IoT- Environmental Monitoring

NAME : Vibisha W

ID:AUT962921104712

EMAIL:wv3956601@gmail.com @gmail.com

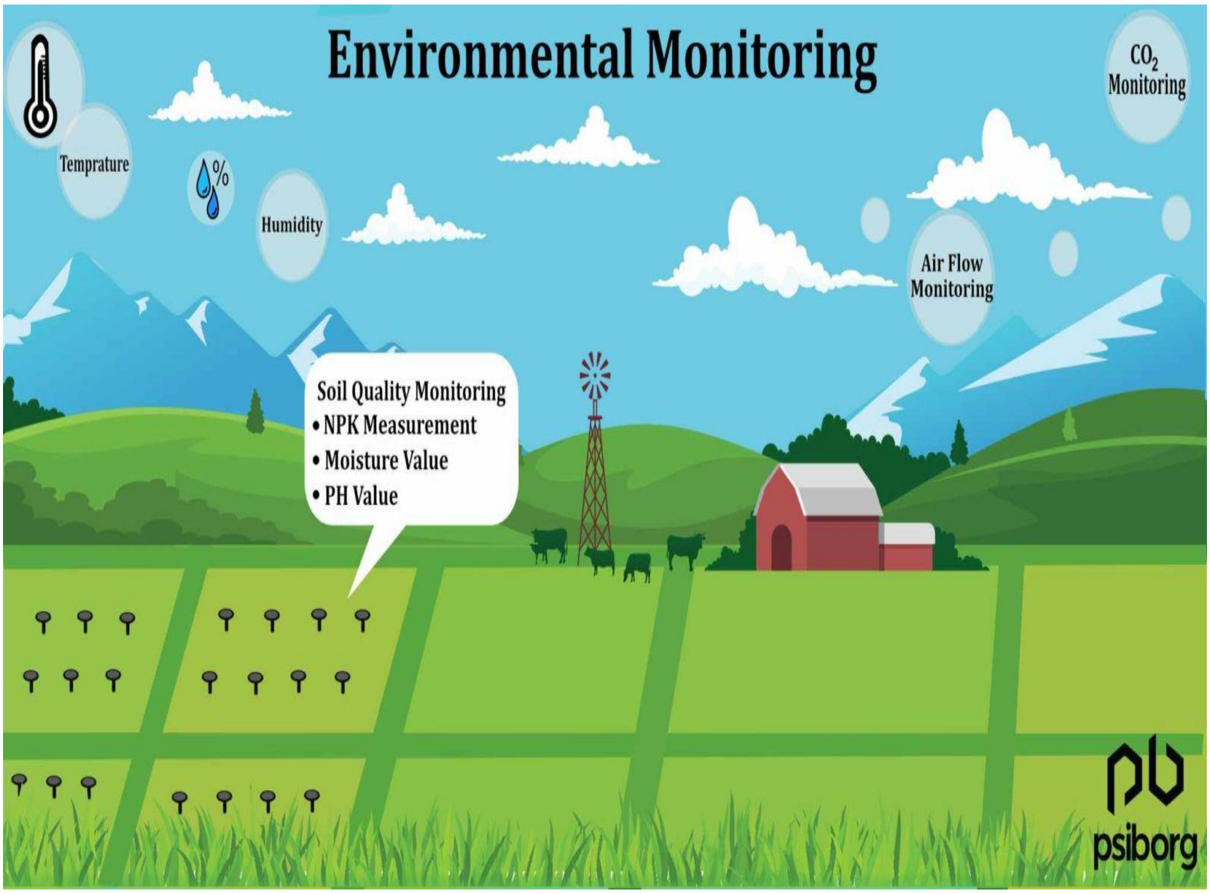


TABLE OF CONTENTS

DEVELOPMENT PART 1

Start building the IOT enabled environmental monitoring in park system:

1.Introduction:

With the continuous expansion of the total industrial volume, the integration of enterprises has gradually formed a relatively concentrated industrial layout. Industrial centralization has brought advantages in capital, technology and industrial chain, and also put forward higher requirements for environmental protection and safety. However, in recent years, major environmental pollution incidents have occurred frequently, and the life safety of construction workers has not been guaranteed. The root cause is that the supervisory department lacks effective real-time monitoring methods, so that it cannot grasp the pollution situation in time. Traditional human inspections and on-site assessments by professionals have high implementation costs and insufficient coverage of time and space.

2. Overall Design:

In order to meet the requirements of remote access, scalable capacity, and low power consumption, an NB-IoT-based networking system was designed, which is mainly composed of a monitor terminal, an operator network, and an independently built network server. The monitor terminal is mainly composed of sensors and STM32L151 control chip and BC95. The NB-IoT module transmits the signal to the operator's base station, which is forwarded by the operator to the server, and the data sent by the server is also transmitted to the monitor terminal through the operator. The NB-IoT networking structured in this way realizes multi-point monitoring data and can be transmitted to the server in time. After being obtained, the data is saved in the database and further analysed then displayed on the web page. The overall structure of the system.

3. Software design

The overall software flow mainly includes three steps: system initialization, measuring and processing data, and sending data. When the system is powered on, the system is initialized first, which includes the system working frequency initialization, delay function initialization, BC95 initialization, I2C initialization and so on. After the sensor measures the data, packing the acquired data through a custom communication protocol data format, and then sends the packed data to the server through the NB-IoT module. After the transmission is completed, it will enter the stop mode, and then give a 30-second transmission interval, so that the system is in the low-power mode as much as possible, and only when the module transmits data will it enter normal mode.

4. System testing

Since this chapter mainly introduces the hardware and software implementation of the system, the specific implementation of the server on the network will not be described in detail. The basic process is that when the server receives UDP data, the data is parsed according to the set format and stored in the MySQL database. The original data received by the server and the processed data in the database.

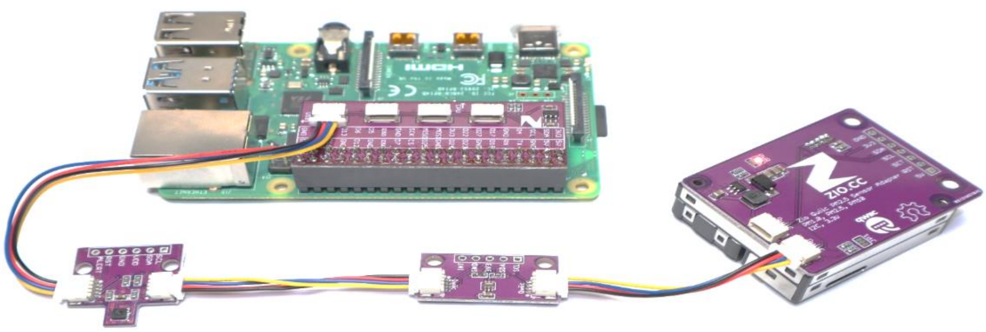
the server receives the data sent by an IP. The beginning of the data is the flag bit and the version number. The following data are separated by'##', which are the values of device ID, smoke, carbon monoxide, carbon dioxide, TVOC, temperature and humidity. In addition, you can see that the corresponding data is stored in the database.

PYTHON SCRIPT

Step 1 Setup the Raspberry Pi

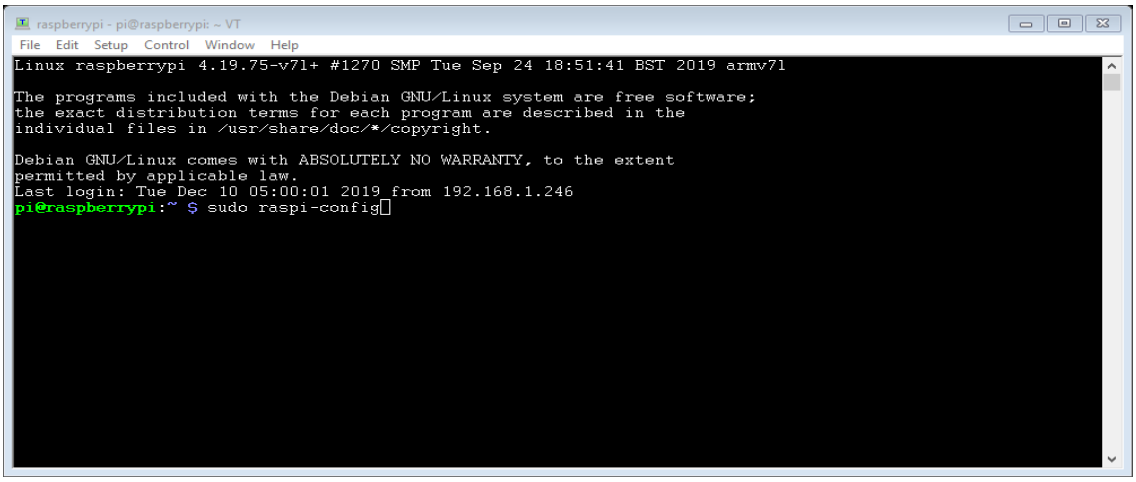
Step 2 Connect

Connect the ZIO SHT31 Temperature and Humidity sensor, the ZIO TSL2561 Light sensor and the ZIO Particulate Matter Sensor to the Raspberry Pi via the ZIO QWIIC HAT.

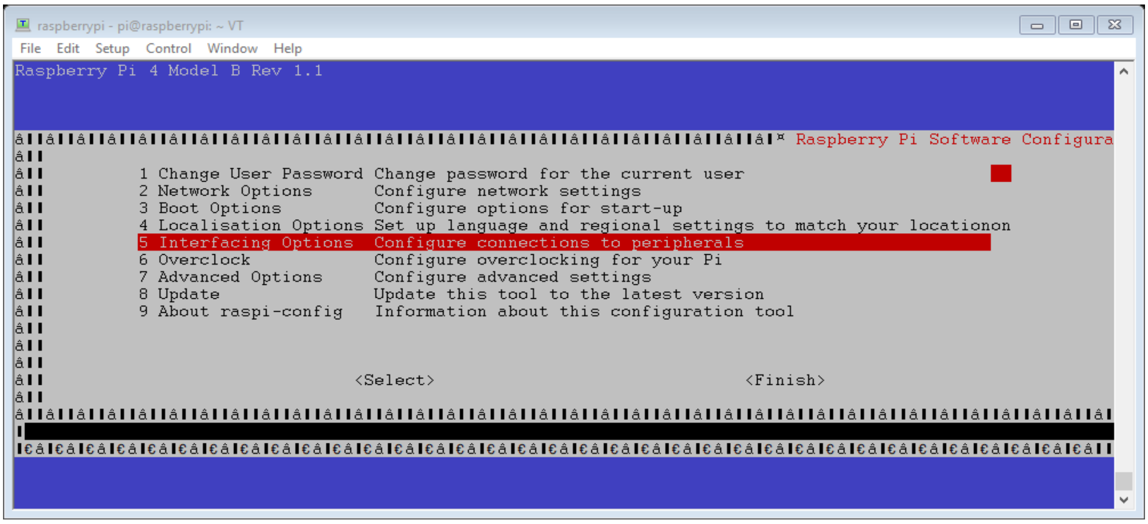


Step 3 enable the I2C bus

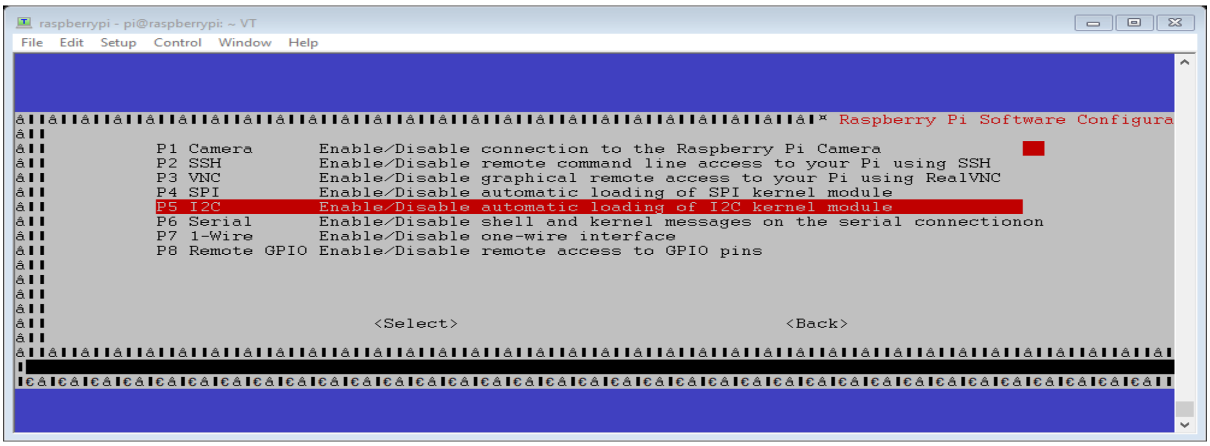
Either from the Raspberry Pi’s desktop or via SSH, Open the terminal and type in:
`sudo raspi-config` and press enter.



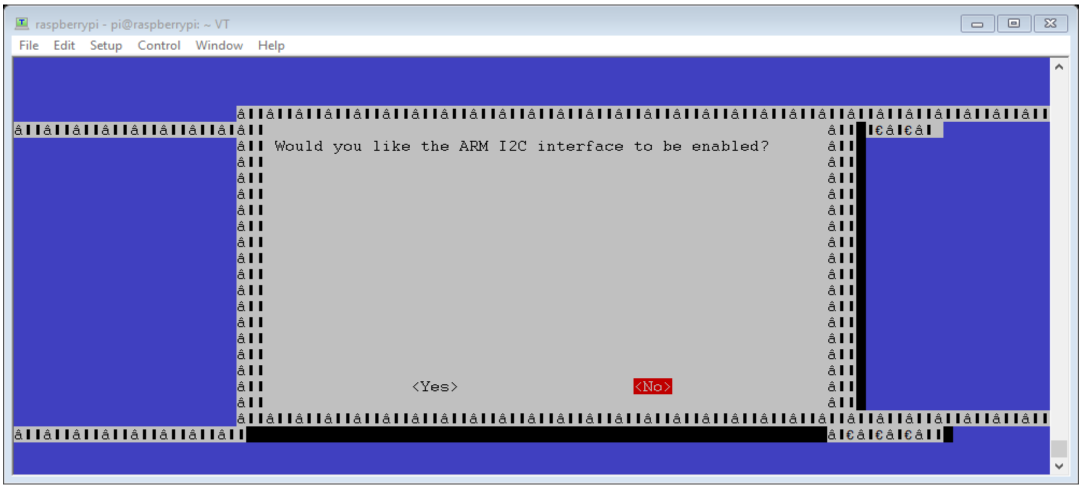
Using your keyboards arrow keys, select '5 Interfacing Options' and press enter.



Scroll down to 'P5 I2C' and press enter.



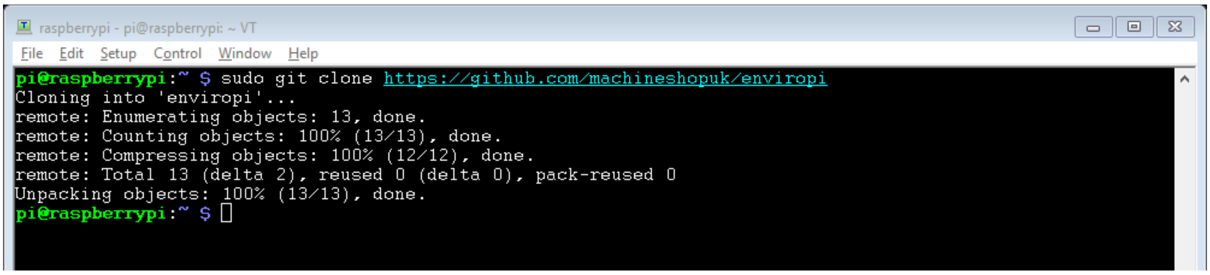
Then select '<Yes>' and press enter to enable the I2C interface for the ZIO QWIIC ecosystem.



Select '<Ok>' and '<Finish>' to return to the terminal.

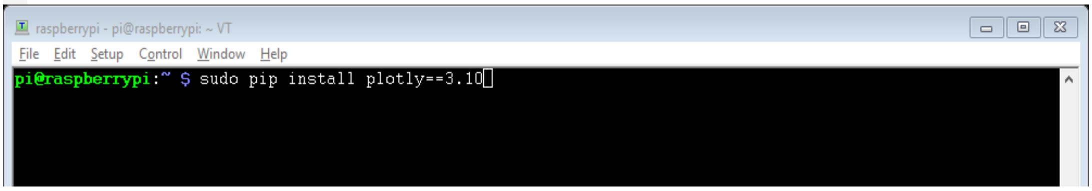
Step 4 Download python script

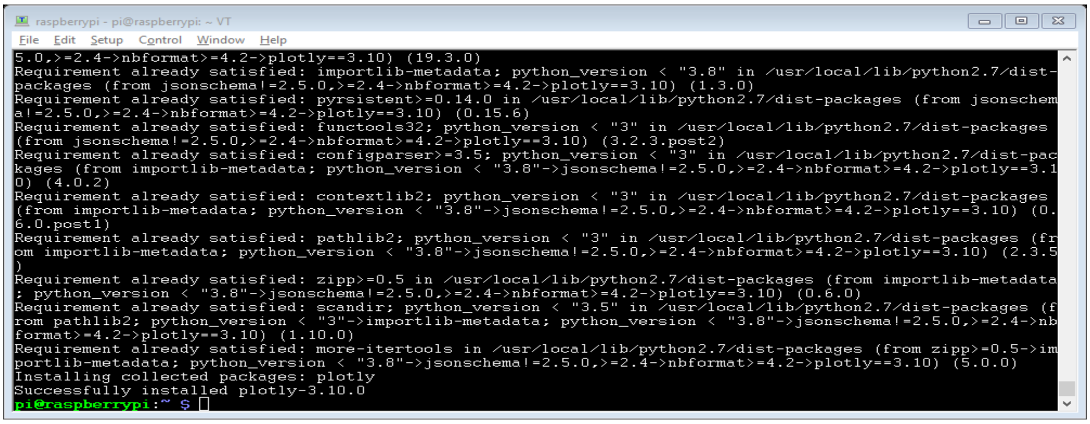
Whilst still in the terminal type:
sudo git clone
https://github.com/machineshopuk/enviropi



Step 4 Install Plotly
We need to install the Plotly library to utilise the functions to communicate with the plotly servers. Simply use this command to install it. This will also install any necessary support files.
sudo pip install plotly==3.10

6





Step 5 Generate Plotly API details

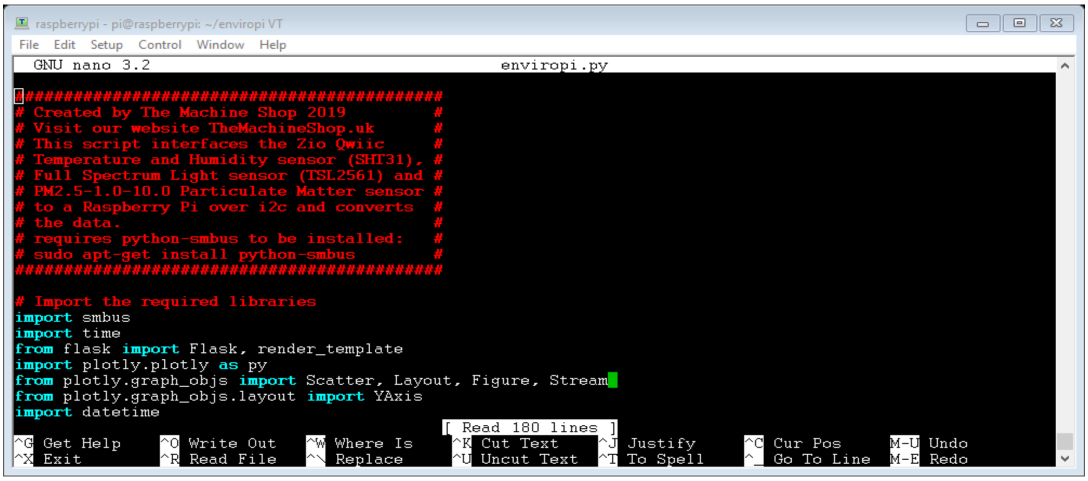
Create a Plotly account by clicking on Signup at https://chart-studio.plot.ly and entering your desired login details.
Once you have your account setup, hover over your username and click on settings.
Click on API Keys and click Regenerate Key, it will ask for your account password. This will create a long string of lower and uppercase letters and numbers. Copy this into a text file, we are going to need this in a minute.
We are also going to need several streaming tokens, one for each data set. In this tutorial we have Temperature, Humidity, Light, PM1.0, PM2.5 and PM10.0, so we will need 6 streaming tokens. Click Add A New Token 6 times to generate all of the key and note them down with you API Key you generated above as we will need to enter them into our python script.

Step 6 Edit Python script
Before we run the script, we need to enter the Plotly API details we collected in Step 5.

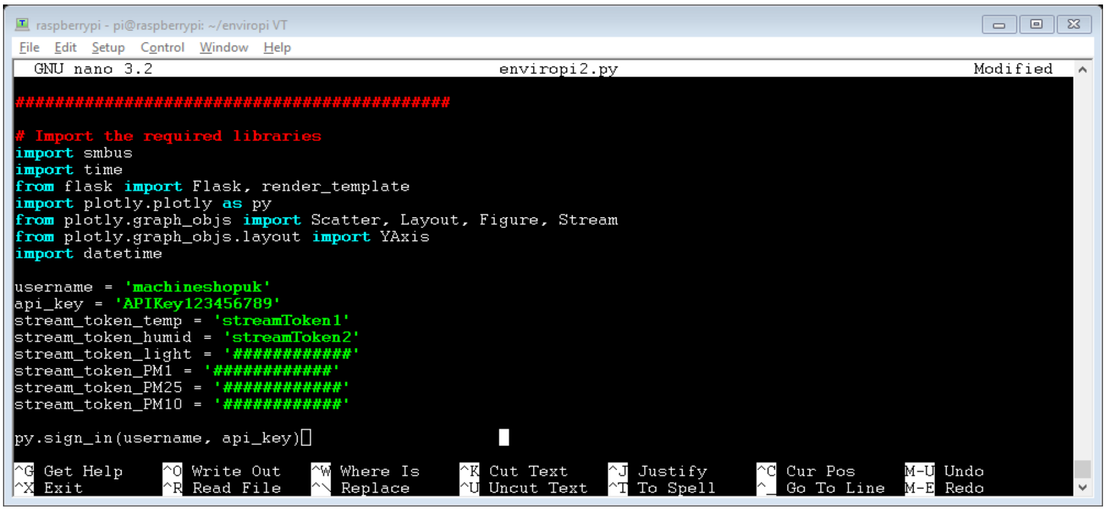
7

At the command prompt, enter the enviropi folder and open the python script.

```
cd enviropi
sudo nano enviropi.py
```



Scroll down to the API settings section of the code and enter your API username and keys from step 5 in between the 'quotes' and replacing the ### symbols.



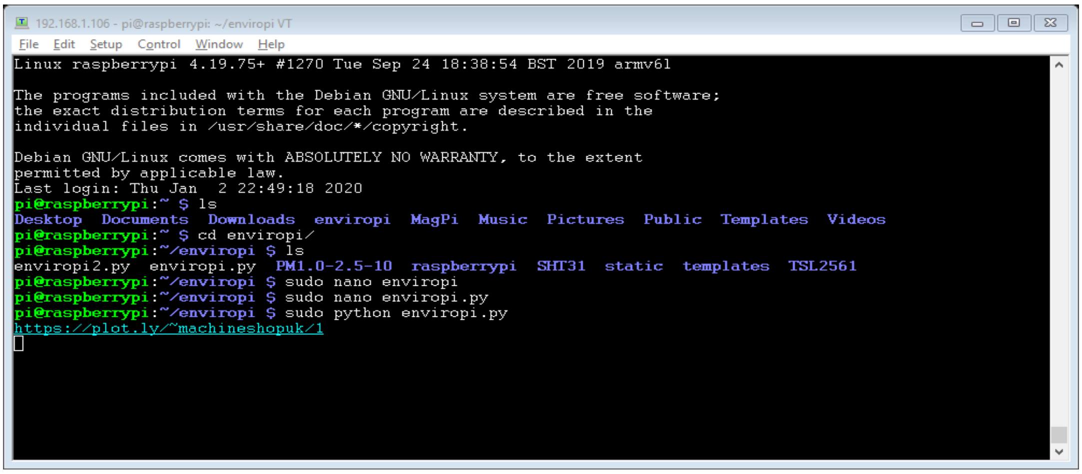
Now save the script and exit from nano by pressing CTRL + X and when prompted 'Save modified buffer?' press Y

8

Step 7 Run the Script

Then run the script by typing:

sudo python enviropi.py

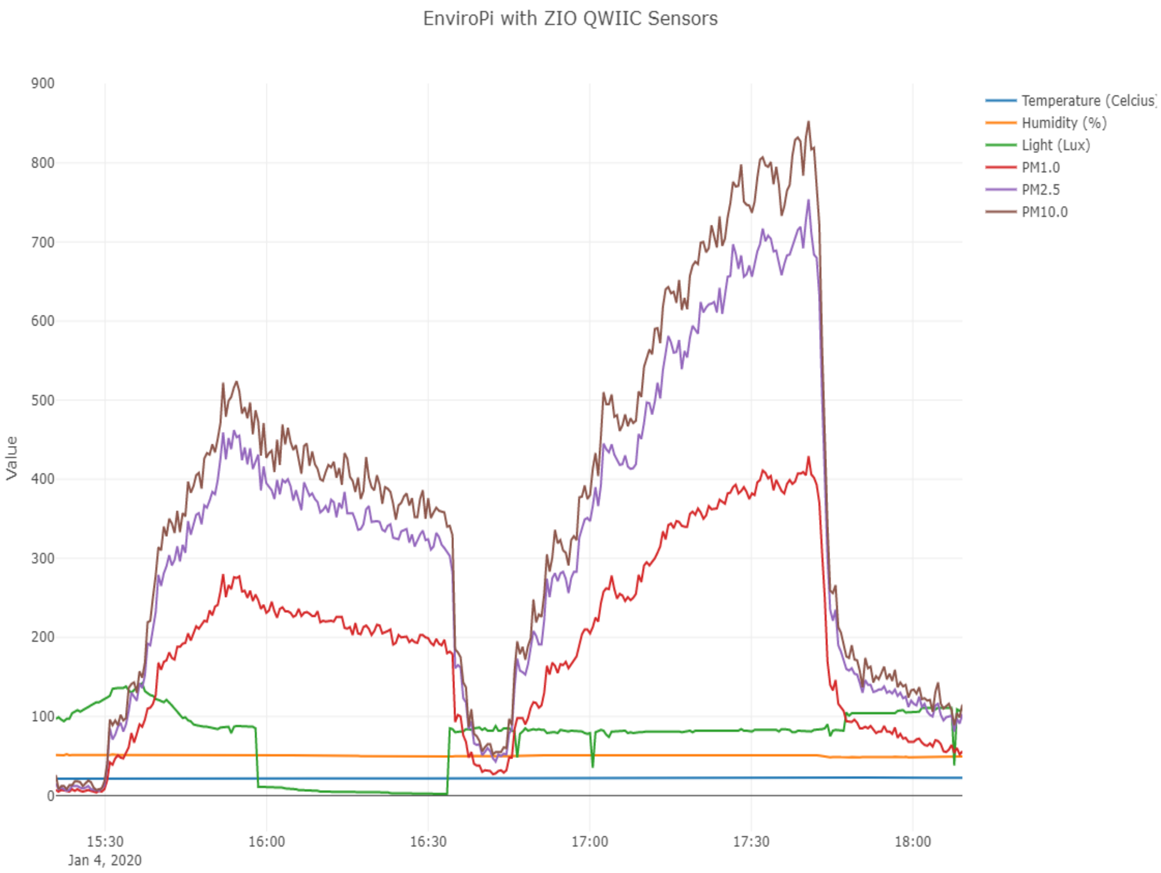


If you have entered all of your details correctly, then it should output a link to view the data on the Plotly website. If will start off with a graph with just one data point then after 30 seconds, another data point will be submitted and it will draw a line between the two points. As the graph fills up, it will automatically scale to show all of the data. This graph is configured to show a maximum of 10,000 data points with an interval of 30 seconds giving a total duration of 3.47 days' worth of data.

The graph below is an example of the output it will achieve. We had it setup in the office monitoring the environment. The blue and orange flat lines are the temperature and humidity which no surprise, didn't change much. The green line is the light intensity. This shows that the light was switched off at about 15:55 and switched back on again at 16:36. The red, purple and brown lines are from the ZIO Particulate Matter sensor.

We had the soldering irons switched on whilst we were monitoring the environment and we can see that particulates in the air dramatically increased at 15:30 up until 15:55 when the soldering stopped and the person left the office, switching off the light as they left.

9
The particulates in the air slowly decreased so I'm guessing the office
door was shut and at 16:36 when they came back they left the door open which quickly brought in fresh air. It looks like they started soldering again at 16:45 until 17:45 and then they opened the door but left the light on.



This data is extremally valuable and has given us an insight into the environment we work in. We can see that the temperature and humidity is nice and stable and that perhaps the light levels need to be slightly increased to ensure people can see what they are doing. The alarming data is from the particulate matter sensor and obviously shows that our extraction system needs to be improved. We could even use the data from the sensor to automatically

activate the extraction system if the particulates in the air get too high. This would ensure that everyone in the office is working in clean air just in case someone who is soldering has forgotten to turn the extractor on. I know I've done that in the past far too many times!

5. Conclusion

Real-time and comprehensive environmental monitoring of industrial parks is indispensable for pollution prevention and safety monitoring, and traditional monitoring systems often have problems of high prices, poor deployment flexibility, and incomplete coverage. In view of the above shortcomings, this paper proposes a set of NB-IoT-based industrial park environment monitoring system. The system mainly includes the hardware side of the acquisition node and the software side of the cloud server. The test results show that the basic monitoring function of the monitoring system is complete and reliable, and it also has the advantages of low power consumption, wide coverage, and convenient interaction. The use of the system to achieve data visualization is more reliable and scientific.