terminal of the home appliance is connected to the relay so that when the relay is energized it will trigger the appliance and then the appliance comes ON. Pin 2 of the microcontroller is connected to the data pin of the relay which receives a high and low signal from the ESP32 microcontroller to trigger the relay and the normally open(NO)terminal of the delay is closed to close the switch the relay forms in the second terminal of the home appliance.

The relay module is powered by the breadboard power supply 5v pin and ground (GND) respectively. The ESP32microcontroller is also powered by the breadboard power supply port.

Software Module

The mobile application was developed with flutter framework, a Dart programming language framework, which is an open-source UI software development kit created by Google. It is used

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/85BCJ

to develop cross-platform applications for Android, iOS, Linux, Mac, Windows, Google Fuchsia, and the web from a single codebase.

The mobile application is an IoT application that converts speech to text and signal to the hardware via Wi-Fi. The application uses the fingerprint as its only means of authentication and it has a menu bar where users can on/off the phone Wi-fi.

Technology Overview

This section describes each tool or technology that was used to develop the system.

Android studio

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development

Flutter

Flutter is an open-source UI software development kit created by Google. It is used to develop cross-platform applications for Android, iOS, Linux, Mac, Windows, Google Fuchsia, and the web from a single codebase. First described in 2015, Flutter was released in May 2017.

Dart

Dart is a programming language designed for client development, such as for the web and mobile apps. It is developed by Google and can also be used to build server and desktop applications.

Working Principle of the system

The above components and software are used to implement the system. The core component of this system is the ESP3 microcontroller and the android application. A 5 volts adapter power supply serves as input supply to the microcontroller system. The relays connected to the ESP32 microcontroller output pin serve as switches to the loads. Android is a Linux kernel-based mobile operating system developed by Google. Android phones have an inbuilt feature called ‘voice recognizer’ which the user uses to control an appliance.

For wireless communication systems, a Wi-Fi module present in the microcontroller is used as a remote for sensing the signals sent by the android voice application. The relay circuit is connected to the microcontroller while the android based application is launched on the smartphone. The application is authenticated using the fingerprint and can be orally instructed by the user to control an appliance either ON/OFF. The microcontroller sends a signal to the relay board having received instruction through the Wi-Fi module. The application, first of all, searches for the Wi-Fi device to establish a wireless connection. The voice recognizer is launched as soon as the connection is established. The audio signal read from the voice is converted into a string. Value is assigned to each of the appliances and fed to the microcontroller. The microcontroller decodes the sent data signal and activates the relays for appropriate load switching

The Seybold Report
ISSN 1533-9211
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3. RESULTS AND DISCUSSION

Performance tests and measurements were carried out for every stage. Some of the procedures carried out during constructions are:

- All components were mounted on their respective circuit position onto the breadboard.
- The microcontroller was mounted with due consideration to pin output to input as programmed, after which the microcontroller was programmed and tested to be "OK".
- At the end of mounting components on the breadboard, the overall system was tested and results were measured.

A 5-volt charger of 6 amps was used for the relay module and another 5 volts charger of 2 amps was used for the Microcontroller. A 12 volts charger was initially proposed but we had to make use of the two different chargers due to differences in the power consumption of the relay and Microcontroller.

Results Of Accuracy Tests

Tests were performed in order to map the difference in effectiveness of the prototype during the development. Recognition accuracy was recorded for different models and implementations.

The accuracy tracker already built into the backend was used to gather the exact percentage regarding accuracy of valid commands accepted by the prototype's grammar.

The Accuracy test was conducted by recording ten samples each, that the prototype can understand, and then running the test program with the same configuration file but with two different acoustic models.

In fig 3.2, the comparison between the adapted acoustic model and the standard acoustic model in regard to word accuracy shows that even though the acoustic model is only adapted with a small amount of recorded speech data the accuracy is greatly improved. The accuracy is also improved for users, outsiders, whose voices were not recorded for the adaptation of the model.

	Accuracy	
Participant	Adapted Acoustic Model	Standard Acoustic Model
Developers	91.50%	77.10%
Outsiders	97.50%	90.25%
Total	93.21%	80.86%

Fig 3.1: Word accuracy data observed during two tests, one on the adapted acoustic model and one on the standard acoustic model.

Further showing Accuracy results on a Pie Chart we have:

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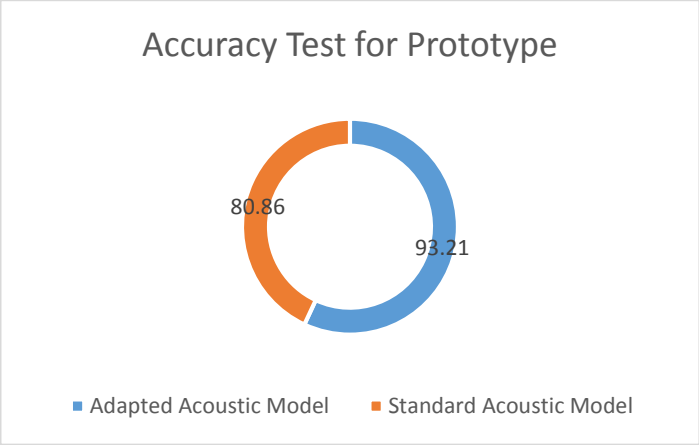

Fig 3.2: Pie chart to represent Accuracy Test

Results Using Test Point Techniques

The system was also tested using test point testing technique.

Test Points	Expected value	Actual value	Comment
Input AC voltage from mains	240 V	228V	AC voltage is notstable and keeps on fluctuating
Line to line Voltage across thetransformer	24.0V	26.6V	Transformer voltage not exact due to light loads
Line to center tapped Voltage acrosstransformer	12.0V	13.3V	Transformer voltage not exactdue to light loads
Dc voltage of the bridge(1N4007)	12.0V	12.6V	Almost equal to the expected value only that itfluctuated around the max value
Terminal voltage at the regulator	5.0V	5.03V	Almost equal to the expected value only that itfluctuated around the max value
Current from the transformer	5A	5.21A	Almost equal to the expected value only that itfluctuated around the max value
Current from the DC-DC LM 2596Converter	3A	2.8A	Almost equal to the expected value only that itfluctuated around the max value

Table 3.1: Result of Test Points

Range (distance), Speaker, Microphone (amplitude), and Environemntal Tests were also performed on the system and the results of those tests are outlined in the table below:

The Seybold Report
ISSN 1533-9211
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TESTING METHODS	TESTING FACTORS	DEVICE RESPONSE	OUTPUT ACCURACY
AMPLITUDE OF VOICE	Normal conversation 60dB	Device responds 3 out of 5 times	60%
	Whisper 35dB	Device responds 1 out of 5 times	20%
NUMBER OF WORDS	Minimum 2 words	Device responds accurately 2 out of 2 times	100%
	Maximum 5 words	Device responds accurately 2 out of 5 times	40%
DISTANCE FROM MICROPHONE	Lesser distance 5 Inches	Accurate response 4 out of 5 times	80%
	Greater Distance 2 Feet	Accurate response 2 out of 5 times	40%
ENVIRONMENTS	Quite	Accurate response 4 out of 5 times	80%
	Noise	Accurate response 1 out of 5 times	20%
MULTIPLE SPEAKERS	Multiple speakers	Device responds accurately 1 out of 5 times	20%
	Individual speaker	Device responds accurately 4 out of 5 times	80%
ROOM SIZE	Small room	Accurate response 3 out of 5 times	60%
	Large room	Accurate response 1 out of 5 times	20%

Table 3.2: Result From Testing Methods -Amplitude, Distance(range), Environmetnt etc

Security Test

As explained in the methodology, the system is secured with a fingerprint biometrics. Tests were performed to observe the security level of the fingerprint scanner. Figure 3.3 shows the result of the accuracy test based on the confidence level. The test was done on five individual with four thumbprints from each and one of them.

The fingers scanned were, left and right thumbprint and also left and right index finger. From the result below, it shows that finger with the most accurate result is left thumbprint with the percentage of 70%, followed by right thumbprint,

right index finger and left index finger with the accuracy of 67.2%, 41.4% and 30% respectively.

ISSN 1533-9211

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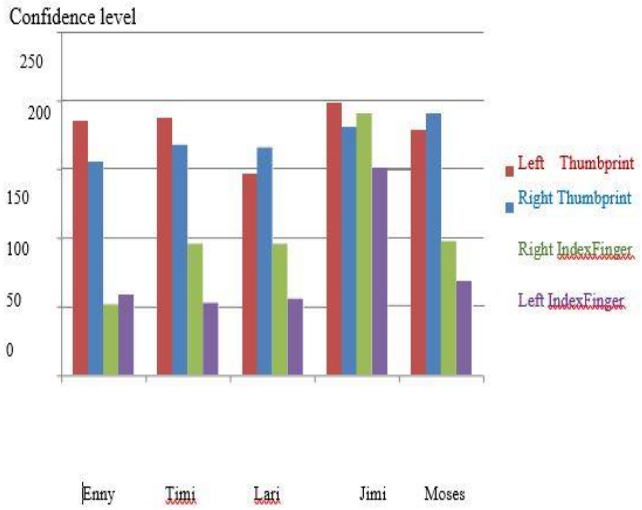

Figure 4.3: Result of Security Test

Fig: 3.3: Assembled View of Prototype

Fig 3.4: Assembled View of Prototype

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/85BCJ

4. CONCLUSION

In this project, we have successfully implemented a "Voice Controlled socket using android phone as authenticator" made of three components which include; Wi-Fi module, ESP32 Microcontroller, and Relay Circuits. The main function of the Wi-Fi module is to establish a wireless link between the microcontroller and the android smartphone. The concept adopted in this project can be used for controlling 4 electronic appliances in the home. This project proposes a low-cost, secure, ubiquitously accessible, auto-configurable, remotely controlled solution that is reliable and flexible in order to control home appliances. The approach discussed in this project is novel and has achieved the target to control home appliances remotely using the Wi-Fi technology to connect system parts, satisfying user needs and requirements. Hence, we can conclude that the required goal and objectives of the "Voice Control Home Automation System" have been met. The relevance of this project is not limited to home applications but can also be used in so many automation applications in the areas of transportation, healthcare, process control, industrial automation, military, etc

5. RECOMMENDATION

1) For the system to be effective to the native people of the country of Nigeria, there needs to be clear set of libraries in the android application to enable diversification to Yoruba, Igbo, Hausa and other local languages.
2) There is a need of thorough research on the availability and stable use of the voice sequence on an offline platform. Also, we can easily integrate Google's latest offering, Google Cloud Messaging to control the voice automated system from the Internet, thus making it possible to monitor our system from anywhere in the world.
3) Expanding the project with security sensitive functionality on the voice application would introduce the need for some type of user authentication. Only a specific user should be able to issue voice commands. One way to implement this security would be to use speaker identification which is the process of determining the identity of a speaker. This process would give the system the capability of blocking access to the voice commands from unauthorized users.

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