

Implementation of Home Automation through Internet of Things

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Abstract - Controlling appliances is a main part of automation. The main object of home automation is to provide a wireless communication link of home appliances to the remote user, which is based on the concept of IOT. The internet of things (IoT) refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other internet-enabled devices and systems. Android has been ruling the market since its inception, and majority of the mobile phone market is captured by android. Hence we plan to use the most popular mobile OS i.e. android to develop our home automation controlling app. Where the appliances are been controlled through voice commands.

Index Terms –Android, Appliances, Home Automation, Internet of Things, .

1. INTRODUCTION

1.1. Home automation

Home automation is similar to smart home, digital home, e-home and intelligent household. They both mean a high living condition with many smart devices. It is the residential extension of building automation which is using automation technology, computer technology and telecommunication technology to give the user a developed living condition, entertainment and security. In this thesis, the word *Home automation* [11] is equal to *Smart home* [12]. Based on human's smart technology improving process, the home automation system does not come by immediate invention. It comes step by step with only insignificant improvement. The previous step is almost same with the next step. The first time people noticed the high technology in dwelling, they did some connection with home automation, it was 1960s. It was called —wired homes at that time. It was built by some hobbyist. After that, the first official name of home automation appeared in 1984 by the American Association of House Builders. This development is the key to the modern smart homes. (Smith, 1988) People at that time understood that a smart home is not owing to how well it is built, not how effectively it uses space, not due to how it is environmentally friendly. It is only because of how interactive technologies that it contains. The basic idea of home automation is to

monitor a dwelling place by using sensors and control systems.

The Raspberry Pi [13] is a credit card sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of stimulating the teaching of basic computer science in schools [5 - 9]. The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC) [3], which includes an ARM1176JZF-S 700 MHz processor [4], VideoCore IV GPU[10], and 256 megabytes of RAM. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage. The Foundation provides Debian and Arch Linux ARM distributions for download. Also planned are tools for supporting Python as the main programming language. The first ARM prototype version of the computer was mounted in a package the same size as a USB memory stick. It had a USB port on one end and a HDMI port on the other.

1. Model A and Model B are cultural references to the original models of the British educational BBC Micro computer, developed by Acorn Computers, who originally developed the ARM processors (the architecture of the Raspberry Pi) and operating system RISC OS, which will also be able to be run on the Raspberry Pi (version 5.17). 2. On the model B beta boards, 128 MB was allocated by default to the GPU, leaving 128 MB for the CPU. On the release model B (and Model A), three different splits are possible: 192 MB (CPU RAM) is the default split. It should be sufficient for standalone 1080p video decoding, or simple 3D (but probably not both together). 224 MB is for Linux only, with just a 1080p frame buffer; likely to fail for any video or 3D. 128 MB is for heavy 3D, possibly also with video decoding (e.g. XBMC).Comparatively the Nokia 701 uses 128 MB for the Broadcom VideoCore IV. 3. The Raspberry Pi (model B) also contains a 15-pin MIPI camera interface (CSI) connector, which at the moment is unsupported, but the foundation is planning to release a camera module for it, sometime in the near future Raspberry Pi.

Python has been used for implementation. Since it is a high-level, interpreted, interactive and object-oriented scripting

language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

Android platform has been used for controlling. The mobile development community is at a tipping point. Mobile developers want the freedom to develop the powerful mobile applications users demand with minimal roadblocks to success. Android Application Runtime Environment refers android application runs in a separate process, with its own instance of the Dalvik virtual machine (VM). Based on the Java VM, the Dalvik design has been optimized for mobile devices. The Dalvik VM has a small memory footprint and multiple instances of the Dalvik VM can run concurrently on the handset.

Related work carried across the globe, some of them has been mentioned. S. M. Anamul Haque, S. M. Kamruzzaman and Md. Ashraful Islam proposed the system “A System for Smart-Home Control of Appliances Based on Timer and Speech Interaction” in year January, 2006.

Is about controlling home appliances through a microcomputer, author discusses two different approaches those are timer option and voice command. The timer option provides control based on timer, and the voice command. This system uses PC and PC parallel ports to control the home appliances. And the software interface is developed on the VB6.0 this is to convert voice command into text and provides the operation to control and monitor the home appliances [1].

Tam Van Nguyen, Dong Gun Lee, Yong Ho Seol, Myung Hwan Yu, Deokjai Choi, proposed the system “Ubiquitous Access to Home Appliance Control System using Infrared Ray and Power Line Communication”, in year Sept, 2007.

Proposed a system that control home appliances through infra-red remote controller and power line communication by developing a home based server, this system helps user to check the status of their appliances from anywhere through the cellular network and internet[2].

Malik Sikandar, Hayat Khiyal, Aihab Khan, and Erum Shehzadi “SMS Based Wireless Home Appliance Control System (HACS) for Automating Appliances and Security” in year 2009.

Proposed GSM based system for controlling the appliances for the people who are not at home, this is done remotely through SMS over GSM network using at commands and on receiver the GSM modem is interfaced with the pc, the home appliances control system is developed on the pc to monitor and control. In the proposed solution they use pc parallel port which is further interfaced with the relay circuit to provide control over the appliances. This system also provides a

feedback by simply SMS to user which also helps when there is any security breach in the home [3].

The motivation comes from the various people who are physically challenged and cannot operate the appliances physically. We are also motivated by the fact that the electric power is scarce and it’s the duty of all the individual citizen of our country to use electricity efficiently.

This paper has been organized in the following manner; section 2, describes the proposed system design. Section 3, describes the results and discussions. Section 4 presents the conclusion with future enhancements.

2. PROPOSED SYSTEM DESIGN

System design is a process of defining the architecture, components, modules, interfaces, and data for a system to satisfy the specified requirements.

2.1. System Architecture

“Software architecture is the structure of the components of a program/system, their interrelationships, and principles and guidelines governing their design and evolution over time”.

Firstly, the raspberry pi is been coded by python programming language. Then we are connecting the home appliances to the raspberry pi pins which are called as GPIO (General purpose input output) pins. We will connect fan and bulb to the GPIO pins which we are going to control through voice commands.

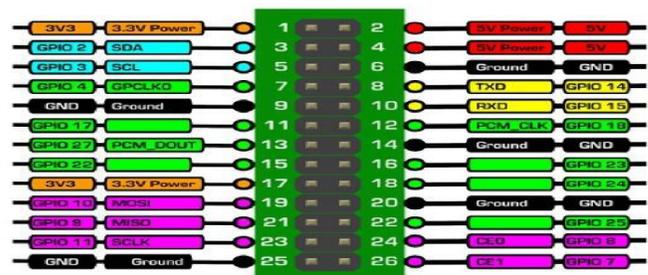


Fig.2.1.1 Raspberry Pi pin configuration



Fig.2.1.2 Connections to Raspberry Pi

Here the fan is connected to pin number 7 and bulb is connected to pin number 5 and the two devices in turn are been ground to pin numbers 6 and 9. Then we will supply a power of 5volts so whenever 5 volts of power is supplied it is taken through the raspberry pi supplied to the GPIO pins where appliances are been connected. Whenever 5 volts of battery is supplied that time the appliances will get ON whenever 0volts of power is supplied that time the appliances are put OFF. Here, we see in below figure how various modules are been connected and how they communicate with each other and how appliances are been connected and controlled.

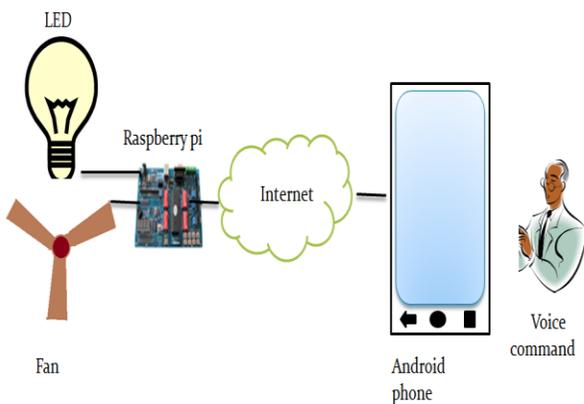


Fig.2.1.3 System Architecture

Firstly, the developed android application is been installed in the cell phone later the

voice commands are been given which are been taken through the application over network and passed to the raspberry pi here depending on the input voice commands the home appliances connected to the raspberry pi are been controlled.

2.2. Modules/Scope Diagram Module diagram help you inspect and document the structure of a design element. A module diagram presents the design's direct sub instances, the connection between them, as well the connections to design ports. Each module is represented by a box. System is divided into 3 modules based on its application.

- Android module: The android app is the android module which is developed using java programming language and will convert voice to text and send it to the Hardware module.
- Raspberry pi module: The hardware module is the raspberry pi module because it will be implemented on the Raspberry Pi using python programming language. The appliances (Bulb and Fan) will be connected directly to the raspberry pi.
- Command module: The communication module is the command module which is responsible for carrying the commands from the android app to the raspberry pi.

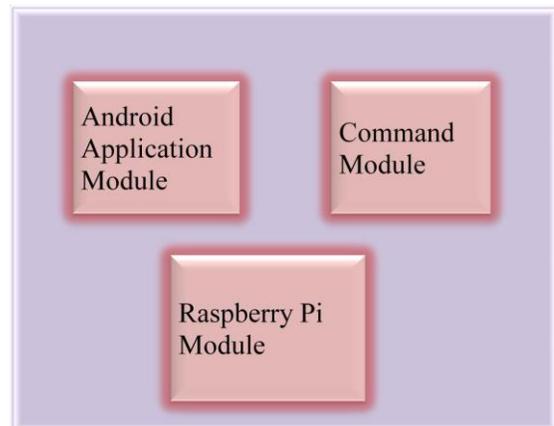


Fig. 2.2.1 Module Diagram

2.3. Sequence Diagram

A sequence diagram is an interaction diagram that shows how processes operate with one another and what is their order. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of scenario. The below diagram will show us how the commands are been carried out from one module to other module to control appliances. The user will send the voice commands to android app later the application will convert that voice commands to text form which are later sent to raspberry pi to control appliances.

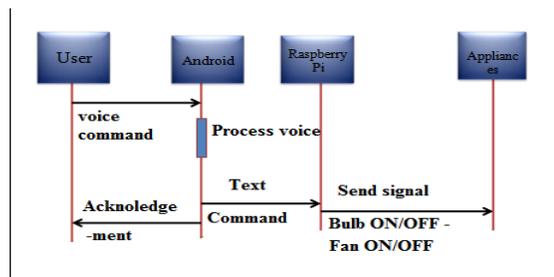


Fig. 2.3.1 Sequence Diagram

2.4. Use Case Diagram

A use case diagram is a graphic depiction of the interactions among the elements of a system. A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. Use case diagram shows the communication between actor and system. In our system actor is a user who will just open the application and click on the icon and gives the voice commands and these commands are been converted to text and been sent to the raspberry pi later the appliances are been controlled according to the given voice commands.

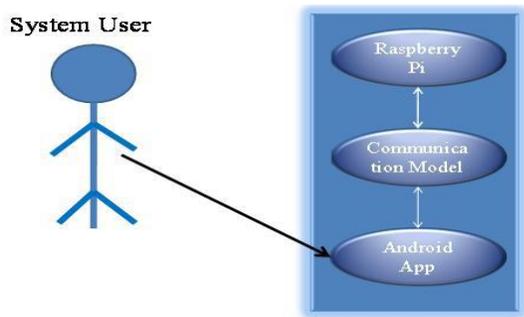


Fig. 2.4.1 Use Case Diagram

2.5. DFD's

The Data flow diagrams (DFDs) is the graphical representation of a system that shows the inputs to the system, the processing upon the inputs, outputs of the system as well as the internal data stores. DFD illustrates the series of transformations or computations performed on the objects or the system.

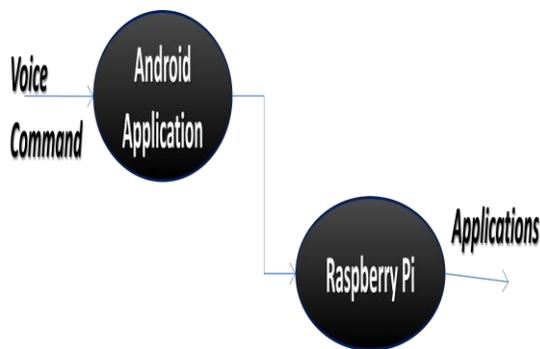


Fig. 2.5.1 Context level/Level 0

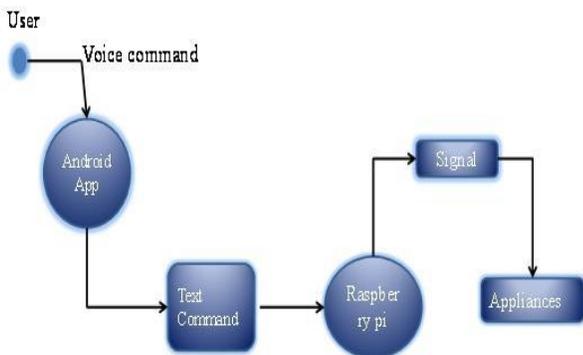


Fig. 2.5.2 Level 1 DFD

The above figure will show us the Level1 DFD where in the voice commands from the user given to the android app are been converted to the text command which are been passed to the raspberry pi then the signals from the raspberry pi are been sent to the appliances which are been controlled.

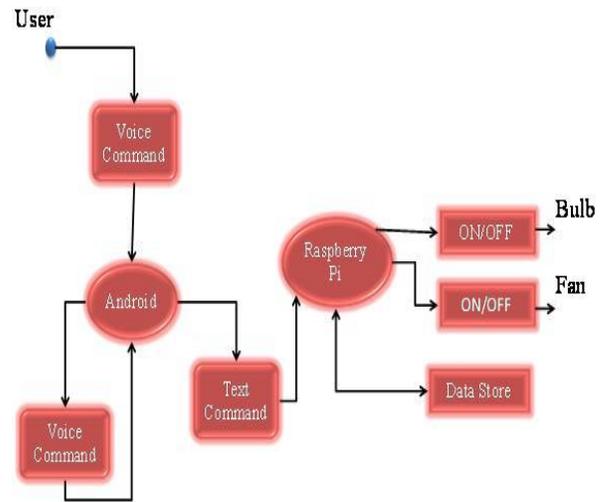


Fig. 2.5.3 Level 2 DFD

The above figure will show the Level2 DFD where the voice commands which are been converted to text commands by android app are been passed to the hardware module. The database will be checked after every second to see whether the database is been updated or changed then according to the voice commands the fan and bulb are been controlled.

3. RESULTS AND DISSCUSSIONS

In this chapter experimental results are detailed and each system functions modules is showcased using system GUI snapshots with a brief explanation.

Below are the snapshots which show the working of various modules.

Speech control is the application created "ON CLICK" the login page opens.

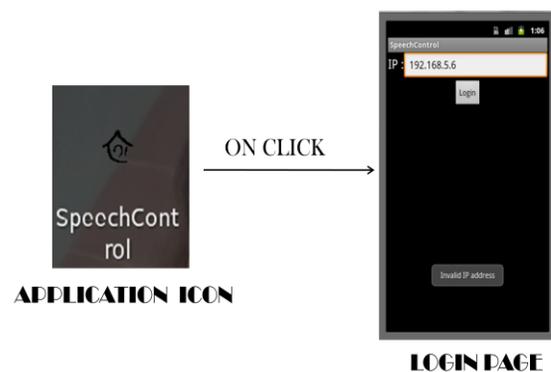


Fig. 3.1 Application icon and Invalid IP address

In the above figure we can see we have entered invalid IP address thus the invalid IP address message will be displayed and login will fail and unauthorized access will be dined.

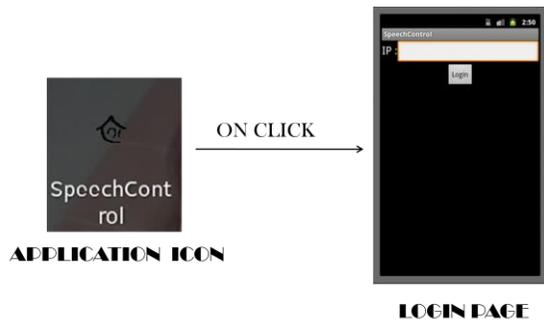


Fig. 3.2 Application icon and Login page

□ In the login page IP address will be put if it matches with the IP address stored in the code then next page opens i.e. "Speech Controlled Home" page.

□ In the "Speech Controlled Home" page the user gives the voice commands.

□ So the various voice commands can be

- HELLO
- FAN ON
- LIGHT ON
- GOOD NIGHT

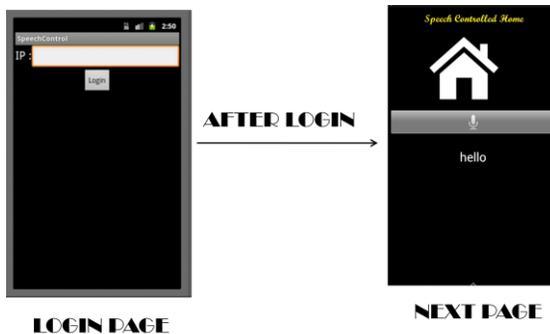


Fig. 3.3 Login Window with Valid IP Address

□ In the below figure we can see that the voice command "HELLO" is been given by that command the both light and bulb will get ON.

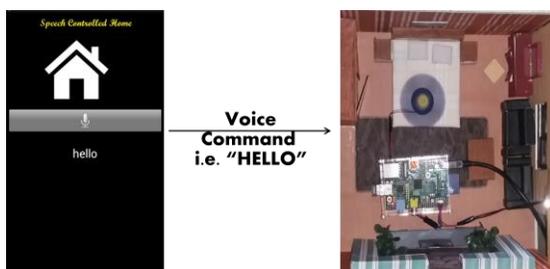


Fig. 3.4 Voice Command "hello" to the App

□ In the below figure we can see that the voice command "FAN ON" is been given by that command the both fan will get ON

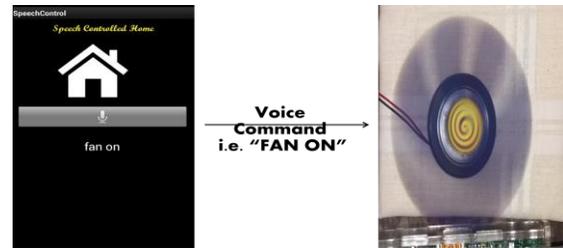


Fig. 3.5 Voice Command "fan on" to the App

□ In the below figure we can see that the voice command "LIGHT ON" is been given by that command bulb will get ON.

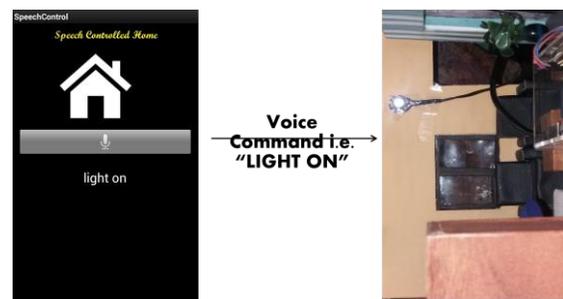


Fig. 3.6 Voice Command "light on" to the App

□ In the below figure we can see that the voice command "GOOD NIGHT" is been given by that command the both light and bulb will get OFF.

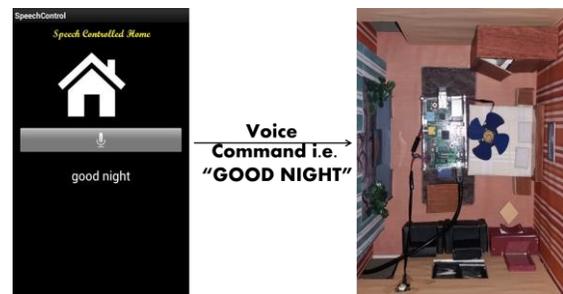


Fig. 3.7 Voice Command "good night" to the App

4. CONCLUSION AND FUTURE ENHANCEMENT

The main object of Home automation is to provide a wireless communication link of home appliances to the remote user. The main objective of this work is to make such a system which controls the home appliances remotely. The communication link between the appliances and remote user plays an important role in automation. In this a system that control electric appliance via voice when the user is in remote area, and also it controls the appliances through home mobile.

In this work, we have implemented a voice controlled home automation system. We used speech recognition system to implement this work. The system is designed for elderly and disabled people so that they can monitor and control the home appliances with their limited ability. The system is highly efficient and it consumes low power. This system is used to remotely control the home appliances through smart devices like so that one can remotely check the status of the home appliances and turn ON or OFF the same. The proposed system has been tested with two home appliances. But, it can be easily expanded to include more home appliances. Our research can extend to all home appliances can be controlled such as TV, Refrigerator, and etc

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