PowerCloud Instruction Manual

Illusion Solutions

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October 23, 2016

Contents

1   Overview

The goal of this project will be to measure the power consumption of machines in easy, cost effective way backed by a powerful cloud based interface. Which will allow the client to interrogate the data in a meaningful way. Providing in depth knowledge of the power consumption. This will allow them to reduce costs and save power leading to our ultimate goal of creating a better world for tomorrow. There is two main components to the project. There will be the software that runs on the particle(Electronic device) and is responsible for logging data to the server. Then the web application that will be responsible for displaying the power consumption. Advanced mathematical analysis and manipulation will be performed on the data. The project will have an optional goal of performing analysis on harmonics. All electronic equipment required will be provided to the students.

2   System Configuration

The system is comprised of multiple components, a web application and a Java-MQTT server, with Google's Firebase as the persistence.

- a power usage device,

    - The device consists of multiple separate parts:
        * A Particle Photon
            · Uses header pins connected to a bread board to read values.
            · Uses the MQTT messaging protocol to send data to the Java server on port 1883.
            · Uses the Particle API for everything else.
            · The Particle code is C++.
        * A multifunction power monitor, used to measure kWh.
        * A current transformer, used to acquire accurate and real time current.
        * A relay to control the flow of electricity through the device.
        * A trip switch to manually turn the device on or off.

- a Java-MQTT server,

    - Uses the Moquette MQTT library to listen, on port 1883, for messages sent from the Device.
    - Uses the Firebase API in order to send and retrieve data, via HTTPS, to and from the database.

- a web application,

    - Uses AngularJS.
    - Uses the Firebase API in order to send and retrieve data, via HTTPS, to and from the database.

- Google Firebase

    - Uses HTTPS to communicate with the Java server and the Web application.

3 Compiling and Installing from Source Code

3.1 Pre-requisites

Software Before proceeding please ensure you have the following software installed on your system:

- NodeJS and NPM

- Bower

- Gulp

- Particle Dev

- Java 8

- Maven

Hardware

- A Particle Photon.

- A computer with internet access which does not block incoming and outgoing connections on port 1883 and 80.

3.2 Firmware

3.2.1 Manual Particle Photon Setup

Compile and flash the photon with the following commands, please take note that if you run the application server on a local machine, retrieve the IP address and insert it into the firmware's code as shown below.

```
// Callback signature for MQTT subscriptions.
void callback(char* topic, byte* payload, unsigned int length);

// MQTT client.
byte PC_BROKER[] { 178,62,75,151 };
MQTT client(PC_BROKER, 1883, callback);

void callback(char* topic, byte* payload, unsigned int length) {
    Serial.println("Command received:");
    Serial.println((char*)payload);
};
```

Follow the instructions here in order to compile the firmware using Particle Dev.

- Open the firmware using Particle Dev.

- Click on "*Compile using Partcicle Cloud*".

- Select the device to flash.

- Click on "*flash device*".

If you run into errors, please see the troubleshooting guide at the end of this document.

3.2.2 How to Register Device Onto System

In order to register a new device onto the PowerCloud system, follow the steps:

- Login to https://power-cloud.tech.

- Proceed to the profile tab, and click on it.

- Once in the profile tab (see page x, picture y) locate Particle.io Settings.

- Using your Particle login details, login into Particle.io to gain access to the Particle API.

- Now locate Devices on the left hand side, click on it.

- Locate the Add Device tab, click "*New*".

- Do the following:

  - Enter the name of the device e.g. "PhotonIT444".
  - Enter the appliance that which the device is attached e.g. "IT 4-44".
  - Enter the ID of the Photon, in order to claim it to your Particle account.
  - Enter the threshold of the device, so as to protect your device from potentially high currents that could prove disastrous should they reach the appliance.
  - Select the time interval between readings from the drop down list.

3.2.3 How to Register on the Particle.io Site

- Navigate to https://login.particle.io/console.

- Click "*Sign Up*".

- Enter the ID of the Photon, in order to claim it to your Particle account.

- Do the following:

  - Enter an email for your username.
  - Enter a password and verify it.
  - Click sign up.

3.3 Application Server

Currently, the *application-server* branch hosts the source code for the Application Server. It needs to be compiled using maven and run on a device which doesn't block incoming and outgoing connections on port 1883.

Compiling the Application Server
Download the sources from GitHub and compile:

- *$ mvn package*

If you run into errors, please see the troubleshooting guide at the end of this document.

4 Starting PowerCloud

4.1 Firmware

Once the firmware has been compiled and the binary file produced. Flash the photon with the following command:

- *particle serial flash Photon Name *.ino*

4.2 Application Server

Once the application server has been compiled, change your directory to IllusionSolutions/test/, run the application server using the following command

- *java -jar applicationServer-*.jar*

4.3 Web Application

4.3.1 Manual Web Application Setup

To start the PowerCloud Web application open the console.

- *npm install*

- *bower install*

- *gulp serve*

  The web application should now be available on **http://localhost:9000/**

4.3.2 Web Application

The web application can be accessed via **https://power-cloud.tech**

4.3.3 Screenshots
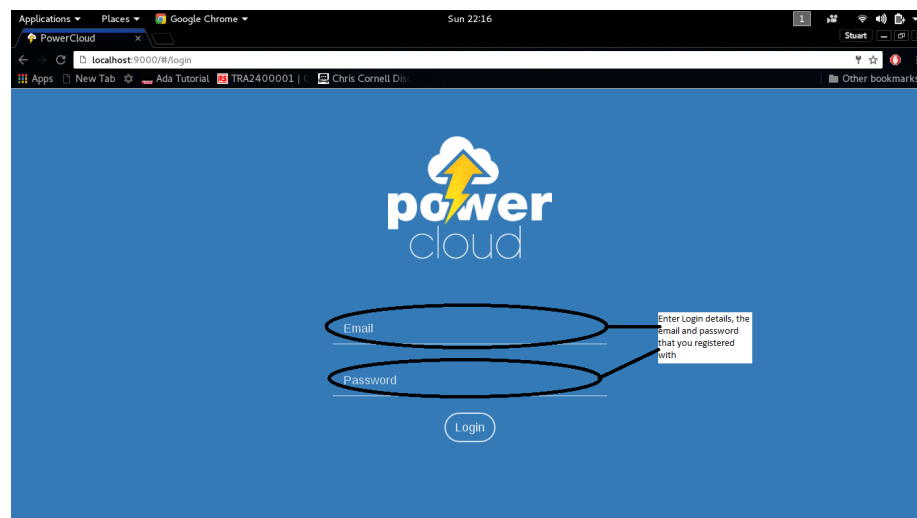
Figure 1: Initial login screen.

- Login

  1. Fill in your email and password.
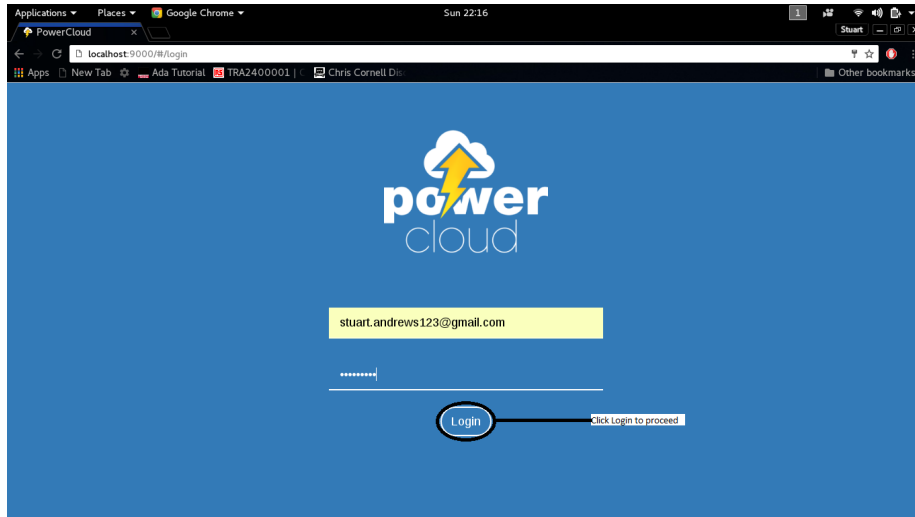
Figure 2: Completed login screen.

- Login

  1. Click "Login".
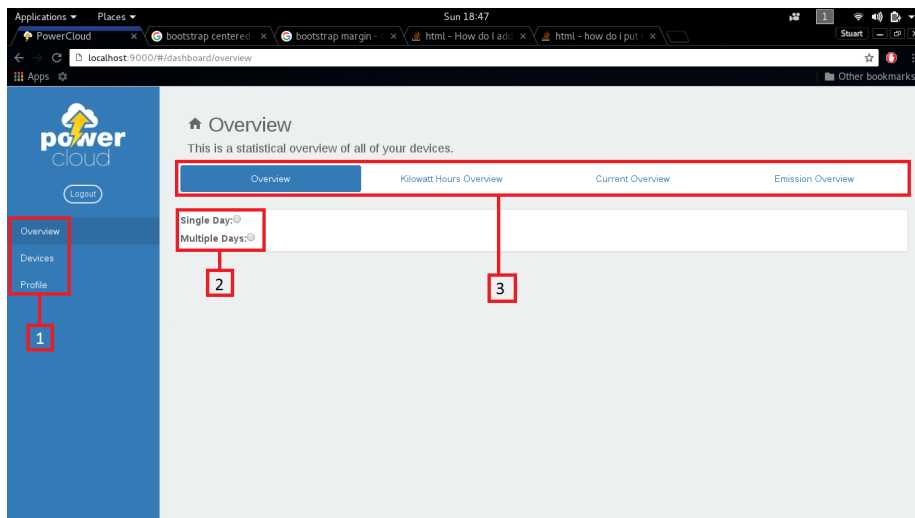
Figure 3: Overview screen.

- Overview

  1. Sidebar menu, with selectable locations.

2. Selection between data over a single day or several.

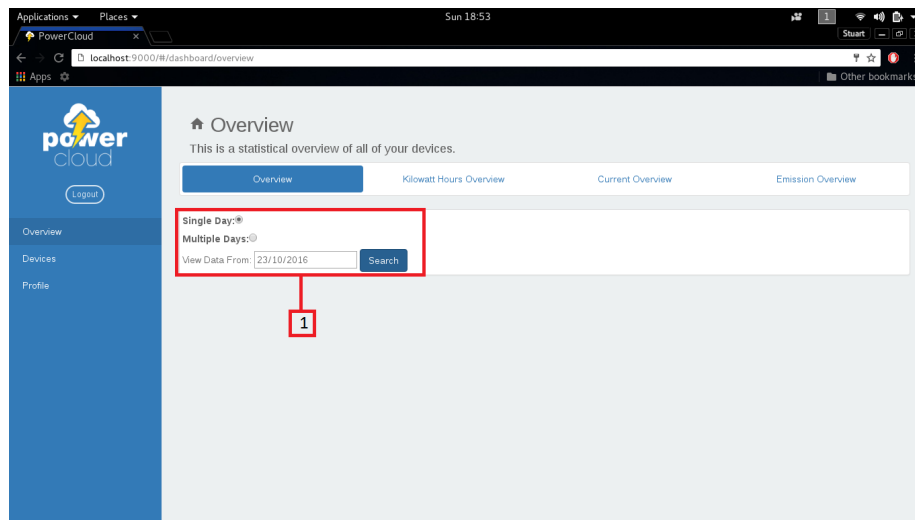3. Different tabs for different collections of data.

Figure 4: Profile settings.

- Overview
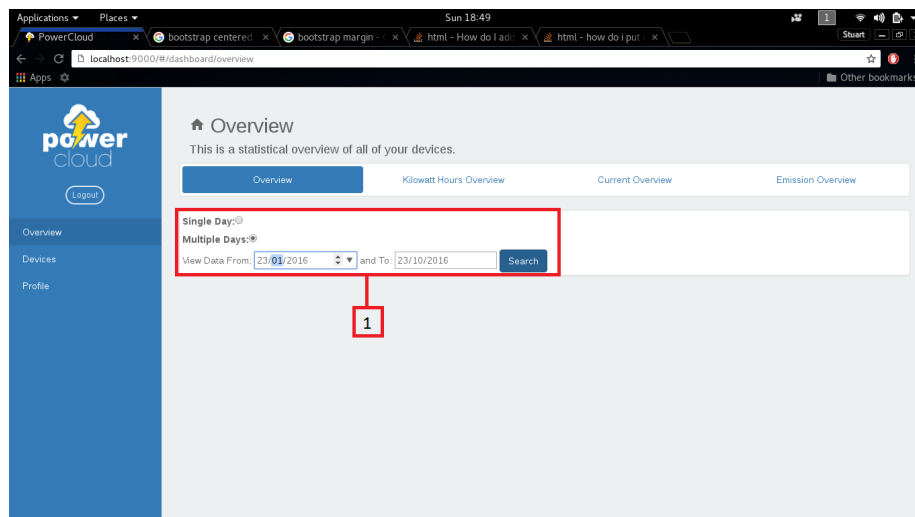
    1. Single day selection for data.

Figure 5: Monitored Areas.
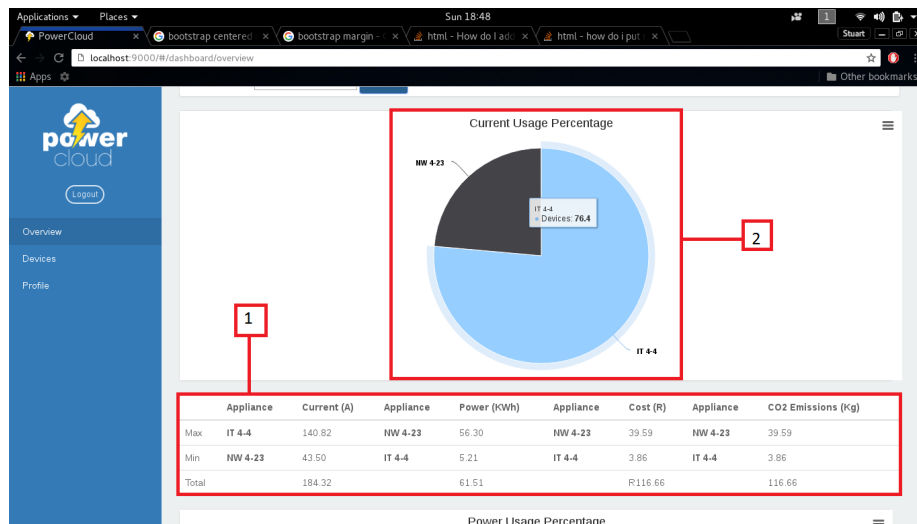
- Overview

    1. Multiple day selection for data.

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Figure 6: Data display page.

- Overview

    1. Averaged data over all devices selected, with key pieces of information displayed, with each pertaining device labelled.
    2. Percentages of consumption of current over the collection of data.
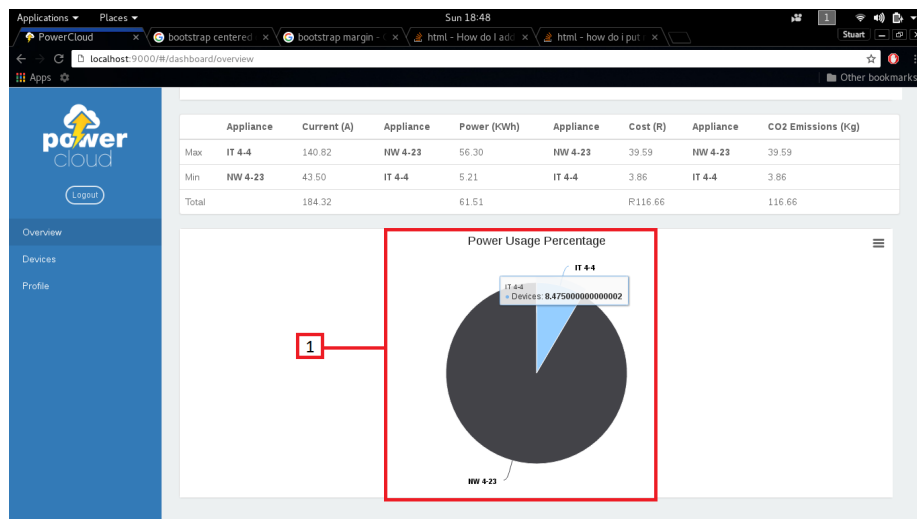
Figure 7: Device settings page.

- Overview

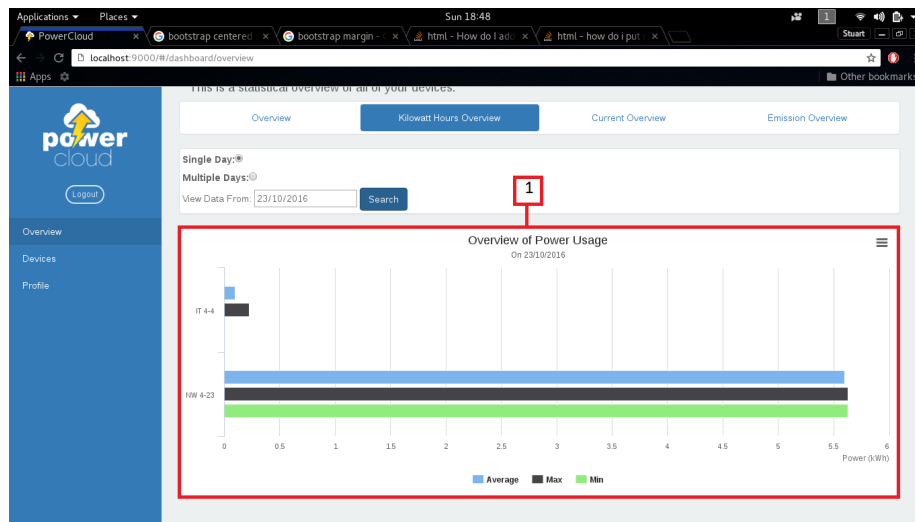   1. As with the current pie above, this pie is identical in purpose, but pertains to power consumption.

Figure 8: Device settings page.

- Overview

    1. Bar chart for power usage only, with 3 specific data types highlighted, the min, the max and the average usage for each device in the collection of data.
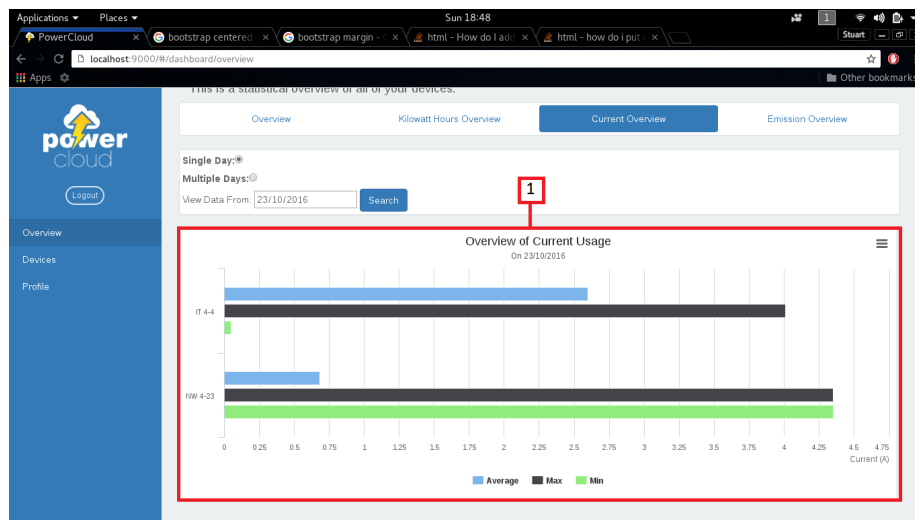

Figure 9: Device settings page.

- Overview

    1. Bar chart for power usage only, with 3 specific data types highlighted, the min, the max and the average usage for each device in the collection of data.
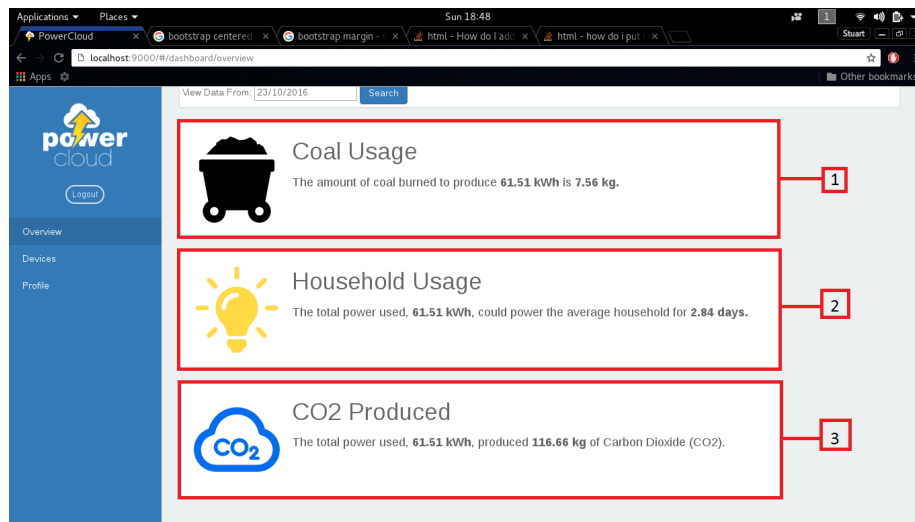
Figure 10: Device settings page.

- Overview

  1. Determines and displays the equivalent amount of coal it took to generate the power usage.

  2. Determines and displays the amount of days the average household could be powered by the power consumed.

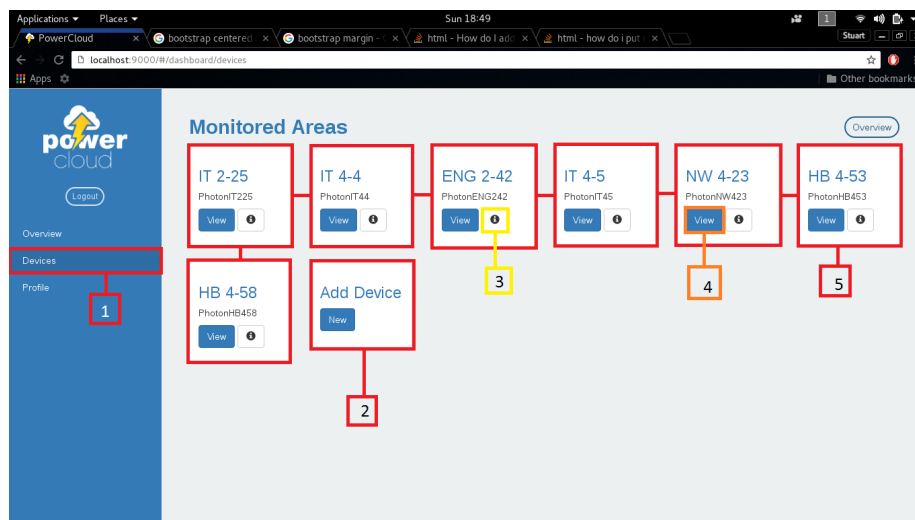 3. Determines the amount of kg of Carbon Dioxide is produced for the power consumed.

Figure 11: Device settings page.

- Devices

1. We're in the devices tab, where we can view all our current devices.

2. Click new to drop the modal down to add a new device, requires Particle.io login in Profile.

3. Click to view information on specific device.

4. View report for this specific device.

5. All the boxes here refer to a device each, with the exception of Add Device.
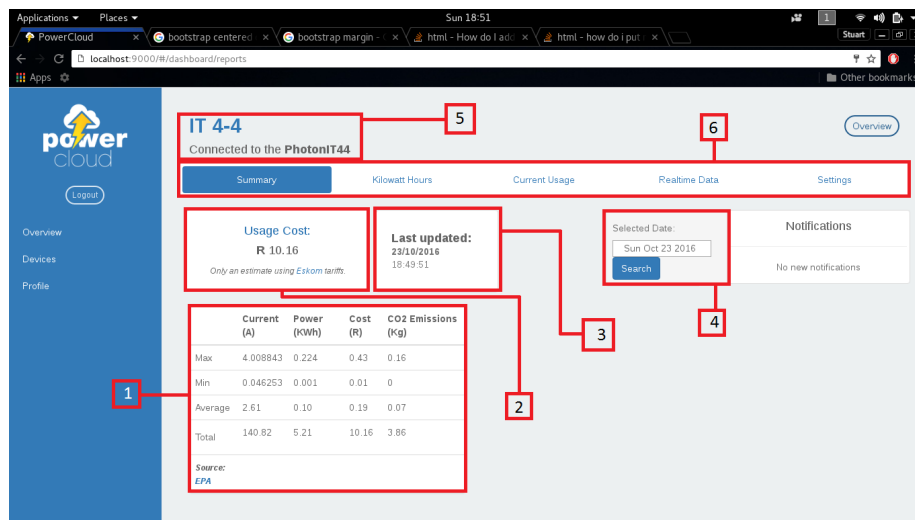

Figure 12: Device settings page.

- Report

  1. Tabular data from that the date specified in 4.
  2. The total cost calculated from the data collection.
  3. Last new value in the data collection.
  4. Date selector to view specific data.
  5. Name of the current Device and its Appliance.
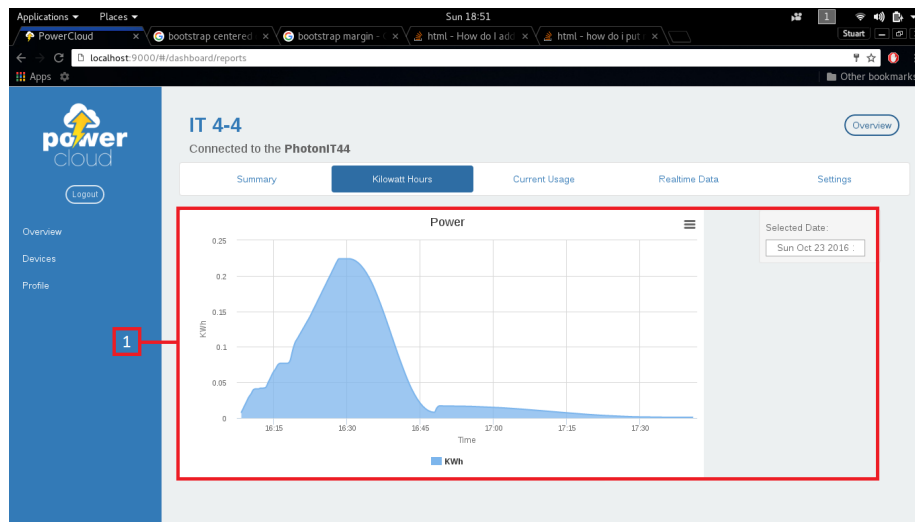 6. The different report tabs to view different data.

Figure 13: Device settings page.

- Report

  1. Power vs Time line graph for the selected date.
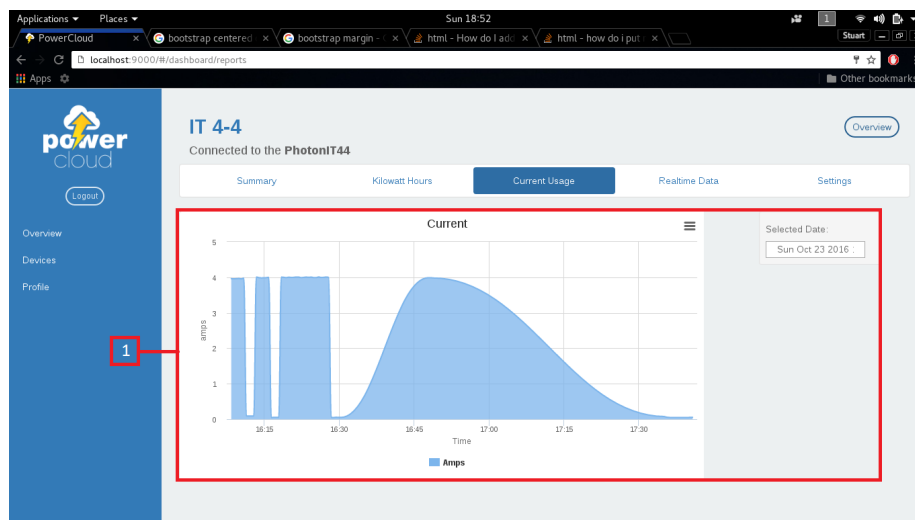

Figure 14: Device settings page.

- Report

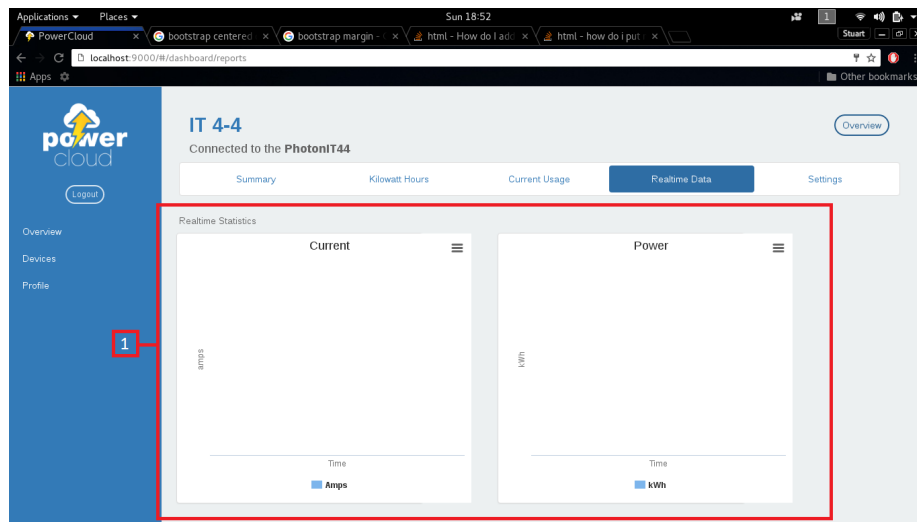 1. Current vs Time line graph for the selected date.

Figure 15: Device settings page.

- Report

    1. Realtime Current and Power vs Time line direct from the device graph when the tab is accessed.
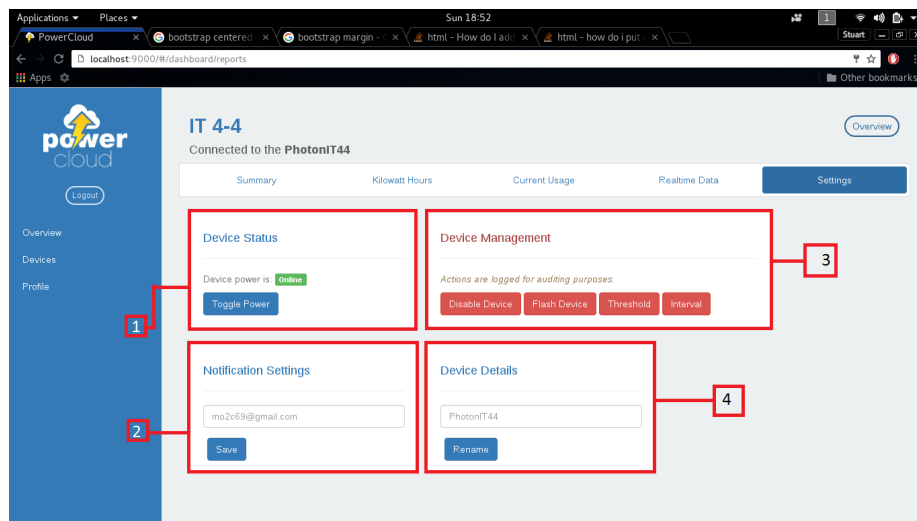

Figure 16: Device settings page.

- Report

    1. Toggle the device power.
    2. Notification settings to change the email to which change in settings are made.
    3. Device Management

(a) Disable the device, once clicked, tells the server to ignore all data from that device.

(b) Flash device, once clicked, writes new firmware to the device.

(c) Threshold, once clicked, allows the user to change the threshold to protect against surges.
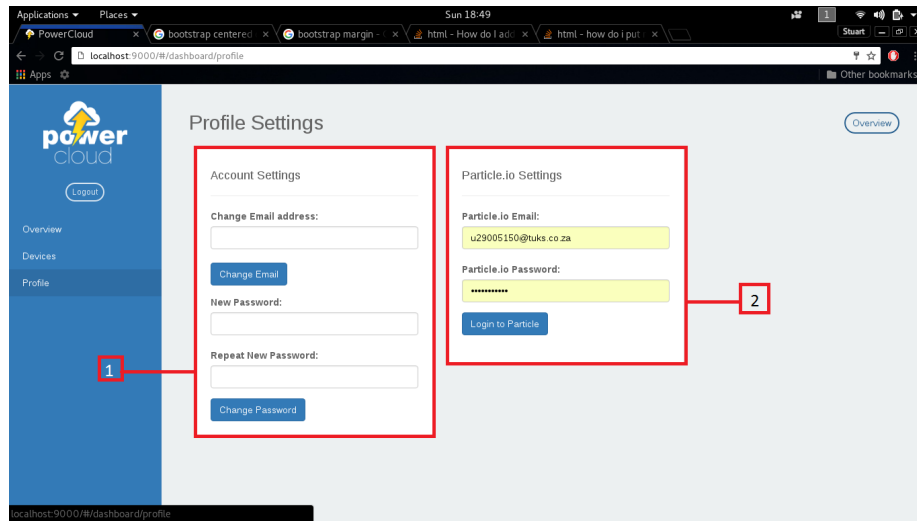
(d) Rename device.

Figure 17: Device settings page.

- Profile

  1. Toggle the device power.

  2. Notification settings to change the email to which change in settings are made.

  3. Device Management

     (a) Edit account settings, like email and password.

     (b) Login to Particle.io, so the user can toggle his/her device and use Device Management.

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5 Troubleshooting

I am getting errors when trying to install through the console.

- Try using sudo before the command. Example: sudo npm install particle-cli

The Web Application won't run and is giving errors when executing the gulp serve command.

- Make sure you've run npm install and bower install.

- Make sure you're in the correct directory where the web application is located.