

Computer Science and Engineering
Chaitanya Bharathi Institute of Technology (A)



Project Review-I Report

On

“JARVIS A Virtual Home Assistant”

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Abstract

This project aims to develop a “J.A.R.V.I.S(Just A Rather Very Intelligent System) -Virtual Home Assistant” that helps users to interact with household appliances. Visually impaired can interact through speech, speech-impaired can interact by text. Embedded augmented reality is used to provide a more interactive and user-friendly living experience. The major element of this project is Raspberry Pi. The Raspberry Pi collects data (speech) from an android app with an AI virtual assistant. Voice assistant application converts speech to text using standard Google API and sends to Raspberry Pi via Bluetooth. Acoustic-phonetic speech parameters are used for speech recognition in android apps. Processed data is sent to relays which manage household devices like light, fan, door, heater etc. Augmented reality application is developed for identifying real time objects to control the appliances.

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INTRODUCTION

Nowadays automation systems have become widespread in many industries by enjoying a significant role in several process-related operations. We have a tendency to board the planet of automation whereby most of the systems become automatic, like industrial automation, home automation and different business sectors. Home automation systems advancing towards mechanization processes whereby, with fewer human efforts needed by the machinery equipment to regulate various systems in homes. It involves automation of home appliances by fully exploiting different technologies and controllers over desktops, laptops, sensible phones or tablets. Automation systems are classified into 2 types: industrial automation systems and residential automation systems.

Automation is the most frequently spelled term in the field of electronics. The hunger for automation brought many revolutions in the existing technologies. These had greater importance than any other technologies due to its user-friendly nature. These can be used as a replacement of the existing switches in home which may produce sparks and also result in fire accidents in few situations.

When home automation was first introduced in the 1970s, it had failed to improve the lifestyle of its users due to several reasons. Firstly, it was not easy to determine the economic benefits of home automation technologies. Secondly, the effects of installing smart home technology must justify their costs. Home automation technologies are required to be cost effective, user friendly, easy to install and flexible with various network infrastructure and appliances. An intelligent personal assistant is capable of organizing and maintaining information and also managing emails, files and calendar events. Some personal assistants have the ability to provide information based on voice inputs or commands.

Amazon Echo which was introduced in 2015 is a hands-free speaker to control with voice commands. The Echo connects to the Alexa Voice Service to perform

various tasks such as play music and instantly provide information such as news, weather and sports scores.

It was observed that personal assistants like Amazon Echo failed to provide the user with a sense of control as it sometimes remained unresponsive when given voice commands that are not valid and these personal assistant devices are expensive. Furthermore, integrating them to household appliances like lighting requires one to purchase lights, such as the Philips which add to the overall cost of automating a house.

The project also aims to assist physically disabled and rehabilitated patients in their daily chores and basic routine activities. Our project is targeted at approximately 4-5% of our total population. A problem we are facing in our society is when the physically disabled are left home alone without a companion or a domestic helper, as their family members go to work. In addition, there are also many mildly handicapped individuals living alone, either because they value their independence or because they do not have any close family members. One major challenge these people face is how to perform simple household tasks by themselves. Examples of these tasks include turning on and off light switches and controlling household appliances.

With the popularity of mobile devices today and the emergence of smart home devices, the general population is becoming more and more comfortable with their use. There have been multiple attempts to use these devices to control and communicate with home appliances remotely; creating what is known as the Internet of Things (IoT). However, a key challenge of using these smart devices is that many of their Graphical User Interface (GUI) controls are difficult to be used by the disabled. There is now an emergence of Augmented Reality (AR) technology that is increasingly being developed and used in the mobile platforms, iOS and Android. We believe using an AR application will greatly aid the physically disabled user to control the home appliances easily from their wheelchairs. Our application will allow the user to control a physical switch simply by pointing their smart phone's camera to it from a distance, thus allowing the user to control different appliances easily and conveniently.

In this project we described controlling all the home appliances using an android application. All the appliances were controlled by Raspberry Pi and Bluetooth Module. In this we are using Bluetooth Module to receive the commands from the smartphone and processed by Raspberry Pi. Android application is developed in Android Studio.

Literature Survey

The main feature of this system [1] is that the people with hand disability can use this system by voice recognition. This feature makes this a total hands free home automation system. This system is mainly used by handicaps and elders who are suffering from hand disability or those who cannot move their limbs frequently. This is an affordable and easy to use system. Initially the system takes input as voice signals and stores these voice signals in the system's memory. To control a device, the user gives voice commands to the system. System takes voice input given by the user, compares the input with previously saved directory. If matched, then the PIR sensor is activated for checking the presence of any human. If the human presence test passes then it activates the relay that is responsible to perform user intended operation.

The main feature of this system [2] is that the speech impaired people can use this system by gestures which make this system completely easy and simple for operating home appliances. This system is mainly used by people who are unable to speak and control home appliances through voice. In this paper, a new Hand Gesture Control in Augmented Reality System (HGCARS) is introduced in which the gesture recognition is performed using a secondary camera and the reality is captured using an IP camera. Based on input gestures the virtual object is projected to real world video.

In this paper [3], the concept of home automation using IoT is realized using a low cost microcontroller (raspberry pi) and an Android mobile phone. Raspberry pi is an open source platform that can be used for prototyping any hardware and software. Raspberry pi can be programmed to receive keyboard input or android application data or sensor data and control various electrical appliances connected to output peripherals. Since mobile phones are wireless communication devices, connectivity between raspberry pi and smartphone is established using Bluetooth, one of the short range wireless communication technologies that can be used for communication in an indoor environment. Operating at a universally available frequency of 2.4 GHz, it can connect digital devices within a range of 10–20 meters (theoretically expandable up to 100m, by increasing transmitter power) at the speed of 256 Kbps to 1 Mbps. Since the raspberry pi micro-controller unit does

not have an inbuilt Bluetooth module, an external HC-05 Bluetooth module is used for establishing wireless connectivity as shown in Fig 2. Once home appliances are connected to a raspberry pi board, they can be easily controlled using any Bluetooth enabled smart phone inside a smart home.

The Home automation system that uses Wi-Fi technology [5], consists of main components; web server, which presents system core that controls and monitors users home and hardware interface module(Arduino PCB, Wi-Fi shield, 3 input alarms PCB, and 3 output actuators PCB), which provides appropriate interface to sensors and actuator of home automation system. The System is better from the scalability and flexibility point of view than the commercially available home automation systems. The User may use the same technology to login to the server web based application. If the server is connected to the internet, remote users can access server web based applications through the internet using a compatible web browser.

The application has been developed based on the android system [6]. An interface has been developed to assure communication between the remote user, server, raspberry pi and the home Appliances. The application has been installed on an android Smartphone, a web server, and a raspberry pi to control the shutter of windows. Android application on a smart phone issues a command to raspberry pi. An interface card has been realized to update signals between the actuator sensors and the raspberry pi.

Cloud based home appliance monitoring and controlling System [7]. Design and implements a home gateway to collect metadata from home appliances and send to the cloud-based data server to store on HDFS (Hadoop Distributed File System), process them using MapReduce and to provide a monitoring function to Remote users.

It has been implemented with Raspberry Pi through reading the subject of Email and the algorithm. Raspberry Pi proves to be a powerful, economic and efficient platform for implementing smart home automation [8].Raspberry pi based home automation is better than other home automation methods in several ways. For example, in home automation through DTMF (dual tone multi-frequency) [10], the call tariff is a huge disadvantage, which is not the case in their proposed method. Also, in Web server based home automation, the design of web server and the memory space required is ejected by this method, because it simply uses the

already existing web server service provided by G-mail. LEDs were used to indicate the switching action. System is interactive, efficient and flexible.

Shih-Pang Tseng et al. [9] proposed Smart House Monitor & Manager (SHMM), based on the ZigBee, all sensors and actuators are connected by a ZigBee wireless network. They designed a simple smart socket, which can be controlled remotely via ZigBee. The PC host is used as a data collector and the motion sensing, all sensing data is transferred to the VM in the cloud. The user can use the PC or Android phone to monitor or control through the Internet to power-saving the house.

Arduino microcontroller to receive user commands to execute through an Ethernet shield. Our house network used together both wireless ZigBee and wired X10 technologies [11]. This system followed smart task scheduling with a heuristic for the Resource-constrained-scheduling problem (RCPSP). The mobile device can be either wired to the central controller through USB cable or communicates with it wirelessly, within the scope of the home. Arduino contains the web server application that communicates through the HTTP protocol with Web-based Android application. The system is highly flexible and scalable and expandable.

The home network which monitors the appliances and sensors which transmits data to the cloud-based data server which manages the information and provides services for users by transmitting data and receiving user commands from mobile applications [12]. The proposed system has good modularity and configurability characteristics with very low power consumption in a cost efficient way.

Application developed using the Android platform controlled and monitored from a remote location using the smart home app and an Arduino Ethernet based micro web-server [13]. The sensors and actuators/relays are directly interfaced to the main controller. Proposed design offers control of energy management systems such as lighting, heating, air conditioning, security, fire detection and intrusion detection with siren and email notifications.

Embedded system with Raspberry Pi acts as a communication gateway between mobile devices and Konnex-Bus (KNX) in home automation systems [14]. Store the information of all actors and sensors within a Smart Home, instead of using

separate profiles. Ensures energy-consumption could be reduced, compared to a standard desktop computer.

Dual Tone Multi Frequency (DTMF) used in telephone lines [15]. There are three components in the system: DTMF receiver and ring detector, IO interface unit, PC. The PC detects the ringing of the line and then authenticates the user and uses keypad tones to control the devices as required. An example of stepper motor control is taken up. This system has the advantage of being secure and allowing international standardization. This is because the DTMF tones are the same all over the world. But it suffers from the drawback that the number of appliances is limited by the number of keys in the keypad.

PIC16F887 microcontroller with GSM module used to control home appliances. [16]. It has high availability, coverage and security and also charges for SMS. Commands can be sent through the GSM network to control the home appliances. The system does not have any state information related to the devices and expects the user to keep track of it.

Arduino board is the controller used to control the appliances by using GSM technology. It uses certain peripheral drivers and relays to achieve this interfacing. The application on smartphones generates SMS messages based on the user commands and sends them to the GSM module attached to the Arduino and controls the home appliances [17]. The system has drawbacks of cost and reliability of SMS. An interface cannot be customized based on devices.

It has been designed by Arduino board with Bluetooth board for home automation [18]. A Python program is used on the cell phone to provide the user interface. The Bluetooth board has I/O ports and relays are used for interfacing with the devices which are to be controlled and monitored. The Bluetooth is password protected to ensure that the system is secure from intruders. The Bluetooth has a range of 10 to 100.

S.No	Year	Title	Authors	Remarks
1	2011	Bluetooth Based Home Automation System Using Cell Phone	R.Pivare, M.Tazil	Mobile application system using

				Arduino with low cost and secured
2	2012	Design and Implementation of a Wi-Fi Based Home Automation System	AhmedElShafee, Karim AlaaHamed	Web based application for temperature and humidity control motion detection fire detection
3	2013	Smart GSM Based Home Automation System	RozitaTeymourzadeh, SalahAddinAhmed, Kok Wai Chan and MokVeeHoong	PIC16F887 microcontroller is used to control appliances by sending messages
4	2013	Low cost Arduino/Android-based Energy-Efficient Home Automation System with Smart Task Scheduling	Kim Baraka, Marc Ghobril, Sami Malek, RouwaidaKanj, Ayman Kayssi	Android application for energy management and task scheduling with power and cost
5	2014	Remote control of a domestic equipment from an Android application based on Raspberry pi	HayetLamine and HafedhAbid	Android application with webserver and interface card used for controlling shutter of window

6	2014	Home Appliance Management System for Monitoring Digitized Devices Using Cloud Computing Technology in Ubiquitous Sensor Network Environment	YunCui, MyoungjinKim, YiGu, Jong-jinJung, and HankuLee	Smart device to monitor and control home appliances
7	2014	Raspberry Pi based Interactive Home Automation System through E-mail	Jain Sarthak, Vaibhav Anant and Goyal Lovely	Smart and efficient E-mail based system for switching lights
8	2014	An Application of Internet of Things with Motion Sensing on Smart House	Shih-Pang Tseng, Bo-Rong Li, Jun-Long Pan, and Chia- Ju Lin	PC or Android phone to monitor and control through the Internet to power-saving of the house.

9	2014	GSM Based Home Automation System Using App-Inventor for Android Mobile Phone	Mahesh.N.Jivani	Mobile application system for controlling home appliances by sending messages
10	2014	Internet of Things for Smart Cities	Andrea Zanella, Nicola Bui, Angelo Castellani, Lorenzo Vangelista, and Michele Zorzi	Logical controller with I/O interface system for authentication

				of user by ringing line
11	2014	Ubiquitous Smart Home System using Android Application	Shiu Kumar	Android application for controlling lights, switches, humidity and smoke/gas sensor
12	2014	Ubiquitous Smart Home Controlling Raspberry Embedded System	Jan Gebhardt, Michael Massoth, Stefan Weber and Torsten Wiens	mobile application system with improved performance and low power consumption
13	2015	Smart Power Management System For Home Appliances And Wellness Based On Wireless Sensors Network And Mobile Technology	Kim Baraka, Marc Ghobril, Sami Malek, RouwaidaKanj, Ayman Kayssi	Mobile application for monitoring home conditions and power consumption
14	2017	Hand gesture control of virtual object in augmented reality	S. Siji Rani, K. J. Dhriya, M. Ahalyadas	Android application to control home appliances by taking hand gestures as input commands

15	2017	Home automation by using raspberry Pi and android application	H Bharathi, U Srivani, M D Azharudhin, M Srikanth	Android application system using raspberry pi to control home appliances with low cost
16	2017	IOT based home automation by using personal assistant	V. Chayapathy, G S Anitha, B Sharath	Android application to control home appliances by taking voice commands from user as input

Diagrams

DFD -0

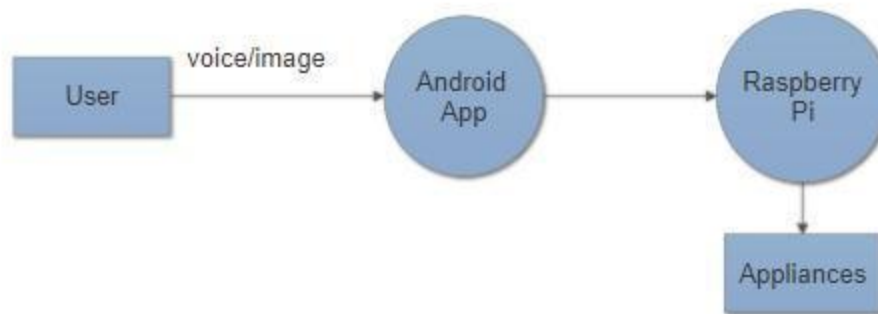


Fig.1 Data Flow Diagram Level 0

- Users and the home appliances are the end units.
- User interacts with the system using an android application and gives voice/text/image input.
- Raspberry pi receives processed input from applications and generates signals which are sent to devices.

DFD -1

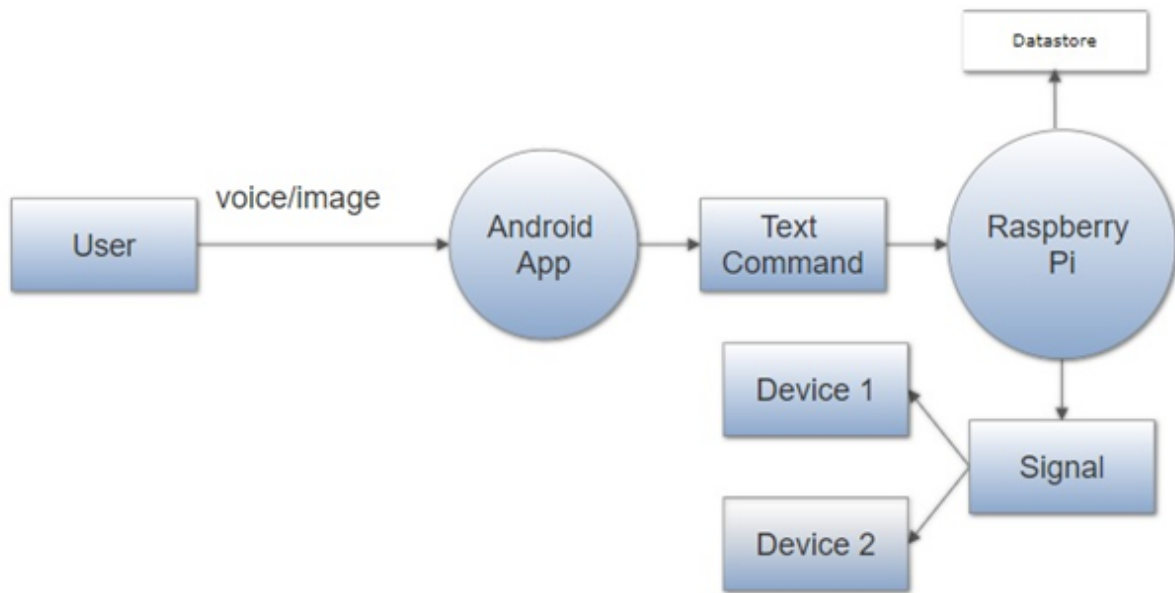


Fig.2 Data Flow Diagram Level 1

- Users and the home appliances are the end units external end units of the system.
- Users send text input to check power consumption to raspberry pi, raspberry pi responds with the units consumed by another text message.

Use Case

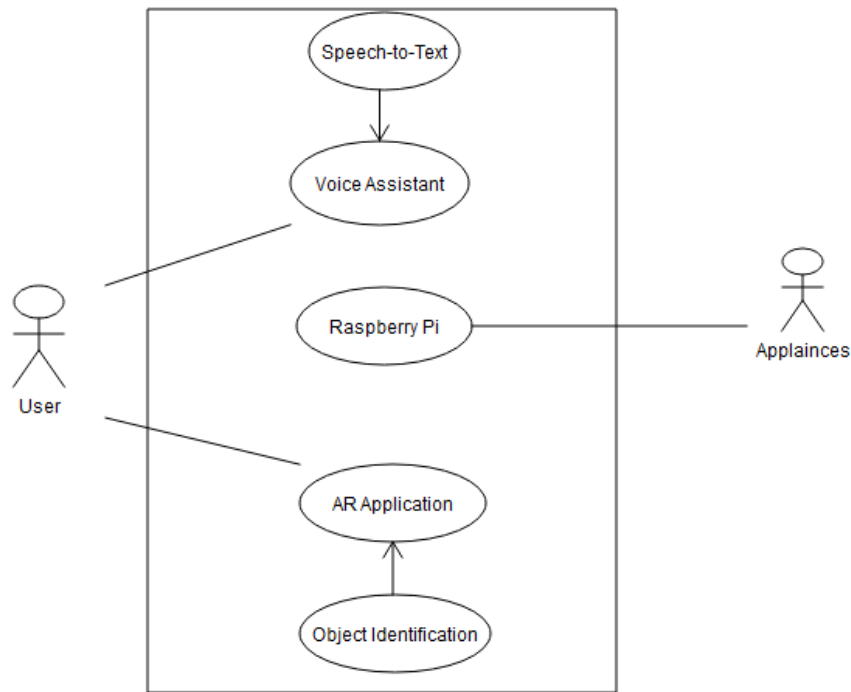


Fig.3 Use case diagram for “Virtual Home Automation”

- Users and home appliances are actors.
- Voice assistant application includes speech-to-text engine to convert voice input from user to text commands.
- AR application includes object identification to identify device scanned by user.

Sequence

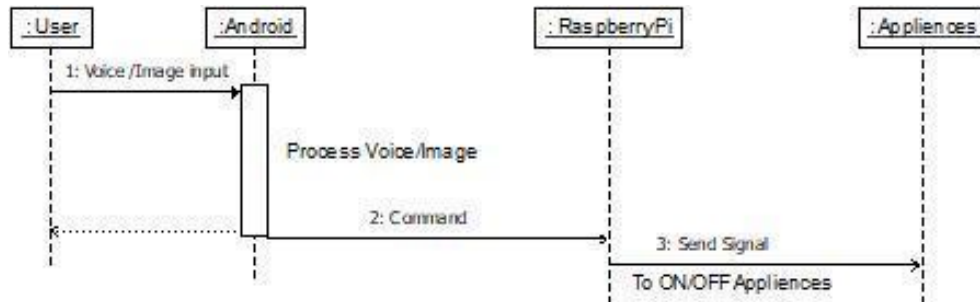


Fig.4 Sequence diagram for “Virtual Home Automation”

- Initially the user gives input to the voice assistant/augmented reality application.
- Application sends the processed input to raspberry pi.
- Raspberry pi is programmed in the python programming language. It generates command signals and sends signals to appliances.

Conclusion

With this work we develop a complete Virtual home automation system for visually challenged and speech impaired people which make their daily routine simple and easy.

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