Amazon Alexa Based Home Automation Using Particle Photon

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ABSTRACT

Amazon Voice Service (AVS) is one such technology which can helps to achieve this goal with Internet of thinking (IOT) of flexibility. Particle Photon is one of IOT device which contain microcontroller and wi-fi module interface with Amazon Alexa. In this project, a hands free Amazon Alexa voice service (AVS) prototype is build on Particle photon. This project is further extended by adding skills to Amazon alexa to control or operate any appliances in home as well as in industries on our command voice.

Keywords : Amazon Echo, Alexa, Automation, Internet of Things (IoT).

I. INTRODUCTION

1.1 Amazon Alexa

The idea of human machine interaction using voice led to research in Speech technology and Automatic speech recognition uses the process and related technology for converting speech signal into a sequence of words or may be other linguistic units by means of an algorithm implemented as program.

Today, there are many devices or software and technologies available for smart work or smart operations which has doing very easily without any hard work. Just like Ok Google, it is already present in our smart phones; which is doing maximum task in smart phone only giving a command.

Amazon alexa is one of the smartest device among them. Amazon Alexa Echo dot is a small device which has voice-enabled wireless speaker developed by amazon lab 126. Amazon alexa is available in two model or size. The Amazon Alexa can be connects to the voice controlled intelligent personal assistant service Alexa, which wake up or activate responds to the name "Alexa". This device is capable of voice interactions, music playback, making to-do lists,

setting alarm, streaming podcast, playing audiobook, and providing weather, traffic and other real time information. It can also control several smart devices using itself as a home automation hub. Home automation is a very expensive luxury that a lot of people in India and other countries.

Figure 1. Amazon Alexa

This project aim and objective is to build a smart voice enabled device based on Alexa Voice service by using Particle Photon. It demonstrates how to access and test AVS using our Java sample apps, a Node.js server, and a third-party wake word engine. Alexa voice service is Amazon's intelligent voice

recognition and natural language understanding service that allows to voice enable any connect device. Alexa, the voice service provide capabilities to interact with the device in a more intuitive way. This Alexa-enabled device also provide a platform for experimenting with the current services and adding new skills to it. In the default mode the device continuously listens to all speech, monitoring for the wake word to be spoken, which is primarily set up as "Alexa". It requires a wireless internet (Wi-Fi) connection in order to work. Its voice recognition capability is based on Amazon Web Services. Amazon Web Services (AWS) is a secure cloud service platform which offers computing power, database storage, content delivery and other functionality to help businesses scale and grow. The device performs well with a 'good' Internet connection which minimizes processing time due to minimal communication round trips, streamable responses and geo distributed service endpoints. While the Alexa app is free, an amazon account is required, and setup is not possible without one.

1.2 Particle Photon:

Small and power Wi-Fi connected microcontroller: Based on Cypress's WiCed architecture, the particle photon series combines a powerful STM32 Arm Cortex M3 microcontroller and a cypress Wi-Fi chip. This keeps to footprint small but the function board.
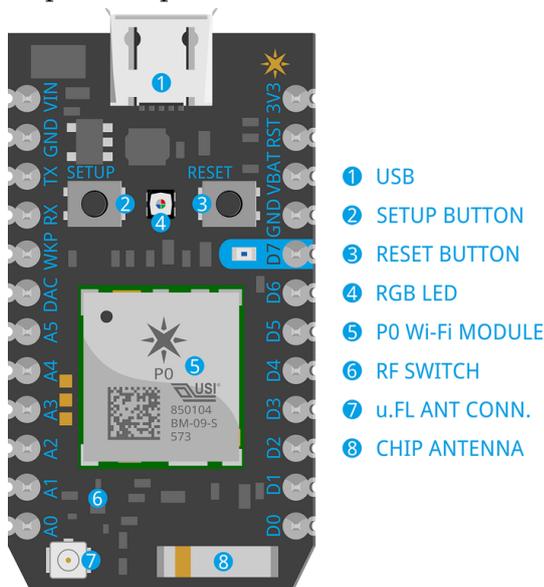
Figure: Particle Photon

1.2.1 The Wi-Fi Module:

This is probably why you bought your device—the Wi-Fi module allows your Photon to communicate with the Internet in the same way that your smartphone might connect to a Wi-Fi network. Do not press down on the Photon's module. Doing so triggers a reset and is generally not good for the Photon.

1.2.2 The microcontroller:

The microcontroller is the brain of your device. It runs your software and tells your prototype what to do. Unlike your computer, it can only run one application. This application can be simple or very complex, depending on what you what you want to do. The microcontroller interacts with the outside world using pins.

The Particle Photon has a powerful STM M3 microcontroller as its brain and a Broadcom BCM43362 Wi-Fi chip as its connection to the internet. 18 mixed GPIO pins and a web-based IDE similar to Arduino IDE makes it easy to give connectivity to your project. The Photon has an RGB LED and two buttons--Setup and Reset--to switch between different modes to help debug your project. Particle is an open source platform, so you have access to all of their schematics and code to easily improve upon their products. Spark Fun has taken advantage and created a Photon Red Board, which gives the Photon the form factor of an Arduino so you can use your favorite Arduino shields with the Particle service.

The Photon itself is just like a breakout board for their Wi-Fi module called the P0, which contains the microcontroller and Wi-Fi chip, but not antenna. The Red Board uses the P1 module, which is the P0 with a built in antenna. Both of these come preloaded with Particle firmware and access to their cloud service, but requires a custom breakout board to give access to all of the pins.

Particle makes it easy to go from prototype to large scale manufacturing with these three modules. This four part series will let you know what to expect with the Photon and help you get started to making your own internet of things.

II. LITERATURE SURVEY

In today's growing world the technologies are evolving to make life easier, to make life better. One such new tech is human-machine interaction using voice. Many intelligent Voice assistants are available today:

Amazon Echo (shortened and referred to as Echo) is a smart speaker developed by Amazon.com. The device consists of a 9.25 inch (23.5 cm) tall cylinder speaker a seven-piece microphone array. The device connects to the voice –controlled intelligent personal assistant service Alexa, which responds to the name "Alexa". This 'wake word' can be changed by the user to "Amazon", "Echo" or "Computer". The device is capable of voice interaction, music playback, making to-do lists, setting alarms, streaming podcasts, playing audiobooks, and providing weather, traffic and other real time information. It can also control several smart devices using itself as a home automation hub.

III. METHODOLOGY

As we all know Amazon recently release Alexa Smart Home Skill API. Amazon Alexa provides built-in smart home capabilities like turning on/off lights, controling air conditioner. Developer can use Alexa Smart Home Skill API to extend the smart home capabilities of Alexa. For Smart Home Skill APIs you don't need to create a custom voice interaction models. Alexa has built-in standard interaction models for smart home, like:

Alexa, turn on lights,
Alexa, set light to 50 percentage,
Alexa, set the temperature to 24.

Previously Alexa works with a limited number of smart home devices like Philips LG, etc... But with this newly introduced Smart Home Skill APIs we can integrate devices that are not supported by Alexa by default. Recently I started working on integrating with Particle Device and Smart Home Skill API. It is fairly simple to create a Smart Home Skill if you already know how to create a Alexa Skill. I have created a Skill before using Particle Photon. The only issue was to figure out how to integrate OAuth2 login with Particle photon. Smart Home Skill API needs a server that supports OAuth2 Authorization Code Flow With the help awesome people like ... I was able to integrate OAuth2 with Particle photon.

In this project, I emulate two lights that can be turned on-off using Alexa Voice Interaction. For the purpose of this demo, I have connected two LEDs to pins A4 and A5.

Describing how to create a Smart Home Skill is not in the scope of this article. For a detailed explanation of how to create a Smart Home Skill.

In order create Smart Home Skill, Amazon requires a server that supports OAuth2 Authorization Code Flow and Cloud API to control devices. At time writing this article, Amazon does not supports devices without Cloud APIs. Also as of now Alexa Smart Home Skill API supports only two types of devices, lights and air conditioners. But you can hack it to work with other type of devices also. By default the Skill you creates will be private to your account. After testing you can submit to Amazon for review and if it is approved you can make open for public. After the Skills is created, you have to enable it using the Alexa application. To enable it select Skills from side menu and find and enable your skills and Then start discovering device using the Smart Home items in menu. This will asks you to login to the cloud using the OAuth2 and Once you successfully authenticated the access token will be saved and it will be passed on to your Lambda function.

When the device discovery is performed, the Smart Home Skill API will call the Lambda function attached to the Skill with Alexa Connected Home. Discovery event. When this event is received your Lambda function will return to the device list. When the user controls these devices using voice input, the Lambda function attached to the Skill will be called with Alexa. Connected Home. Control event and you can call the Cloud APIs to control the device. For a more detailed explanation of how to create Skills and Lambda function.

Some of the screenshots of the Skill Information and Lambda function is given below:

- The Particle firmware emulates two lights using LEDs. These LEDs are attached to the A4 and A5 pins. The firmware has functions to turn on-off the LEDs and to set the brightness of the LEDs.
- Alexa Smart Home Skill has Skill information and the Lambda function. The Skill information contains the details about the skill such as Skill name, OAuth2 details, etc. The Lambda function responds to the Smart Home Skill Events.

User can interact with skill using voice input such as follows:
- *Alexa, turn on fan*
- *Alexa, turn off fan*
- *Alexa, set fan speed to 50 percente.*
- *Alexa, turn on kitchen light*
- *Alexa, turn off kitchen light*
- *Alexa, set kitchen light to 60 percentage.*

- The Particle application is really simple, just read temperature and humidity from a DHT22 sensor. Also it has two functions to control two LEDs Red and Green. The firmware exposes three functions.
- *gettmp* returns temperature, *gethmd* returns humidity and controls the LEDS attached to D2 and D6. On the Amazon Echo side, we have to

use Alexa Skill Set to interact with it. For this I have created one Alexa Skill Set.

Following are some of the interactions possible:
User: Alexa, ask particle, what is the temperature?

Alexa: Temperature is 40 degree. Same as:

User: Alexa ask particle, what is the humidity
 Alexa: Humidity is 75%.
User: Alexa, tell particle to turn on blue light
Alexa: OK, blue light turned on.
User: Alexa, tell particle to turn off blue light
Alexa: OK, blue light turned off.
User: Alexa, tell particle to turn on yellow light
Alexa: OK, yellow light turned on.
User: Alexa, tell particle to turn off yellow light
Alexa: OK, yellow light turned off.
User: Alexa, tell particle to turn on fan
Alexa: OK, fan turned on.
User: Alexa, tell particle to turn off fan
Alexa: OK, fan turned off.
      Similarly we can implement any appliences in home as well as office using this Alexa based with any IOT devices and third party.

IV. CONCLUSION

Amazon echo is a voice assistant device and it provide a way to communicate with it via voice and also can provide different services like of delivery food, request Taxi, weather, news, Wikipedia, traffic, music, any smart home automation / IOT device. So it can be used almost anywhere like in home as well as office.

On focusing on technology and automation to reduce importance of the servants in home as well as in industries. Whatever any task of home, we do that task to order to amazon Alexa. Just example, Alexa turn on the light, it will turn on the light; Alexa book the cinema ticket at corner seat it will book the ticket, etc. This project control some home appliance in our

own demand or order. This project is responsible for change the life of human being is faster,

safe and luxurious.

4.1 Advantage

Amazon Alexa advantage can be found in certain categories:

1. It has a specialty for Far-field voice recognition.
2. It is able to interact Omni-direction sound.
3. Desktop Alexa device has Bluetooth Enabled
4. Companion with Android, iOS.
5. Echo can be extended with the help of custom skills.

4.2 Disadvantage:

Alexa Disadvantage can be found in certain categories are as follows:

1. Sound quality - directly comparing the echo sound quality compared with other high quality speakers falls short and that being said the frictionless use of voice makes an improved experience.
2. Complex tasks - Alexa cannot process complex commands such as Alexa play U2 and order me Uber it lacks the ability to handle multiple commands based skills
3. Cost - There is a cost factor of selling a $150-$180/unit

4.3 Application

1. Asking general question to get answer (information).
2. Making to do list for shopping purpose.
3. Playing game with Alexa.
4. Play music on mobile or controlling other mobile functions.
5. Control home appliances like light air conditioner and fan etc.

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