Problem

The popularity of virtual assistants such as Amazon Alexa has made it increasingly easy to interact with everyday technology. Basic household items such as clocks, refrigerators, lights and vacuums are becoming smart devices capable of integrating with mobile devices and virtual assistants. There is immense potential for smart home devices, but there are significant challenges to integrating DIY projects with these advanced systems. The Raspberry Pi Foundation is a charitable organization that develops the Raspberry Pi computer. Although Raspberry Pi projects are easy to setup as standalone projects, it can be difficult to integrate them with voice assistants such as Amazon Alexa. Popular methods that currently exist often involve using libraries that trick Amazon Echo devices into thinking the Raspberry Pi is something else, such as a Wemo device. There needs to be a better way for people with limited programming experience to integrate their small projects while still following the approved developer practices.

Solution

Amazon Alexa was initially released in November 2014, and the Alexa team recently introduced Alexa Gadgets. These gadgets are devices that pair with an existing Amazon Echo using Bluetooth. They have some basic physical requirements such as having support for Classic Bluetooth (4.2) and a 16kb for a protocol buffer. The gadgets can pass events and can receive directives from the Echo. The Echo device communicates with the cloud to process input and to get updates. This architecture allows for complex behavior to be processed outside of the gadget hardware and keeps the cost and power consumption of the gadgets down. They do not need a wifi connection on the gadget to
be linked with the cloud. While Raspberry Pi and Arduino projects typically have many tutorials and sample projects to work from, Alexa Gadgets currently have very limited 3rd party documentation. The aim of my project is to learn about Alexa Gadgets and to make it extremely easy for others to connect Raspberry Pi projects to Alexa. I will do this by creating my own Alexa Gadgets while keeping track of the challenging parts. I will then create a library (or whatever software is most needed) to make this process easy for others, as well as an instructional post to walk others through the process. In the end, using the tools I come up with, it should be very straightforward to go from having a small electronic project to integrating it with Alexa.

**General Chronology**

1. Research: In this phase I will continue to survey what materials exist for developing Alexa Gadgets with Raspberry Pi. I will also attempt to get a good understanding of the architecture behind the Alexa Gadgets. This will involve researching things like data transmission over Bluetooth and proper usage of cloud functions in Alexa Skills.

2. Planning and Design: Once I have familiarized myself with the resources, I will construct a plan for how to best go about setting up a functional gadget.

3. Working Implementation: In this phase I will assemble and program a basic working gadget that I can use for reference and to explore new ideas with.

4. Library/Script/Other Helpful Software Creation and Modified Implementation: After experimenting with the working implementation, I will think about what preceding components could be improved most with additional software. I will implement something helpful and use this new tool to get to the same stage in the previous implementation.
5. Documentation and Analysis: Finally, I will analyze the project as a whole and provide documentation to allow others to continue on the work.

**Deliverables**

1. **Library/Script/Other Helpful Software and Documentation:** In the process of implementing my own gadget, I expect to find holes in existing libraries and documentation. For example, if I found that downloading and installing many necessary but obscure libraries was one of the most time consuming parts of the process, I would write a script to automate it. If I find that I have to write lots of new code to communicate with the Echo via Bluetooth, I would write a library that makes this communication easy.

2. **Hello World:** the program that everyone is used to. I will attempt to write and document the most stripped down Alexa Gadget interaction possible to just get a basic integration completed.

3. **Example Application:** This will be an example project that goes into more features than the Hello World program. It will likely be something like an Alexa-controlled water kettle that can be set to hold at any temperature specified via voice command by the user.

4. **Instructables-like Post** I will create a post similar to those on Instructables.com that will walk through everything needed to set up an Alexa Gadget. This post would include everything from hardware requirements and setup to the necessary programming.

5. **Discussion and Reflection:** In this section I will look back over the project and reflect on what I might have done differently. I will also comment on the challenges and successes, as well as suggesting places for further improvement that could be continued by others.