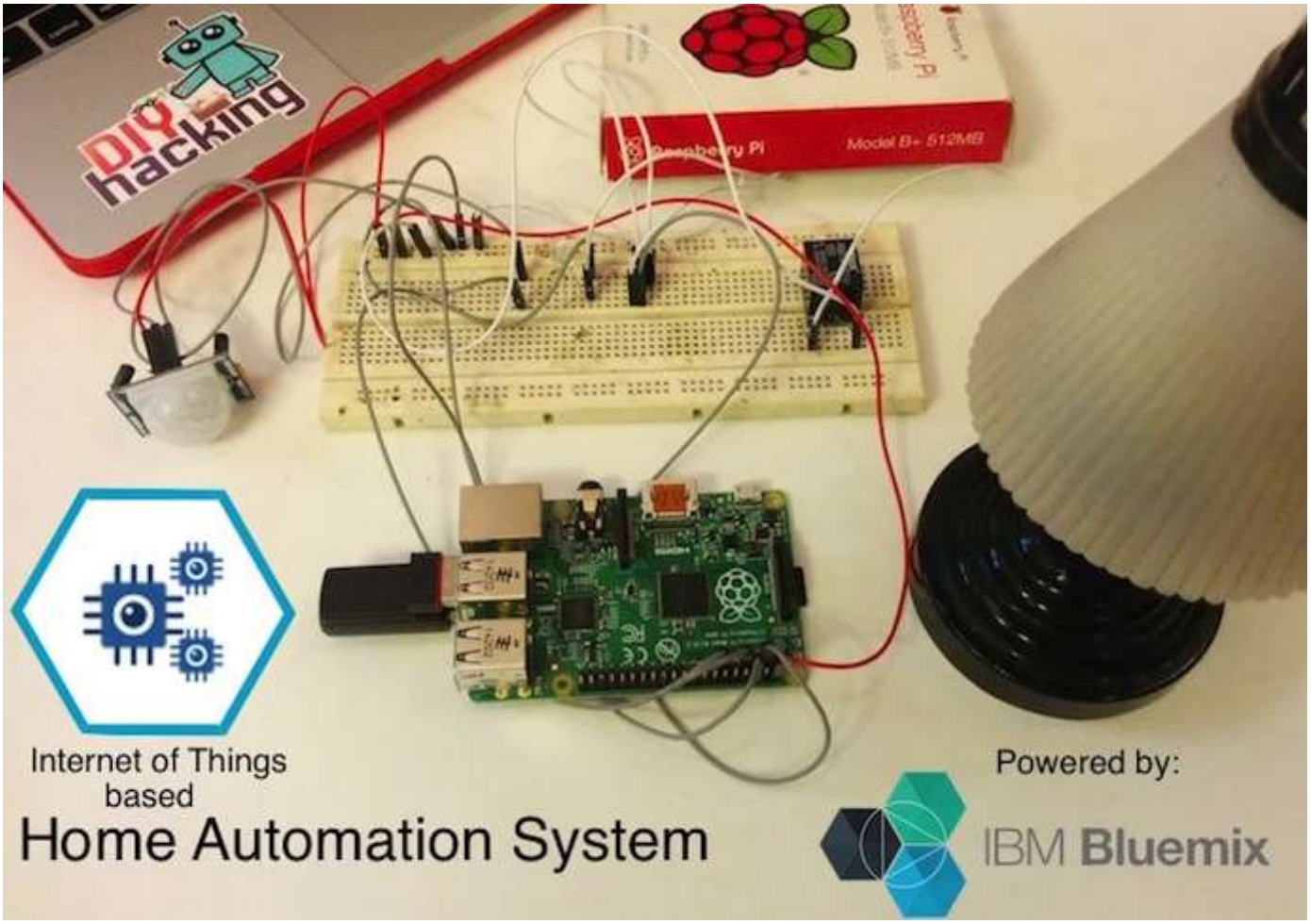
IOT BASED RASPBERRY PI HOME AUTOMATION USING IBM BLUEMIX



We all have at some point of life desired to control everything at the click of a button. May it b turning off unnecessary lights when you are not at home to detecting intruders when you are not around. This tutorial will guide you to build a simple raspberry pi home automation syster that will allow you to control appliances in your home from anywhere in the world. And it will also allow you to view data from the PIR motion sensor via the internet to detect intruders. Th project will be using platforms like the Raspberry Pi, IBM's IoTF (Internet of Things Foundation) and Bluemix packages. And can be used as a perfect project to get into the world of Internet o Things. So lets get started!

What are the stuff required to do this project?

Hardware:

1. Raspberry Pi 2 / B+.
2. USB wifi dongle.

3. USB keyboard and mouse.
4. HDMI monitor and cable.
5. Micro USB power adapter (smartphone charger).
6. PIR motion sensor.
7. Male-female and male-male jumpers.
8. Breadboard.
9. BC547 transistor.
10. 5V SPDT relay and 1n4001 diode.
11. LED and 220Ohm resistor.

Software:

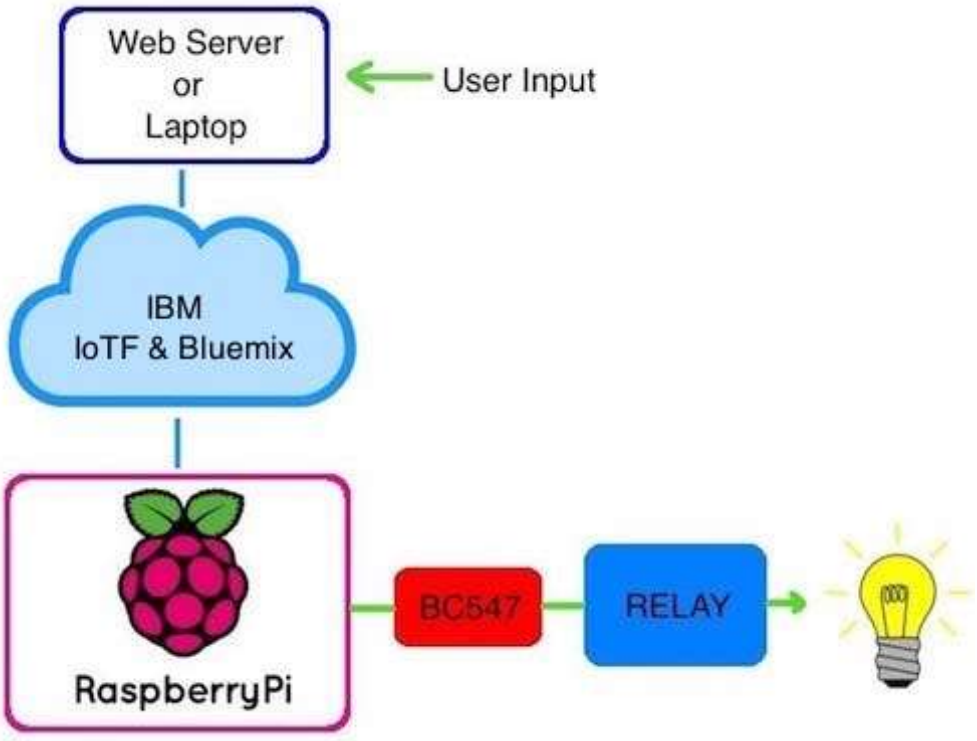
Raspbian OS

How does it work?

If you are a beginner to Raspberry Pi, you can always use our free eBook to learn how to setup the pi and Raspbian OS. The Raspberry Pi home automation system uses client and server side python scripts. These can communicate with each other through IBM's IoTF platform. This whole Internet of Things project can be divided into two parts:

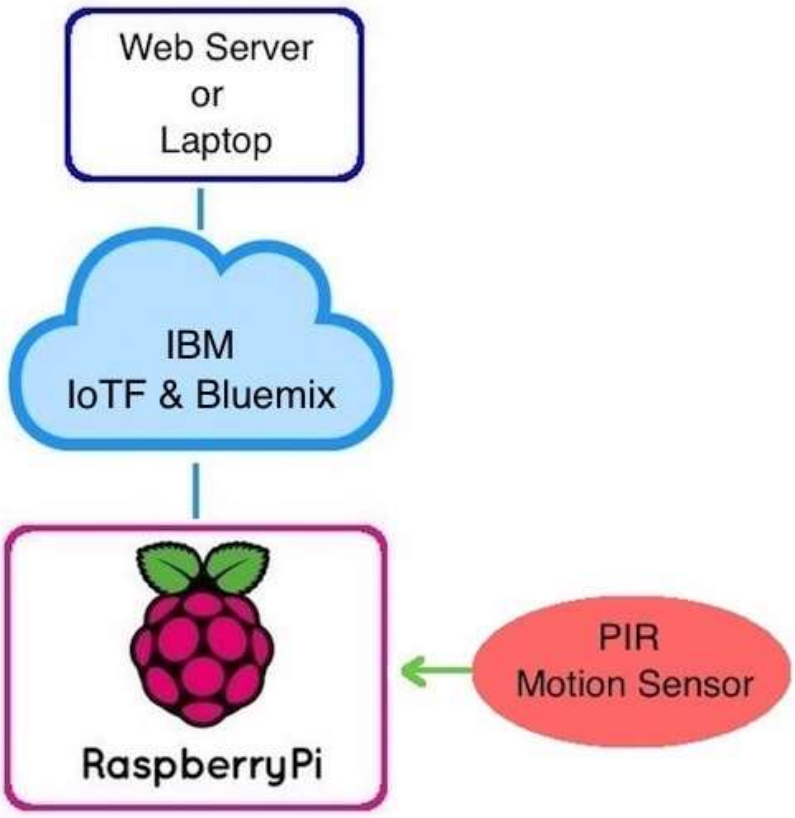
1. Sending commands to the Raspberry Pi

The server side script running on our laptop or on a web server takes input commands from the user and correspondingly sends it to the client (Raspberry Pi). Here, we will be using commands to turn a light ON/OFF. When we pass the command to turn ON a light through the server side script, the information is relayed to the Raspberry Pi and it's GPIO pin turns ON a relay. The system also sends status updates to the server on whether the light is ON/OFF.



2. Receiving data from the Raspberry Pi

In case of sending data from the PIR motion sensor connected to the Raspberry Pi, we run a script which reads the sensor through a GPIO pin and broadcasts the data through the IoTF platform. This can then be viewed through the IoTF console or through a custom web application designed using the platform.



A few quick reads that will help you before you get started:

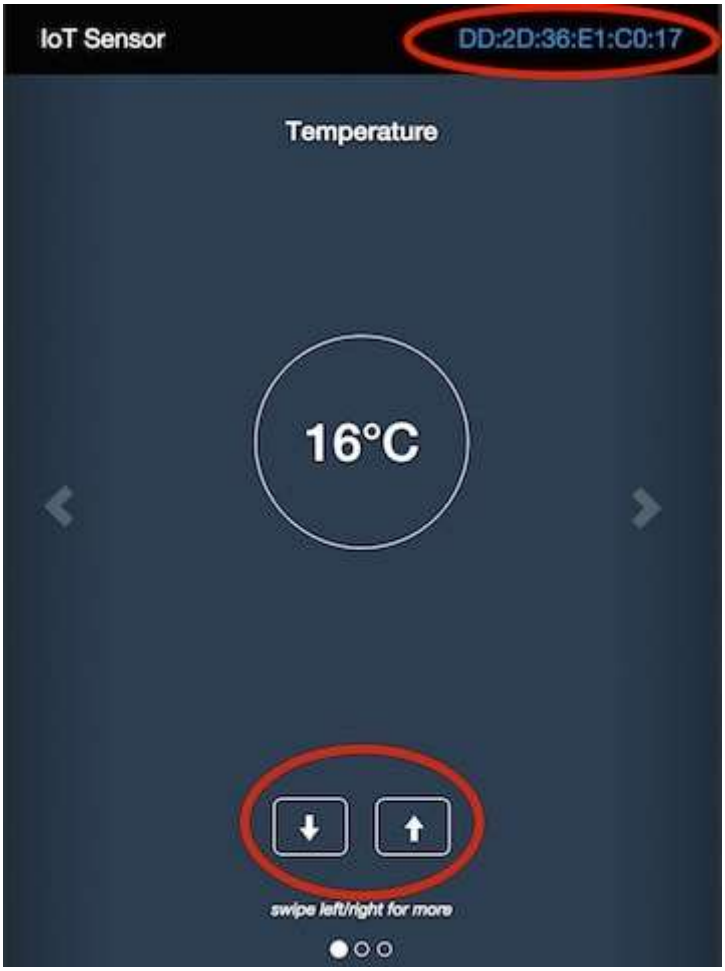
1. The concepts of using IBM IoTF https://docs.internetofthings.ibmcloud.com/reference/concepts.html
2. Creating applications using bluemix: documentation.
3. Interfacing Raspberry Pi with an accelerometer sensor: IBM blog.

Step 1: Testing IBM IoTF using a simulator

First you need to sign up for a one month free trial account from IBM: https://quickstart.internetofthings.ibmcloud.com/#/. You can do that by going here. Next you need to log into: IBM IoTF page with the credentials you just created. And then you need to cli on “Quickstart” from the above menu. Next, click on: “Find out more” from the “Don’t have a device?” section:

Then from the new window that pops up, follow the instructions to setup the simulator or just click this link: "http://quickstart.internetofthings.ibmcloud.com/iotsensor".

This simulator acts like the data coming from your Raspberry Pi or any other connected device it simulates data like: temperature, humidity, etc. The simulator open up in a new tab and look like a smartphone application:

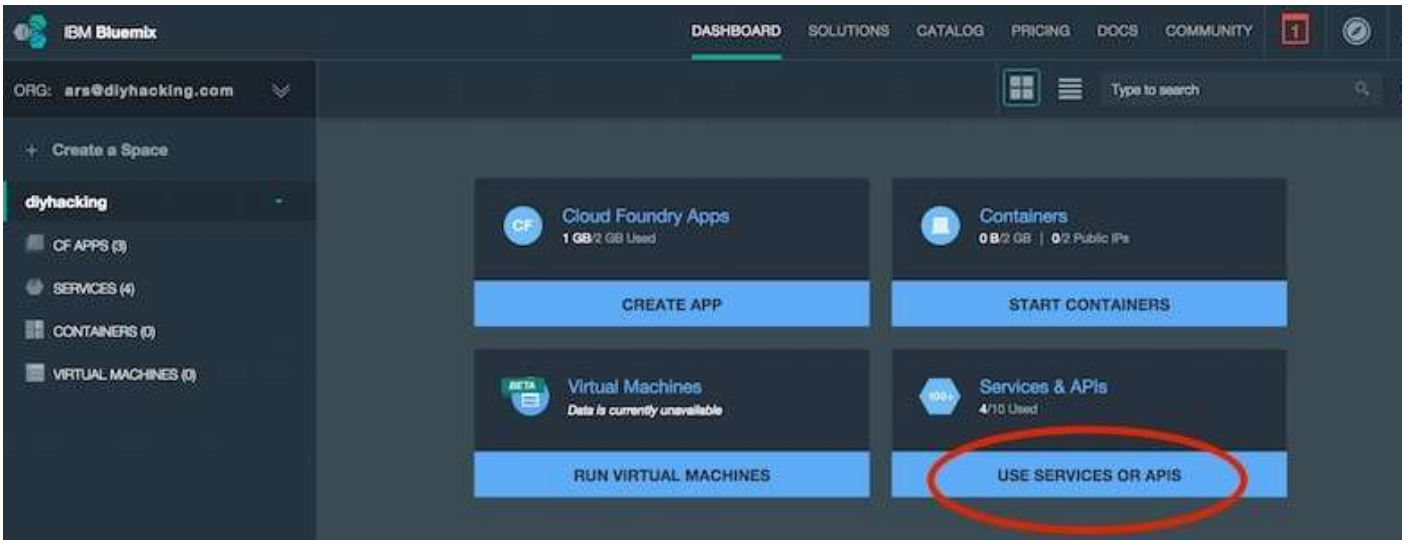


Next, copy the MAC address from the top right corner of the simulator. Here, in this example i is: DD:2D:36:E1:C0:17. Now, paste this MAC address on the IoTF quickstart page: https://quickstart.internetofthings.ibmcloud.com/#/ or just click on the MAC address itself. You can see the data coming from the simulator in this new tab in the form of a graph. Now go back to the simulator and click on the UP/DOWN arrows on it to increase/decrease the value of temperature. And you will get to see that the graph on the quickstart page updates accordingly, and at the bottom of the page you will see the current value of temperature you have set.

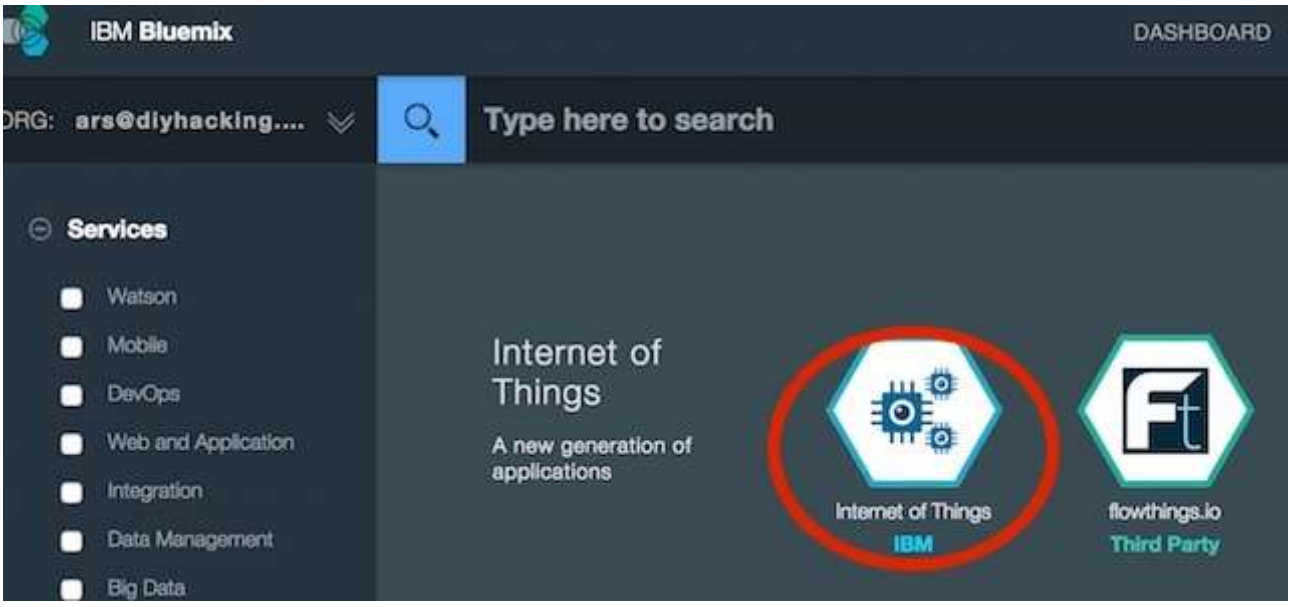
Step 2: Adding the Raspberry Pi to IBM IoTF

The next step is to add our Raspberry Pi device to IBM IoTF platform, so that it can recognise it In order to do this, you need to create a device ID for the pi. To do that, check the instructions on this page under the heading: "**Connect (Quickstart)**": https://developer.ibm.com/iotfoundation/recipes/raspberry-pi/. After installing the packages using the commands on the instructions page, find the device ID of your pi using this command in the terminal:
"service iot getdeviceid". Note down the device ID.

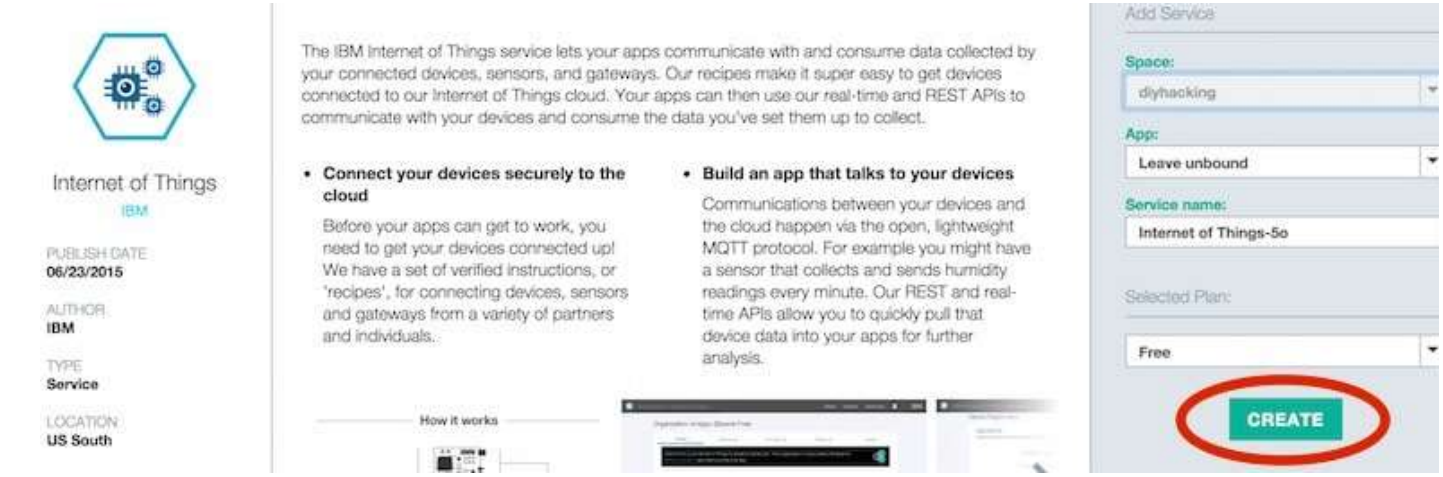
Next log into the Bluemix console: https://console.ng.bluemix.net/ and then click on "Add Service" or "Use Service".



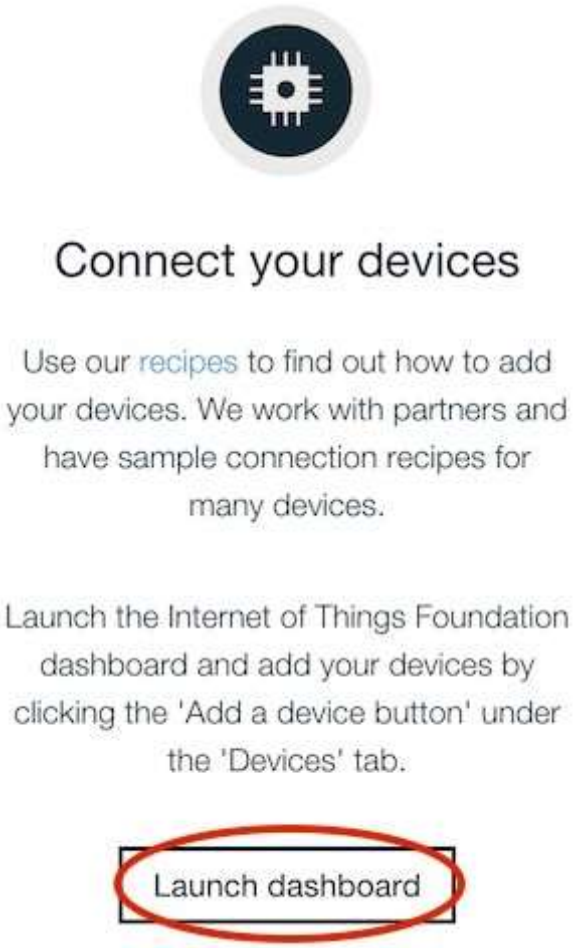
After that scroll down to find and select the "Internet of Things" boilerplate or icon.



Next, assign a name for this project and click "Create".

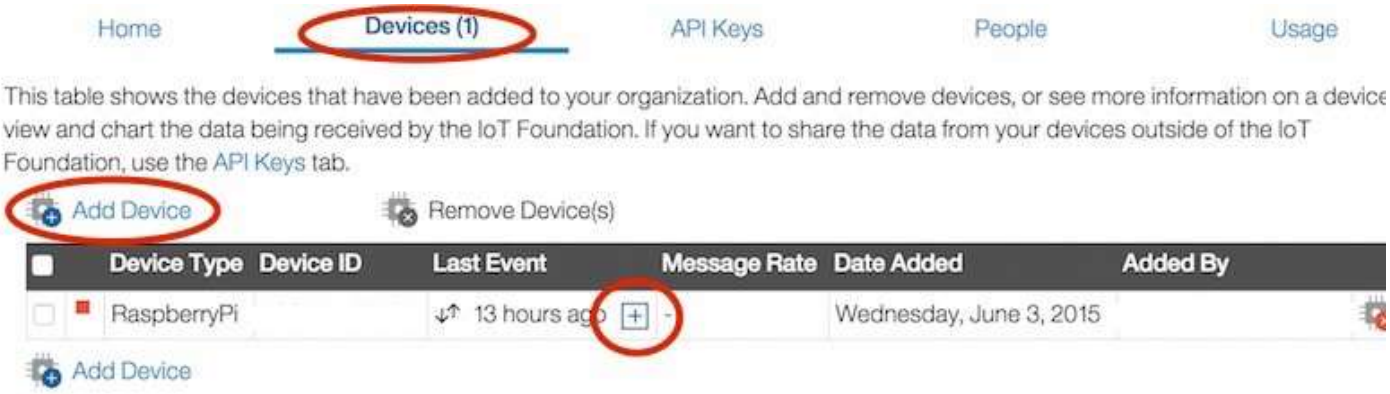


Now from the new page, click on “Launch Dashboard”. And follow the steps below.

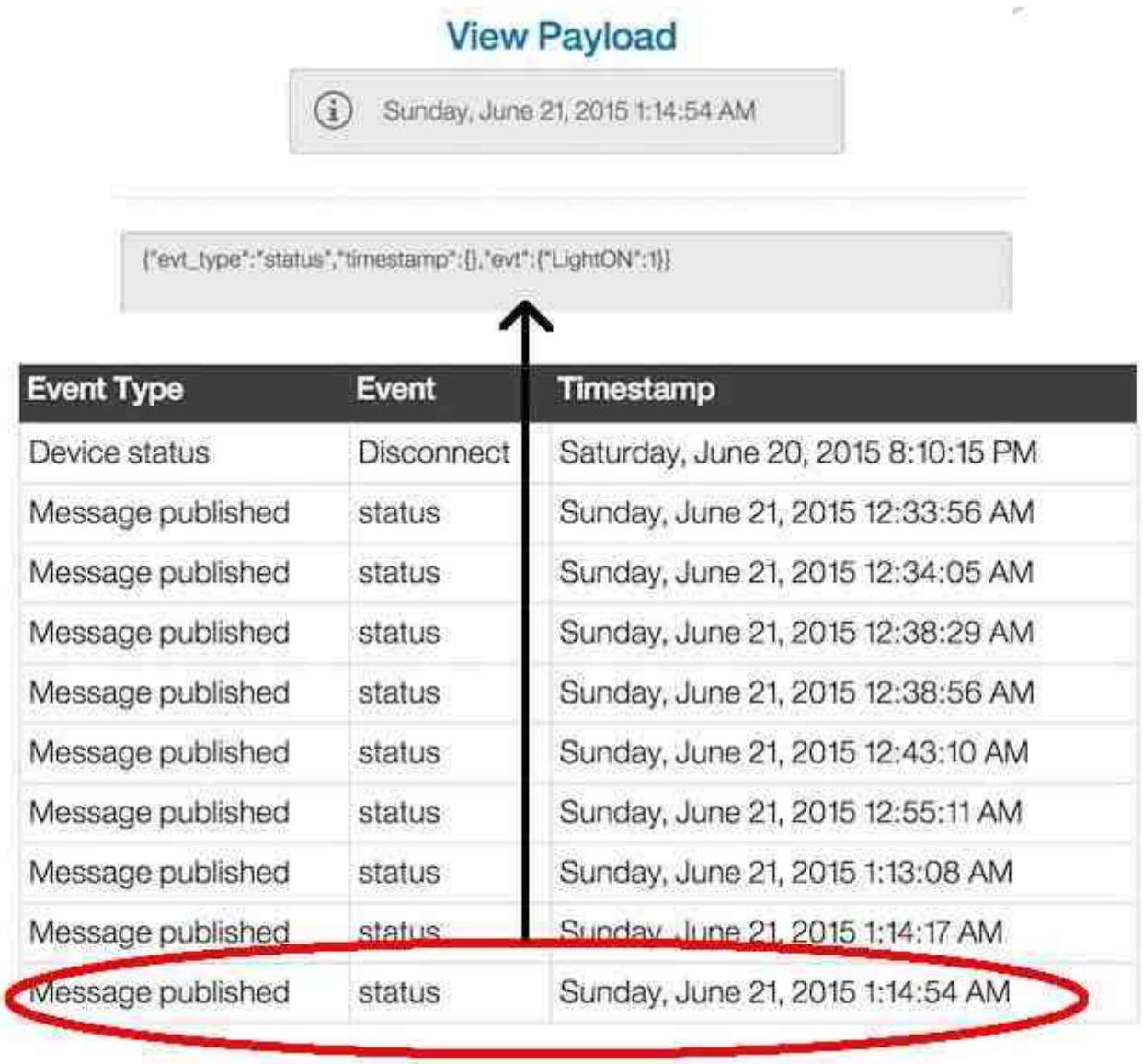


FYI – From next time onwards, you can just log into the IoTF page and click on the top right account section. A dropdown will come up, from there you will see “My organizations”. Click or the that,which will take you to a new page.

Now, after launching the dashboard, select “Devices” from the above tabs. Then click on “+Adc Device” from the page. Fill in the name of your device (anything that you want to name it) and then enter the device ID you got from the earlier steps. After doing this, you will get a Token id please note it down or take a screenshot of the window. You will be using this Token id to crea a configuration file.



Now, you can view the data coming from your pi (CPU temperature, etc) when you enter the device ID of your pi on the quickstart page. And you can also see it from the “Devices” section on your account page. Just click on the “+” symbol in the “Last Event” column to view the incoming data. Click on each of them, to see the data in detail:

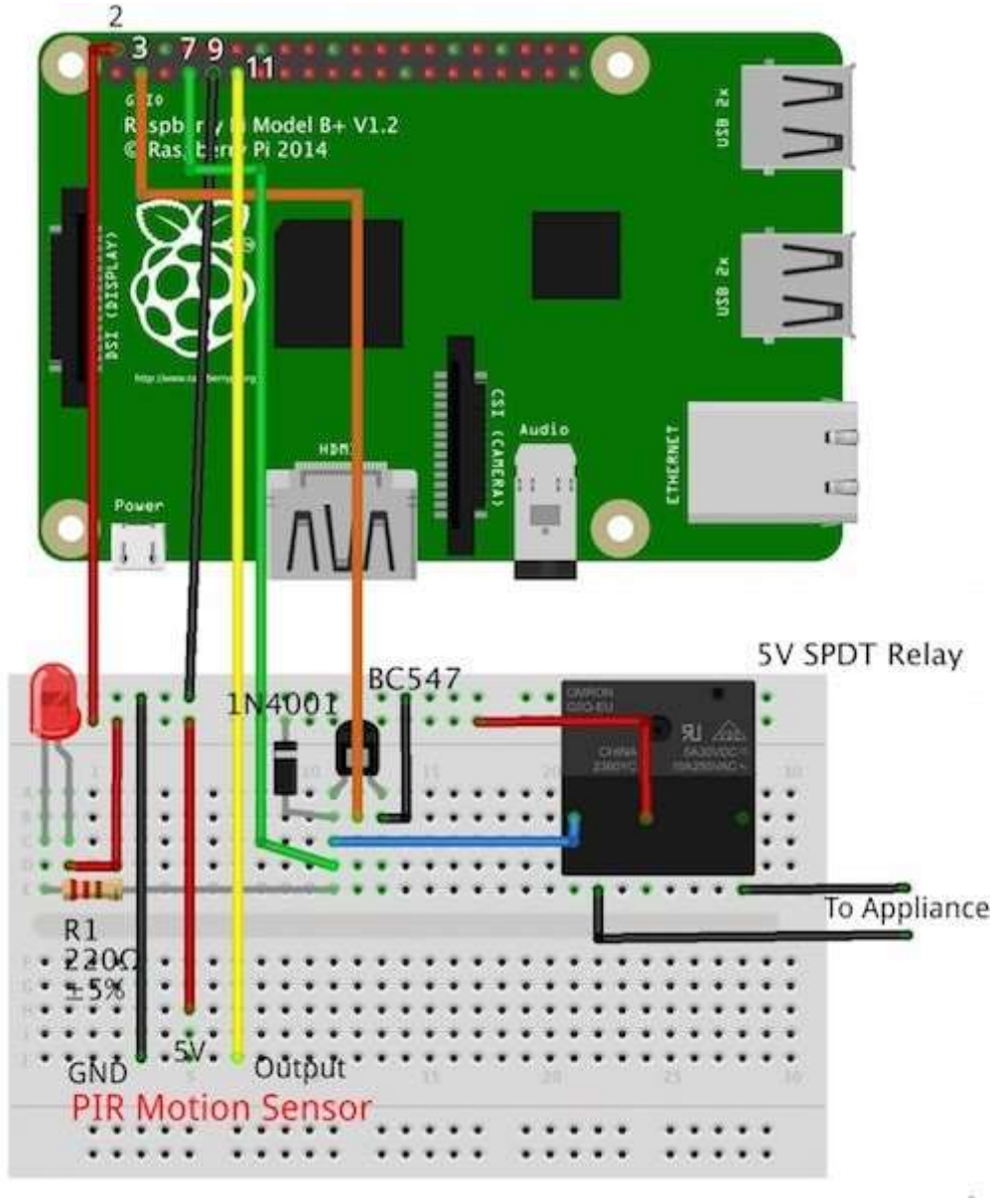


Next you have to follow the steps listed under the heading: "**Connect (Registered)**" on this page: https://developer.ibm.com/iotfoundation/recipes/raspberry-pi/. This will initialise your Raspberry Pi with details like Organization id, Device id, Token, etc so that we can communicat with it through other applications.

Step 3: Get the API key

Now you need to create an API key for the Raspberry Pi, so that we can read data from it through other external applications. Click on the "API Keys" tab on your organisation page and click on "New API Key". Note down the key and authentication token that is generated, this will be shown only one time, so note it down or take a picture.

Step 4: Assembling the components together for the Raspberry Pi home automation system



Based on the above connection diagram, connect the components for the Raspberry Pi home automation system. You can learn more about connecting relays here, if you are a beginner. And you can find the pin out for the BC547 transistor here. Also, check out the pin out for the Raspberry Pi here. You can connect the appliance you wish to control to the relay as shown above. One line of the light/bulb should be connected directly to power and the other line through the relay. You can use the relay guide link given above as a guide. We are using mainly three GPIO pins, which are used as follows:

1. GPIO pin 3: To provide the control signal to BC547 which in turn activates the relay.
2. GPIO pin 7: To monitor the status (ON/OFF) of the appliance connected to the relay.
3. GPIO pin 11: To provide the status for intruder detection via the PIR motion sensor (0/1).

Step 5: Setting up the client and server side python scripts for the Raspberry P home automation system

You can clone or download the python scripts for this project from here: https://github.com/DIYhacking/IoT.git. But, please note that you have to edit both these script

with your organisation/device details. Next, log into your Raspberry Pi and open the terminal and follow these steps:

```
cd /home/pi

git clone https://github.com/DIYhacking/IoT.git
```

The git clone will copy the folder “IoT” from github to the pi. Next, you need to go inside that folder and edit the python script called: “client1.py”. You can use the nano editor within the terminal to add the details about your organization, deviceType, etc. So do the following commands:

client1.py

```
cd /home/pi/IoT

nano client1.py
```

Go to the lines in the editor which asks for organization id, device type, etc and fill in the detail You can view these details by using this command in a new terminal window:

```
service iot getdeviceid
```

After updating your client1.py python script with all the information,

next we need to do the same for the server1.py script. So open your laptop and clone the code files (git clone https://github.com/DIYhacking/IoT.git or just download it from the link) and open the editor for server1.py and add all the details about the organization, etc just like earlier for the pi. But, here there is an additional information that needs to be filled in. You also have to fill in the details of the API key (authkey and authtoken). You can get this information from Step3.

server1.py

After performing the above steps, next we need to install the python IoTF packages for running the

server1.py script on the laptop/webserver. To install that, perform this command:

```
pip install ibmiotf
```

You also need to check if your system has “pip” installed, if it isn’t you need to install it based c your OS.

For linux–> sudo apt-get install python-pip
For mac–> sudo easy_install pip
For windows–> Check this tutorial.

Step 6: Running and executing the Raspberry Pi home automation system

Finally, we can execute the system for running our raspberry pi home automation project. Follow the instructions for executing and viewing the output here:

First we need to stop the default IoT service running on the pi, use this command to do that:

```
sudo service iot stop
```

Next, run the script on the pi using:

```
sudo python client1.py
```

And then from the laptop, run the server side script:

```
sudo python server1.py
```

We will be able to do two things with this system:

1. See whether there are any intruders using the PIR motion sensor and check whether a light is ON/OFF from a internet connected device.
2. Control an appliance/light using a remote device connected to the internet.

1. Checking the PIR motion sensor data and light status sent from the Raspberry Pi

Here we are following the same steps we used in Step 2. To do this, log into your IBM IoTF account using the same link we used earlier: https://internetofthings.ibmcloud.com/. Next, clic on your account section on the top right corner and click on your organization (check out the pictures in Step2). Then, click on the “Devices” tab and next on the “+” symbol in the “Last Even

column. You will see the data being updated and on click each of those data rows, you can see the data in detail, showing the Light and Intruder status (0/1) from the Raspberry Pi home automation system:

2. Controlling an appliance by turning it ON/OFF using the server side script

Now execute your server side python script on your laptop. You can use the command:

```
sudo python server1.py
```

This script will then ask for commands, like so:

You can use two commands to control a lamp:
To turn it ON: **lighton**
To turn it OFF: **lightoff**

Type in “lighton” and hit enter, you will see that in a few seconds the relay and LED connected the Raspberry Pi home automation system gets activated. Whatever appliance you had connected to the relay will be turned ON. And on the terminal of your laptop you will see the data generated from the Raspberry Pi like in the picture above.
Next, enter the command “lightoff” to disable the relay and LED and correspondingly your appliance turns OFF.

Potentially, you can create a webpage and a HTML button and run this script when the button clicked to control appliances through online webpages. Check out python and HTML integratic to do that. And you will be able to control appliances in your home from any part of the world.So thats it guys, I hope you guys come up with really cool project ideas to make use of this powerful platform from IBM. And you can post your suggestions and queries in the

comments section below :) Now check out a video showing the demo of the raspberry pi home automation system: