Voice and Gesture Based Smart Home Automation using Raspberry PI

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Abstract: This paper proposes the design of Voice and Gesture Based Smart Home Automation using Raspberry PI. In recent years, the home environment has seen a rapid introduction of network-enabled digital technology. This technology offers new and exciting opportunities to increase the connectivity of devices within the home for the purpose of smart home automation. Moreover, with the rapid expansion of the Internet, there is the added potential for the remote control and monitoring of such network-enabled devices.

Speech control is an emerging innovative method to accomplish control tasks. In this work, a system is created to control two of the most human interactive activities; switching on and off of lights and fans using voice and gestures given input given by humans. This system improves the living standard by making life easier and increasing productivity.

Keywords: Firebase Server, Smart Home automation, Internet of Things, Raspberry Pi, Personal Assistant

I. INTRODUCTION

The Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data." (IoT). The development of the prototype will be made within a low budget in hopes to attract people. This work presents the design, specification, and prototype implementation of a composite smart home automation system using Wi-Fi module in raspberry pi. The research work provides multiple yet simple design approaches for developing flexible and robust smart home automation system to cater for the deficiency in overall control of user appliances. It also tackles the problems with complex, multiple, incompatible standards and the resulting expenses in the existing systems. Overall, the system extends the capabilities of smart home automation beyond the basic appliances switching and monitoring by giving broad control over the appliances' functionalities in addition to switching their power.

Smart Home automation system consists of switches and sensors connected to a central hub from which the systems are controlled with a user-interface that is interacted via a wall mounted terminal, mobile phone software or via a web interface. The smart home automation system is increasingly used due to the wide manufacturer brands and various available technologies. From a social point of view, residents are admitted to smart homes for comfort, luxury, improving quality of life, and for providing security against intrusion and burglars. Secondly, smart home automation is achieved using a single controller, monitoring and the controlling many interconnected appliances such as lights, power plugs, HVAC system, humidity and temperature sensors, gas, smoke and fire detectors, audio, video and home theatre as well as security and emergency systems.

Figure 1: Smart home Automation

Smart homes are cheap, low-power, cost-effective, efficient, and realize the automation of a variety of domestic appliances using user-friendly interface as the remote control or any other handheld devices. Elderly, handicapped patients and people with disabilities who have problems with locomotion difficulty can benefit from this smart home to totally operate, with high performance, all appliances, and devices from anywhere in the house. Smart Home automation plays a very important role in the modern era because of its flexibility in using it at different places with high precision which will save money and time by decreasing human hard work.

IoT is having the potential to change the lifestyle of peoples. In today's life, people prefer more of automatic systems rather than any manual systems. The major elements of the IoT based Smart home automation systems are Arduino Uno and Raspberry PI 3 for a personal assistant. Smart Home automation can be defined as an Automatically controlling Home Appliances through voices and gesture given as Humans. Ultimately it is a system that aims to heighten the quality of life with the automation of household appliances that may be controlled over the Internet.IPv6 allows us to assign a communications address to billions of devices. Electronics companies are building Wi-Fi and cellular wireless connectivity into a wide range of devices. ABI Research estimates over five billion wireless chips will ship in 2013.

II. LITERATURE SURVEY

This paper provides a simple introduction to the IoT, its application and potential benefits to the society. In day-to-day life, every people want to be smart by using home automation. This project is intended to construct a Smart home automation system controlled by Voice and Gestures This system is designed to assist and provide support in order to fulfil the needs of elderly and disabled beings in our society. The gesture mode and voice mode are used to control home appliances. The main control system implements wireless technology to provide remote access from a smartphone. The design remains the existing electrical switches and provides more safety control on the switches with low voltage activating method. The switches status is synchronized in all the control system whereby every user interface indicates the real-time existing switches status. The system intended to control electrical appliances and devices in the house with relatively low-cost design, user-friendly interface, and ease of installation. Implementation of a low cost, flexible home automation system is presented. It enhances the use of wireless communication which provides the user with remote control of various electronic and electrical appliances.

III. HOME AUTOMATION & HISTORY

The Internet Of Things, as a concept, wasn't officially named until 1999. One of the first examples of an internet of things is from the early 1980s and was a coca cola machine, located at the carnegie melon university. Local programmers

would connect by the internet to the refrigerated appliance, and check to see if there was a drink available and if it was cold, before making the trip. By the year 2013, the internet of things had evolved into a system using multiple technologies, ranging from the internet to wireless communication and from micro-electromechanical systems (mems) to embedded systems. The traditional fields of automation (including the automation of buildings and homes), wireless sensor networks, gps, control systems, and others, all support the IOT.

IV. SYSTEM DESIGN

A. Raspberry Pi

The Raspberry Pi is a series of a credit card–sized single board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science. They develop free resources to help people learn about computing and how to make things with computers. The Raspberry Pi 3 Model B is the earliest model of the third-generation Raspberry Pi. It replaced by Raspberry Pi 2 Model B in February 2016.

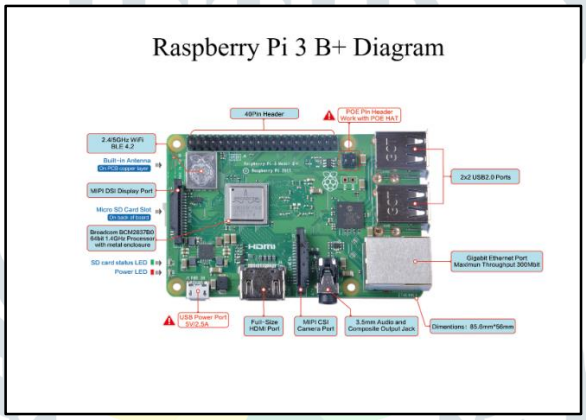

Figure 2: Raspberry Pi Board

Components:

1. Quad-Core 1.2GHz Broadcom BCM2837 64bit CPU
2. 1GB RAM
3. BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
4. 100 Base Ethernet
5. 40-pin extended GPIO
6. 4 USB 2 ports
7. 4 Pole stereo output and composite video port
8. Full-size HDMI
9. CSI camera port for connecting a Raspberry Pi camera
10. DSI display port for connecting a Raspberry Pi touchscreen display
11. Micro SD port for loading your operating system and storing data
12. Upgraded switched Micro USB power source up to 2.5A

B. NodeMCU ESP8266

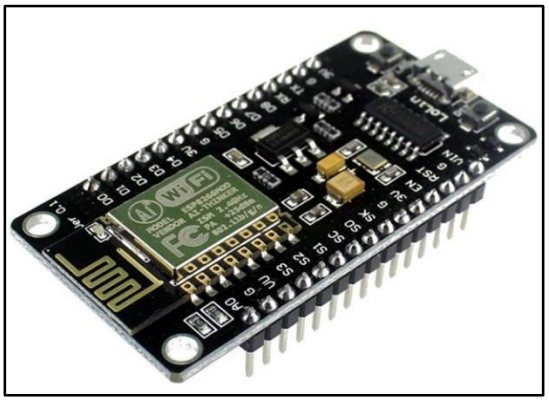

Figure 3: Block diagram of NodeMCU

With its USB-TTL, the NodeMCU Dev board supports directly flashing from a USB port. It combines features of a WIFI access point and station + microcontroller. These features make the NodeMCU extremely powerful tool for WIFI networking. It can be used as an access point and/or station, host a web server or connect to the internet to fetch or upload data.

Components:

1. programmable WIFI module.
2. Arduino-like (software defined) hardware IO.
3. Can be programmed with the simple and powerful Lua programming language or Arduino IDE.
4. USB-TTL included plug & play.
5. 10 GPIOs D0-D10, PWM functionality, IIC, and SPI communication, 1-Wire and ADC A0, etc. all in one board.
6. WIFI networking (can be used as an access point and/or station, host a web server), connect to the internet to fetch or upload data.
7. Event-driven API for network applications.

C. 4-Relay Module:

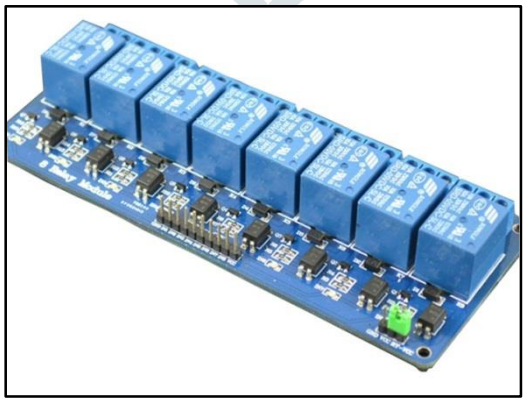

Figure 4: 4-relay Module

This is a 5V 4-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current. It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by a microcontroller.

Components:

1. Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)
2. Weight: 61g
3. CB Colour: Blue
4. There are four fixed screw holes at each corner of the board, easy for install and fix. The diameter of the hole is 3.1mm.
5. High-quality Single relay is used with single pole double throw, a common terminal, a normally open terminal, and a normally closed terminal.
6. Optical coupling isolation, good anti-interference. Closed at a low level with an indicator on, released at the high level with indicator off
7. VCC is a system power source, and JD_VCC is a relay power source. Ship 5V relay by default. Plug jumper cap to use. The maximum output of the relay: DC 30V/10A, AC 250V/10A

D. Camera Module

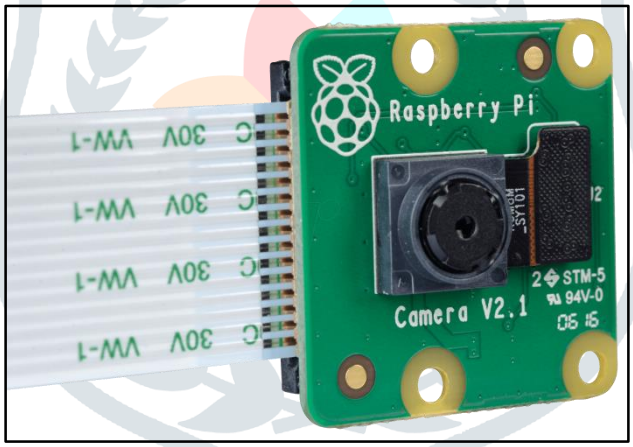

Figure 5: Camera Module

Components:

1. megapixel camera capable of taking photographs of 3280 x 2464 pixels
2. Capture video at 1080p30, 720p60 and 640x480p90 resolutions
3. All software is supported within the latest version of Raspbian Operating System

E. Microphone

This is a tiny USB Microphone that plugs into your laptop or desktop computer. No need to install any extra software; Microsoft Windows will detect the device and automatically install it. There is no need to configure the USB mini microphone, it can be used directly. You can also use it in Raspberry Pi which has been burned with Raspbian

Figure 6: Microphone

Components:

1. A TF card burned with the Raspbian
2. 5V DC power adapter, 2A or above with micro USB interface
3. HDMI interface display (or VGA interface display with a VGA to HDMI adaptor)
4. USB mouse and keyboard
5. Speakers or headphones in the standard of 3.5mm
6. USB mini microphone

V. METHODOLOGY

1. Hardware implementation:

Initially, the user will say something like switch on 'home appliance name' then personal assistant will start recognizing user's voice through a microphone that is connected to Raspberry Pi then that voice input gets converted to text first. It will compare with the dataset if match is found then control goes to the NodeMCU.

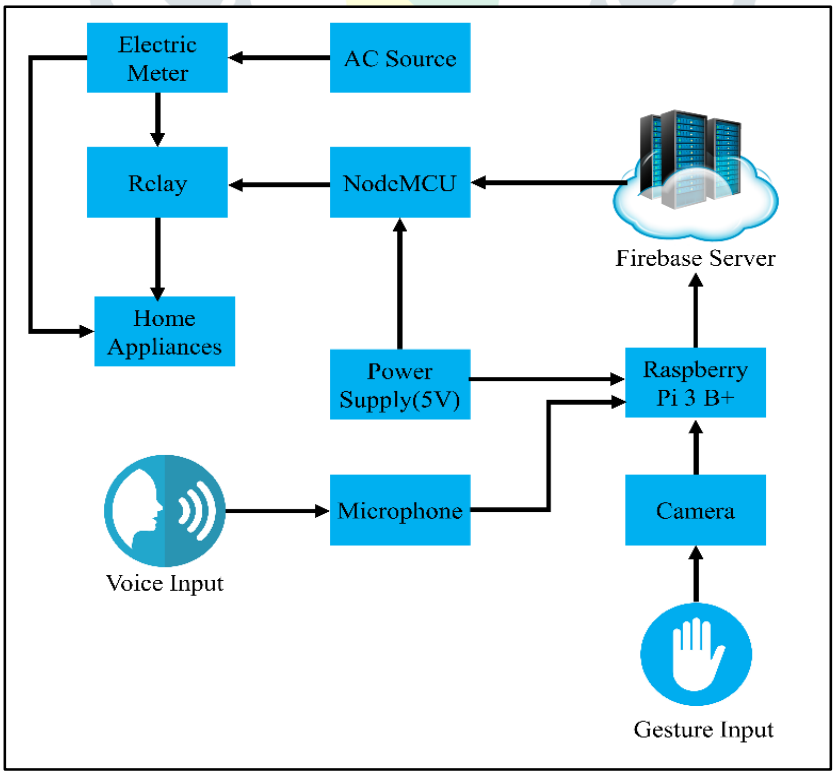

Figure 7: Block diagram of system

In this project thing-speak server is used. Similarly, in gesture mode camera will capture gesture in image format. This image is compared with picture data if a match is found then raspberry pi will send input to NodeMCU. Then it will check whether the input is high or low. Then control goes to the relay module and then power is supplied to respected pins.

2.Software implementation:

Programming is done using python programming and embedded C. The package used are speech recognizer and OpenCV. The speech recognizer is used for converting speech to text. whenever the user gives voice instruction it is converted to text and that text is compared with multiple functions. If a match is found then the device is turned ON or OFF. Similarly, in gesture mode hand gestures are compared with the dataset, if a match is found than for that gesture device is turned on or off accordingly. Devices can be operated using android application.

VI. SIMULATION AND RESULT

1. Working of Voice and Gesture based Smart Home Automation:

Figure 8: Working of Smart Home Automation System

Fig 8 shows the working model of this system. we have tested this system using a fan, led bulb and tube light. The fan, led bulb, tube light is connected to relay switch. For hand gesture input we have used picamera and for voice input, we have used a microphone to test the system. We have used firebase server for connectivity between android application and NodeMCU. Whenever the user says to turn on or off home appliances than data is sent to firebase server. NodeMCU will retrieve data from firebase server and will give 1 or 0 output to relay switch. Thus, the device will be turned on.

2. Layout of Android Application:

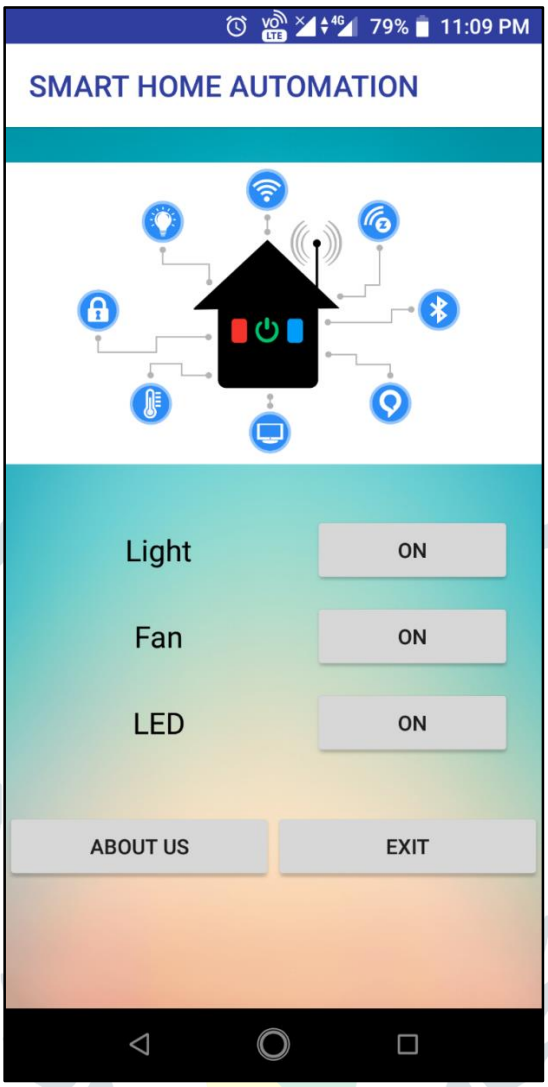

Figure 9: Android Application

Fig 9 shows the layout of an Android application. This Android Application can be used to operate the home appliance anywhere from this world. This android application is connected to Firebase server. Firebase server is used to collect data transmitted by raspberry PI and android devices. This android application supports Android version higher than 4.0.3.

3. Activity Diagram:

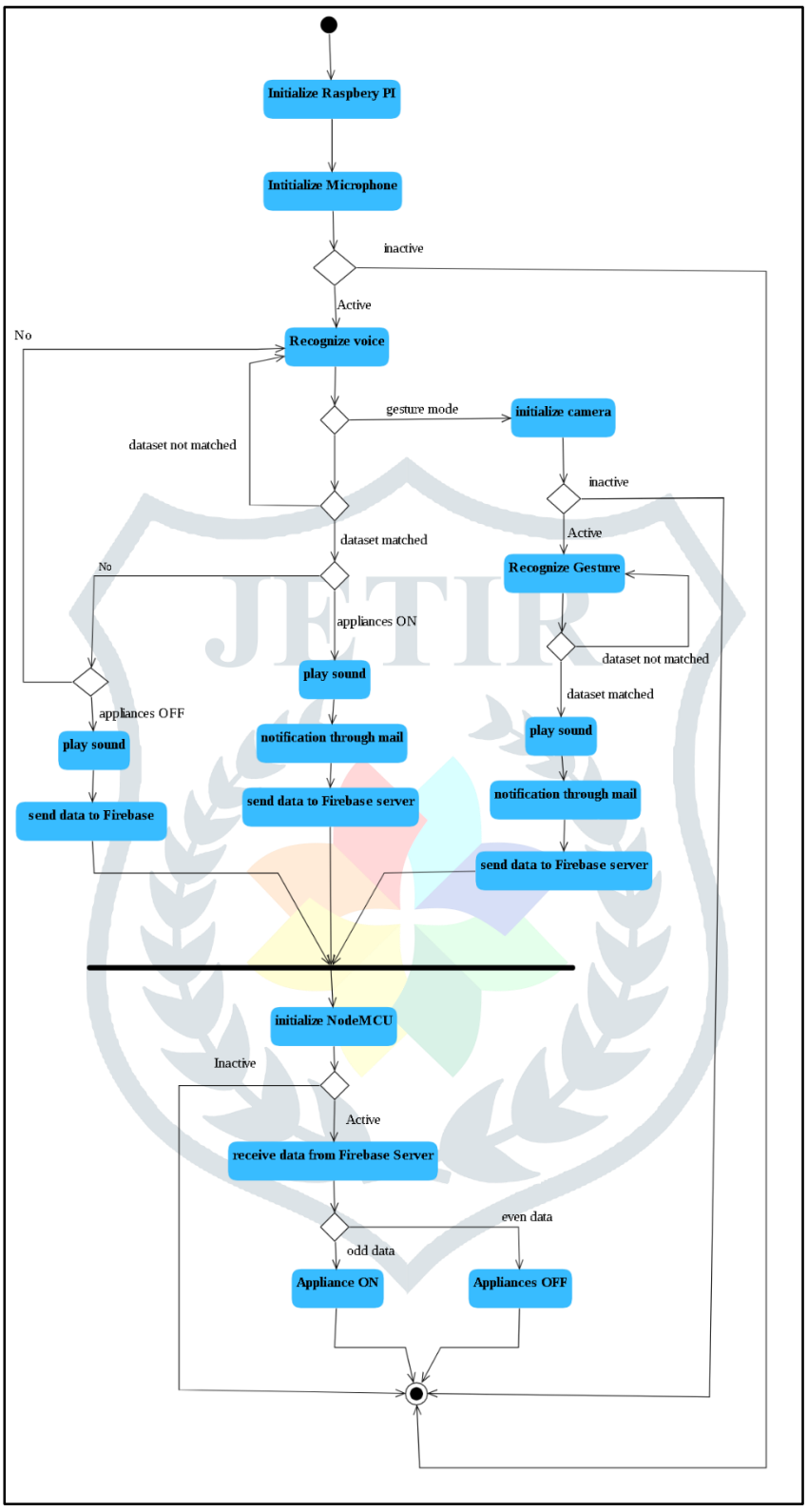

Figure 10: Activity Diagram of Smart Home Automation.

CONCLUSION

The work for IoT based smart home automation is completed successfully using internet source and Raspberry Pi. It is reliable and scalable home automation system with low cost and easy to implement. It makes human life easy and comfortable. It is possible to operate home appliances from any part of the globe.

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REFERENCES

1. Theodore Ramli, Natashia Nabiha Dabimel, Mazlina Mamat, Norfarariyanti Parimon, Rosalyn R. Porle "Simple speech-controlled home automation system using android devices." ISSN 1115-7569.
2. Poonam B. Patil, Rupali R. Patil, Swati V. Patil, Avadhoot R. Telepatil. "Home Automation System using Android and Arduino board." ISSN: 2319-8753
3. Khusvinder Gill, Shuang-Hua Yang, Fang Yao, and Xin Lu "A ZigBee-Based Home Automation System." ISSN: 2134-5548
4. Sumanta Dey, Amit Das, Anupam Mishra, Debayan Dutta "Gesture Controlled Home Automation." ISSN 2349-4395.
5. Prof B.P Kulkarni , Aniket V Joshi , Vaibhav V Jadhav, Akshaykumar T Dhamange4 " IoT Based Home Automation Using Raspberry PI (International Journal of Innovative Studies in Sciences and Engineering Technology)" Vol 3, Issue 4, April 2017, ISSN No: 2455-4863.
6. Krishna Rathi, Dinesh Patil, Sayli Bhavsar, Ketaki Jadhav, Prof. Saurabh V. Thakur "Gesture Human-Machine Interface (GHMI) in Home Automation (International Research Journal of Engineering and Technology (IRJET))" Vol 4, Issue 6, June 2017, ISSN No: 2395-0072.
7. R.Aravindhan, M.Ramanathan, D.SanjaiKumar,R.Kishore "HOME AUTOMATION USING Wi-Fi INTERCONNECTION (International Research Journal of Engineering and Technology (IRJET))" Vol 4, Issue 3, March 2017 ISSN No: 2395 -0056.
8. Dheeraj Kumar, Swati Singh, Neha Singh "Home Automation via Bluetooth using Android Application (ABHIYANTRIKI, An International Journal of Engineering & Technology)" Vol. 4, Issue 4, April 2017, ISSN No: 2394-627X.
9. Kalyani Pampattiwar, Mit Lakhani, Rinisha Marar and Rhea Menon "Home Automation using Raspberry Pi controlled via an Android Application (International Journal of Current Engineering and Technology)" Vol 7, Issue 3, June 2017, ISSN No: 2347 – 5161.