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Iot Based Raspberry Pi Home Automation System Using Amazon Dot

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ABSTRACT: This project presents the design of the low cost home automation system using the IoT(Internet of Things) technology along with the feature of Amazon Dot. The Internet Of Things (IoT) is the most trending technology today alongside the wearable's and robotics. Devices in your home (or wherever they are) have the capability to communicate with each other via the internet wirelessly. This technology usually uses sensors to pass data to the internet. In this paper, we focus on making non-smart homes smart and how to build a robust, cost-effective system that can be widely used. We power our system using Amazon Dot, Amazon's cloud services its speech services for recognizing user request. The computing module used is a Raspberry Pi 3 model B acts as the brain of this system, processing the user requests, responding to the requests. A Raspberry Pi 3 is used as the hardware component for providing smart features for non-smart homes. The project also aims to provide Voice controlled web-based Raspberry Pi home automation system that will allow you to control any appliance in your home from anywhere in the world using normal HTTP protocols. We describe the different components of our product and we show that our system works effectively to switch on and switch off our appliances. This system very much useful for **Physically challenged People.** (who cannot move their limbs but can speak and listen) through various voice commands based on concerned parameters which is also eco-friendly.
keywords: Home Automation, Raspberry Pi 3, Amazon Echo(Alexa) ,Internet of Things (IoT).

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I. INTRODUCTION

Fig. 1. Raspberry pi 3 model B
Fig. 2. Amazon Dot

A Home is considered to be Smart when it is fully equipped with smart technologies like lightning,heating, multimedia, security, window and door operations as well as many other functions.Automation plays an increasingly important role in the global economy and in day by day encounter.For the development of smart cities ,there is need to automate everything, so the concept of smart home automation system is an idea which is used to make city smart. People who are working are so busy so that they often forget to turn off their electrical devices when they are leaving the house for work. Those devices consume the electricity whole day so it leads to huge amount of electricity to go waste. So to overcome this problem Smart Home Automation System concept has been introduced.

1.1.Internet of Things (IoT)

Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. IoT digitizes our world, providing us with prolific amounts of data & new delivery models that allow business to engage in new value creation special needs with a system that can respond to voice command and control all the appliances or devices in the home. I.e. objects that

have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention. The system should be cheap, easy to configure, easy to use and easy to run.

1.2.Amazon Echo Dot

Amazon Echo Dot is small, light weight beautifully designed smart speaker manufactured by Amazon. It is hands-free voice enabled that uses Alexa to play the music, read the news, making to-do lists, setting alarms, streaming podcasts, playing audio books and providing weather, traffic and other real time information. It can also control several smart devices using itself as a home automation hub. Not only intelligent home but intelligent and smarter you.

1.3.Raspberry Pi

Raspberry Pi is a credit card-sized computer originally designed for education, inspired by the 1981 BBC micro. Raspberry Pi 3 is used which is installed in the home and all the appliances are attached with it through the relay. It also leads to the development of smaller devices. Computer gets cheaper and smaller in size. Single Board computer (SBC) is a single circuit complete computer with Memory, Input/output (I/O) and different components of computers. Raspberry pi is an example of SBC that is popular and easily available in the market. We use the Server-client design pattern to communicate between the Amazon Echo Dot and the Raspberry Pi. The Amazon echo runs a Node js program and the Raspberry pi runs a Python program to communicate with each other and control the devices. The aim of the wireless home automation system through voice mainly targets elderly and disabled person. In this paper I will show you how to make web-based Raspberry Pi home automation system that will allow you to control any appliance in your home from anywhere in the world using normal HTTP protocols.

1.4. Web Interface

The Raspberry pi hosts the web pages to control devices through an Apache web server. The web pages include index.html, controller.php, button.php, checklogin.php, logout.php. There file defined for each relays containing the string “ON” or “OFF”. The index page acts as the home page. Once user logs in with a username and password the check login page checks the credential with a preset credential. If a match occurs user will be redirected to controller page with after setting a session variable else user will be redirected to login page. In the controller page user can switch device on or off through buttons. On press of each button a button page is invoked which checks the button id and writes appropriate string to the corresponding relay file. A python script is used called iot.py. It monitors the content of the files for each relays. Based on the content of the file i.e. either “ON” or “OFF” the python scripts turns the GPIO pin high or low for each of the relay connected to it. Thus the relay turns on and off based on user input and any appliance can be connected to it to get controlled via internet.

II. RELATED WORK

In this section, we will present the various systems available in the market and also the recent advancements in the research working in this area. Most of the state-of-the-art systems today can be integrated with IFTTT recipes[1]. To give some context to the reader, IFTTT is the acronym of If This, Then That. It is an initiative in the Internet of Things space where several services can be integrated to provide a robust solution. A. Existing Products The smart home space has seen a lot of industrial investment in the recent years. The following are some of the successful smart home products available today:

Lifx Color 1000: Lifx's second-gen smart bulbs are brighter and more efficient. It has an easy-to-use app, the integrations with IFTTT and Alexa, and the fact that Lifx bulbs don't need a hub is also an advantage.

Philips Hue Wireless Dimming Kit: The Philips Hue Wireless Dimming Kit is a simple, and affordable way to get started with smart lighting. It allows you to control the lights of your home using voice and the internet. It also allows you to control the intensity of the light.

III. TECHNOLOGICAL STACK

In this project, we have integrated many technical components and established a seamless functionality among them. Our technological stack is delineated as follows:

Physical Layer: This layer comprises of the devices with which the user interaction takes place:

1) Raspberry Pi 3 Model B [11] - enabled with Wi-Fi.

Fig. 3. Technology Stack

2) Amazon Echo - Smart Personal Assistant device that is present in the user's home. It is triggered using voice commands. Based on the request made, a response will be returned to the user.

Application Layer: This layer consists of the following components:

1) Alexa Skills Kit (ASK) [12]-It is a minimalist Software Development Kit (SDK) for developing "skills" for the Amazon Echo.

2) Amazon Web Services(AWS)Lambda [14] - Functionality that runs programs when invoked rather than hosting programs on a server.

Programming Layer: The source codes of all our programs are written in Python 2.7 and Node.js 4.3. The technological stack is elaborated in the following sections.

A. DEVICES

The input is given through Amazons Echo. Echos natural lifelike voices result from speech-unit selection technology.It is able to perceive what the users are saying using NLP algorithms built into the Echos text-to-speech (TTS) engine. The Echo hardware complement includes a Texas Instruments DM3725 ARM Cortex-A8 processor, 256MB of LPDDR1 RAM and 4GB of storage space. It connects to the internet through WiFi 802.11a/b/g/n. The Raspberry Pi serves as another I/O device. A Raspberry Pi is a credit card sized computer that can run operating systems including Raspbian, Fedora and Windows. For this project, we have used a Raspberry Pi 3 Model B, which uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache.

B. INFRASTRUCTURE

Alexa voice services powers Amazon Echo by converting speech into text and giving intelligent replies to user requests. Alexa is capable of voice interaction, music playback, making to-do lists, setting alarms, streaming podcasts, playing audio books, and providing weather, traffic and other real time information. Alexa can also control several smart devices using itself as a home automation hub. Amazon has released the System Design AVS API that allows Alexa to integrate with devices and applications. AWS Lambda is an event-driven, server less computing platform provided by Amazon. It is a compute service that runs code in response to events and automatically manages the compute resources required by that code. The purpose of Lambda, as compared to AWS Elastic Compute Cloud (AWS EC2)[15], is to simplify building smaller, on-demand applications that are responsive to events and new information.AWS targets starting a Lambda instance within milliseconds of an event. Node.js, Python and Java are all officially supported languages. Moreover, choosing AWS Lambda is much more cost-efficient option in this scenario.

C. CODEBASE

Node.js. is used to seamlessly integrate AVS with Raspberry Pi. Node.js package system is called npm which comes with a lot of libraries making it a very efficient and flexible choice for programming. In addition to Node.js, we have also used Python to build the Computer Vision module. Python comes with inbuilt libraries that manipulate images according to the users needs. There are also many implementation of face detection algorithms in python which utilizes both complex algorithms like HOG to simple ones like Haar Cascade. For coding this, we have used Python 2.7 which has been a stable release since 2010.

IV. PROPOSED METHOD

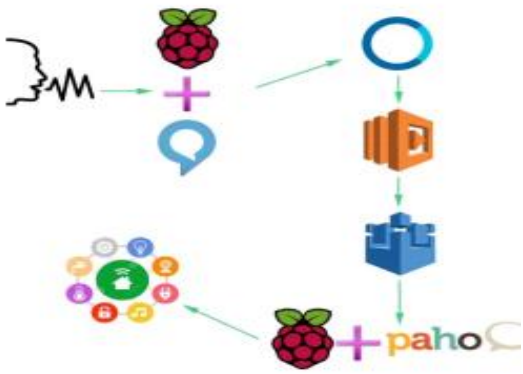

Fig. 4. System Design of Proposed Method

A. System overview

Our system as shown in Figure 4 User, Raspberry Pi and Alexa Voice Service .In this section, we will explain briefly about each component's role to make the system function.

B. Alexa Voice Service (AVS)

Alexa Voice Service is the intelligent voice control service that powers the device, Amazon Echo. Alexa uses natural language processing techniques trained by the developers and the user community of Amazon to process user requests and cater to their individual needs. The voice service can be triggered using the keyword ”Alexa”. As mentioned earlier, the skill/application that we have developed can be triggered using the voice command, ”Alexa, Turn the lights on”. Once Alexa is triggered, it runs a script on the cloud, which in turn runs a subroutine on the Raspberry Pi to Switch on the light. Once computation is done in the Raspberry Pi, it sends the confirmation back to Alexa. Only the essential information is sent to Alexa which passes it on back to the user.

C. Raspberry Pi

Our application relies on Raspberry Pi as it satisfies the hardware requirements and also does all the computation. The Raspberry Pi has a Wi-Fi and it will use the relay to switch on and switch off the appliances.

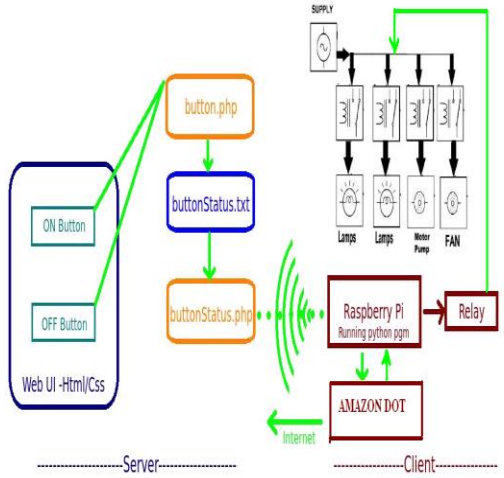

Fig. 5. Extension Method Block Diagram for Raspberry Pi Home Automation

You can consider the whole system to be composed of two parts: server and client. Here, the server is the web interface, consisting of buttons and UI (user interface) that will allow you to turn a device on or off. It consists of PHP files, HTML files, and a .txt file (to store data). The server usually stores information regarding the button press on the page (ON/OFF) on a .txt file. An example of this UI is Maker Pro IoT Implementation.

This is a simple HTML file called main.html, which consists of two buttons. The clicking of the buttons will trigger the execution of a PHP file called button.php. This program serves as an API (application programming interface) to store data on to a text file called buttonStatus.txt. The data is a string: "ON" if ON button is clicked, and "OFF" if OFF button is clicked. Thus the current button-press state is recorded in the text file buttonStatus.txt.The client side consists of a Raspberry Pi3 with a relay circuit connected to its GPIO pin with voice commands through Alexa. The Pi runs a Python program which is used to "post" a URL link using urllib2.

That is, the Pi constantly reads the contents of a URL link. Here, the URL link is another PHP file called buttonStatus.php. This PHP file serves as an API to read the contents of the text file buttonStatus.txt. After reading the data, the Python program checks if the string obtained is "ON"/"OFF" based on which it switches ON/OFF the relay respectively via its GPIO pin.

V. TECHNOLOGIES USED

Platform and Language Used :
1) IoT platform for Pub Sub Services
2) Node.js
3) Linux based Raspbian OS (Jessey Debian)

VI. RESULTS

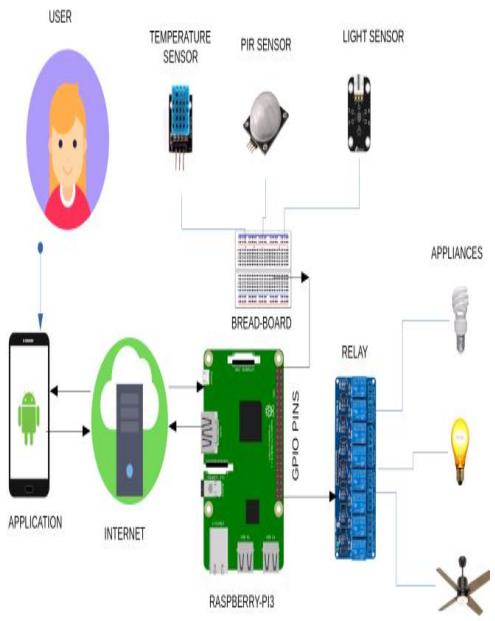

Fig. 6. IoT based Smart Home

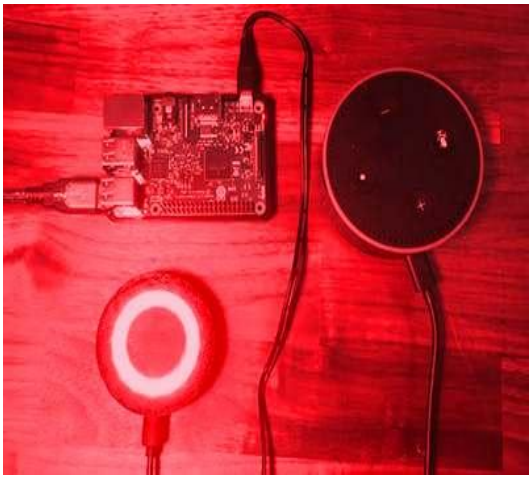

Fig. 7. Experimental setup

VII. CONCLUSION

The smart home space has a lot of interesting challenges to be solved. These kinds of home automation systems are required because human can make mistakes and forgot to switch off the appliances when there is no use and in this case, they are useful in order to utilize the power effectively and also in a secured manner. Raspberry Pi being an intelligent platform using which multiple appliances can be connected to each other and can be controlled from a longer range of distance because the connection which is to be used would be through the internet. Due to which appliances, can be accessible easily. Home Automation system is a leading step towards the increase in the technological advancement in the industry of appliances and another method by which the human errors can be avoided and the energy consumption can be reduced. Raspberry pi based automation is a novel and advance technology. Raspberry Pi simplifies the process of automation. Use of raspberry pi model B to control relay which will be further useful for controlling home based appliances, thereby reducing the price of the system. The nature of our proposed system is such that it provides a great scope for further development. For future work, proposed system will be extended for power managing mode which in a way will help user which when switched on will make all the appliances connected to the system to consume a minimum amount of energy and thus reduce the power consumption by entire home.

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