



Nelson, IOTA Foundation

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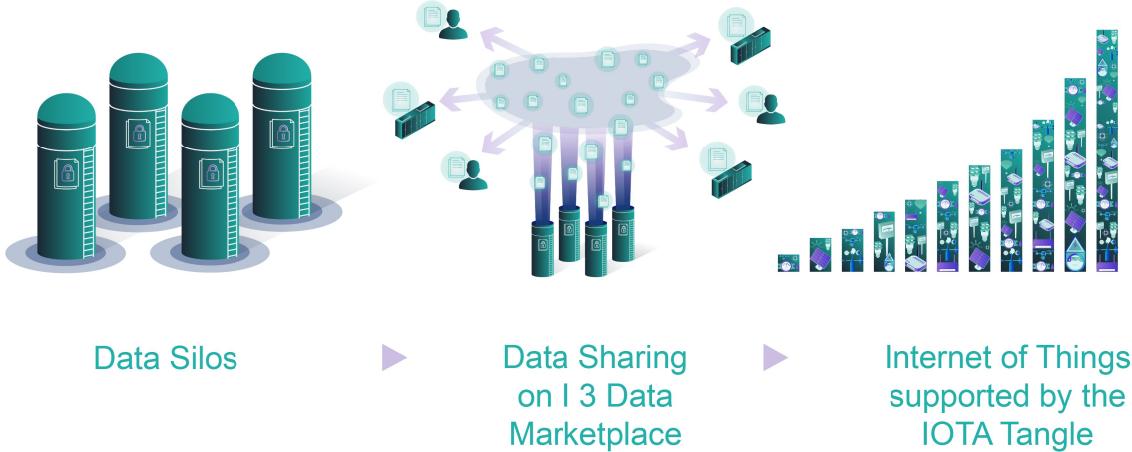
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The I3 Data Marketplace is the express lane for buying and selling data in Los Angeles. Small businesses need an on-ramp.

By design I3 connects buyers and sellers. Buyers need a place to store their data. IOTA offers free and secure data storage.

This presentation reports the results of an experiment building an on-ramp so small businesses (and individuals, communities, and large businesses) can begin profiting from the I3 Data Marketplace.

I 3 Consortium & IOTA Foundation vision for sharing data



IOTA is a nonprofit focused on balancing social good and resource utilization towards a sustainable future for everyone

I 3 and IOTA share the vision of data breaking free from silos and being used in new ways for commerce and social good

GOAL

- Demonstration the value of buying and selling data using I3 and IOTA technologies
- Introduce *Connecting an IoT device to the I 3 Data Marketplace* so you can get started
- Show how I 3 subscribers can save sensor data in the IOTA Tangle
- Show how subscribers can use data science tools to analyze data



The purpose of our experiment was to connect sensor data to the I3 data marketplace and store data on the IOTA Tangle. The expected result was a guide so everyone can participate.

Based on our budget, we built four devices for this experiment. And spent a month using these devices and interviewing small businesses to determine how best to meet their needs. We came up with interesting and unexpected results.



I interviewed some local small businesses including a shopkeeper who owns a destination location for customers to meetup and shop. To comply with city code, she pays a monthly fee for a security system with a smoke alarm. She pays a gardener to water the plants and she pays employees to monitor foot traffic. She has 10 parking spaces. She shops at amazon.com. I told her think of I3 data marketplace as the amazon.com for data. Here are four devices you may want to buy:

LA CO2-TVOC – reports CO2 levels in PPM and TVOC in PPB. A smoke detector can be added

AstroPiOTA weather station – clone of AstroPi onboard the International Space Station. Reports temperature, humidity, accelerometer and gyroscope data

EnviroPhat weather station reports temperature, local color

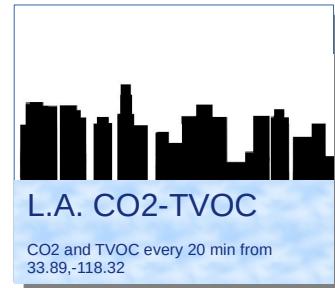
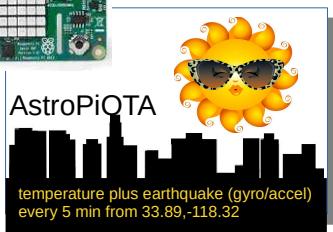
Autonomous Gardener reports the status of buying water to water plants

Picamera – coming soon. Reports foot traffic and parking space data. Security sensors could be connected.

IoT DEVICES



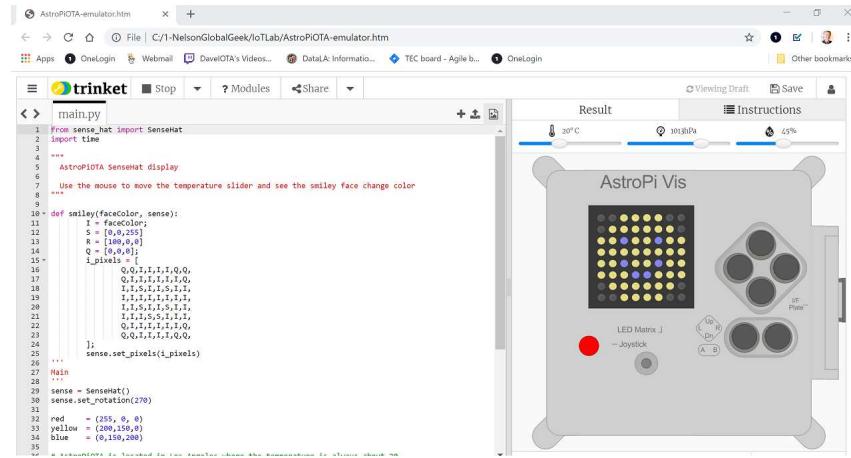
\$20-\$50



These devices are built using inexpensive computers, microcontrollers, and sensors. You can build your own device using our tutorials.

Realize that there's a trade between using your own devices and taking responsibility for monitoring them or buying a service to pay someone else to monitor your business. I3 data marketplace offers alternatives so you can choose.

IoT Device emulators - AstroPiOTA online



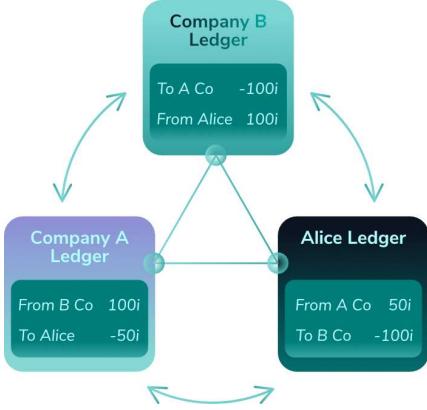
The screenshot shows a web-based IoT device emulator for the AstroPiOTA. On the left, there is a code editor window titled "main.py" containing Python code for the SenseHAT. The code includes imports for SenseHat, time, and a function "smiley" that uses a 8x8 LED matrix to display faces based on temperature. On the right, there is a graphical representation of the AstroPi Vis device, which includes an 8x8 LED matrix, a joystick, and two buttons labeled A and B. Above the device, there are sliders for "Result" (temperature at 20°C), "1010Pa" (pressure at 1010Pa), and "45%" (humidity at 45%). The "Result" section also displays a small smiley face icon.

```
1  From sense_hat import SenseHat
2  import time
3
4  """
5      AstroPiOTA SenseHat display
6
7      Use the mouse to move the temperature slider and see the smiley face change color
8  """
9
10 def smiley(faceColor, sense):
11     I = faceColor;
12     R = [100,0,0]
13     G = [0,0,0]
14     Q = [0,0,0];
15     i_pixels = [
16         Q,Q,I,I,I,I,Q,Q,
17         Q,I,I,I,I,I,Q,
18         I,I,I,I,I,I,I,
19         I,I,I,I,I,I,I,
20         I,I,S,I,I,S,I,
21         I,I,I,I,I,I,I,
22         Q,I,I,I,I,I,I,Q,
23         Q,Q,I,I,I,I,I,Q,
24     ];
25 ...
26 Main
27 """
28 sense = SenseHat()
29 sense.set_rotation(270)
30
31 red = (255, 0, 0)
32 yellow = (255, 159, 0)
33 blue = (0, 159, 255)
34
35
36 # This line is forced to run first when the connection is struck about 100ms
```

<http://www.NelsonGlobalGeek.com/I3/Phase1/AstroPiOTAemulator.htm>

If you don't want to build a device then you can check out the online emulator

What is the IOTA Tangle?

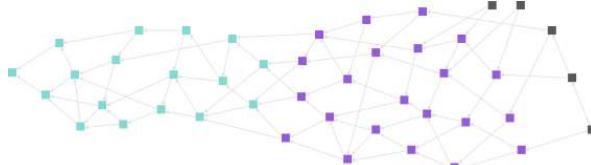


Distributed Ledger where transactions cannot be changed and there are no fees to store data

Blockchain Technology is a chain of data blocks



Tangle Technology is a DAG that looks like a family tree

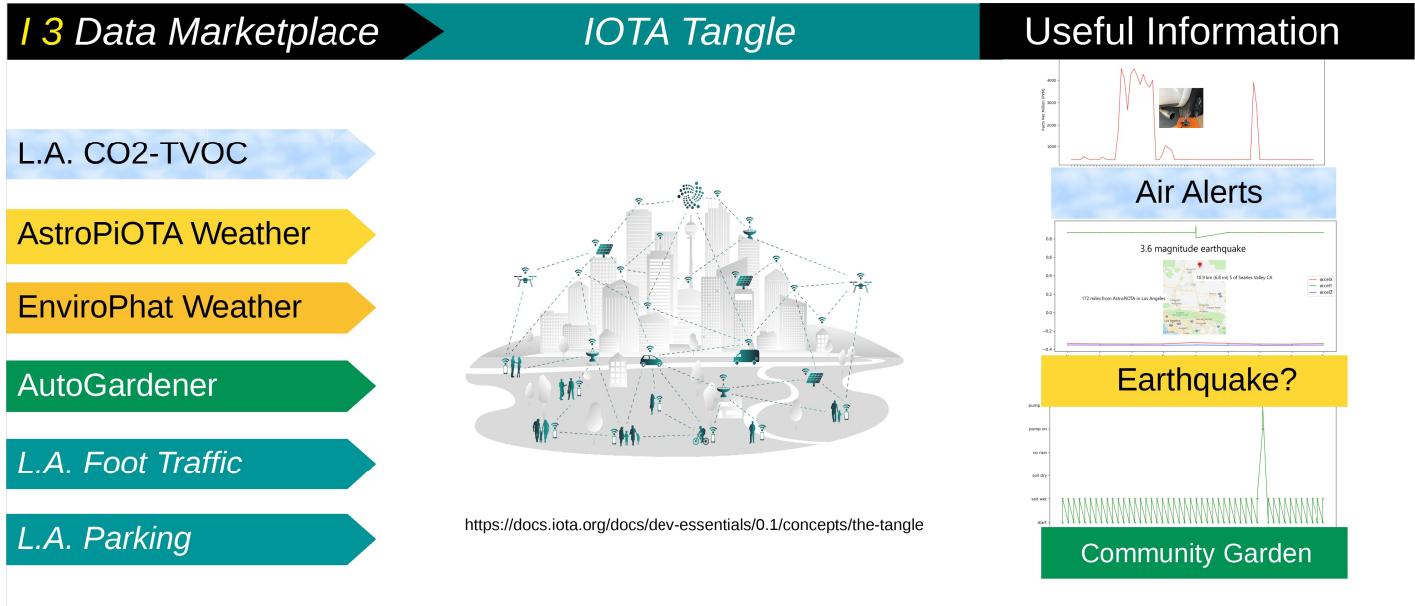


The Tangle stores and shares data. It is a distributed ledger. Once data is published it cannot be changed. There are no fees to use the Tangle.

Some folks confuse the Tangle with a blockchain. Blockchains are literally blocks of data chained together. Your transaction waits in line to process. You waste a lot of resources computing math puzzles. This is called “mining”. You must pay high fees.

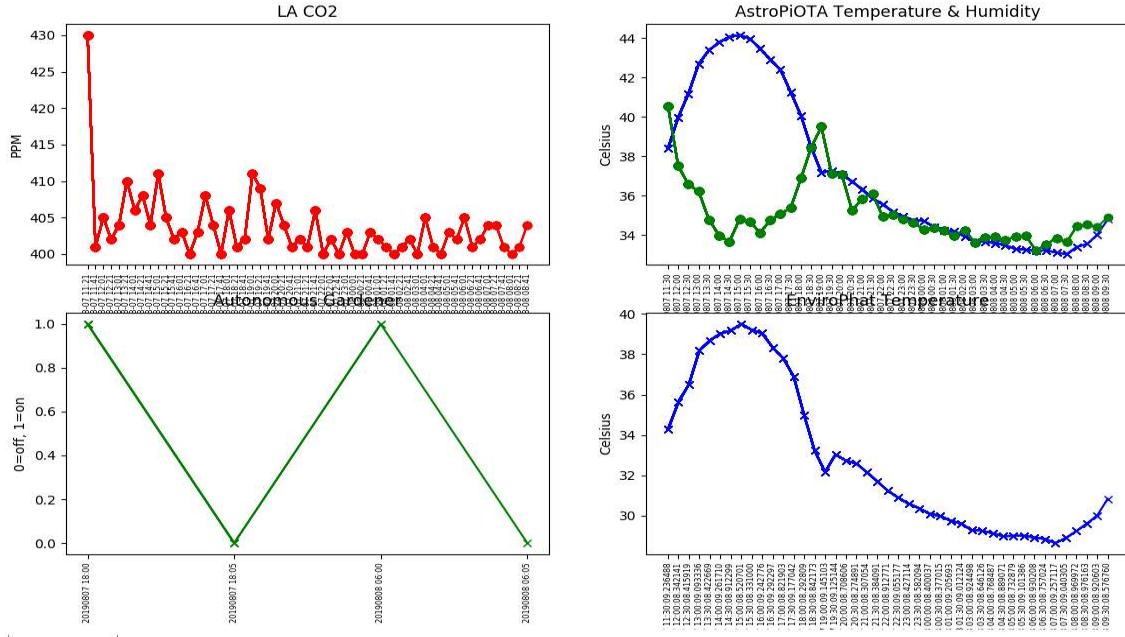
The Tangle looks like a family tree. There are no fees because everyone using the Tangle helps verify each other's transactions. All resources are used to generate useful information.

From raw data to useful information



There is a product on the I3 Data marketplace for each sensor. Each sensor reports data periodically. A subscriber gathers the data and stores it on the Tangle. Data science tools are used to evaluate the data and report results

Results: charting my sensor data subscription



I expected these results:

The CO2 monitor reports data. You can see in my lab the levels are well below OSHA limits. Interestingly, I notice that when I work near the monitor, the CO2 levels go up as I breath.

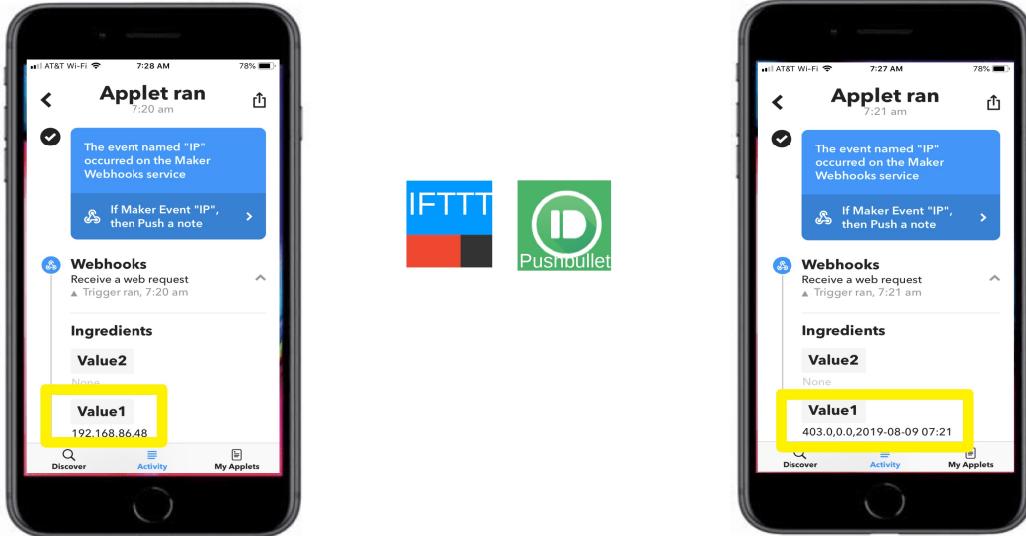
AstroPiOTA is reporting temperature and humidity to the monitor. Behind the scenes it is reporting gyroscope and accelerometer data.

EnviroPhat is reporting temperature

Auto Gardener is reporting when the watering pumps go on and off

Receiving texts about sensor network location & sensor data

Phase 2 – make it easier to read



Tutorial: *Using IFTTT with the Raspberry Pi*

When you run devices without a computer monitor attached, then you can't see what's going on. These devices text me with their network address and data so I can monitor them.

In Phase 2, we plan to improve the readability of these text messages

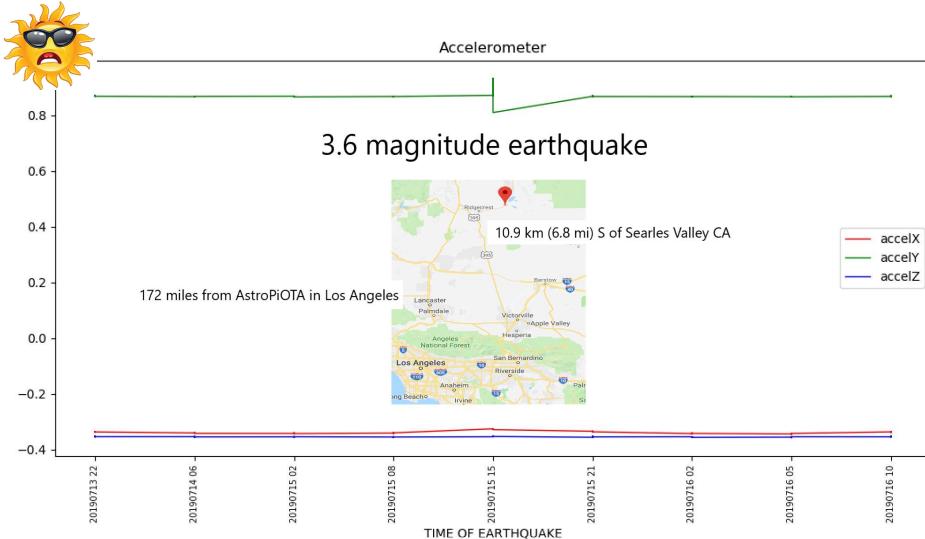
Unexpected Results

On July 4, AstroPiOTA “felt” a 7.1 magnitude earthquake along with many aftershocks – at least that’s what the data looks like!

And Auto Gardener reported data showing the soil moisture sensor was poisoning the plants

AstroPiOTA shakes during earthquake

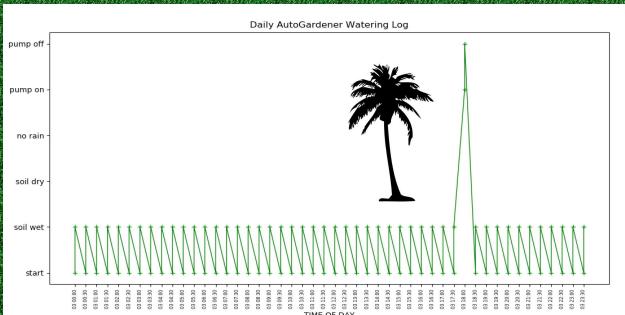
Accelerometer and gyroscope data change as the earth moves



On July 4, we had an earthquake. AstroPiOTA sensed the movement. I'm enlisting some earthquake experts to review this and confirm. If that's the case, then it may help our shopkeeper or earthquake analysts take action during an earthquake.

Especially since ShakeAlertLA did not send an alert about the 7.1 magnitude earthquake on July 4, according the July 15, 2019 LA Times article, *ShakeAlert's Quake App Performed Horribly Well.*

L.A. Community Garden – Autonomous Gardener



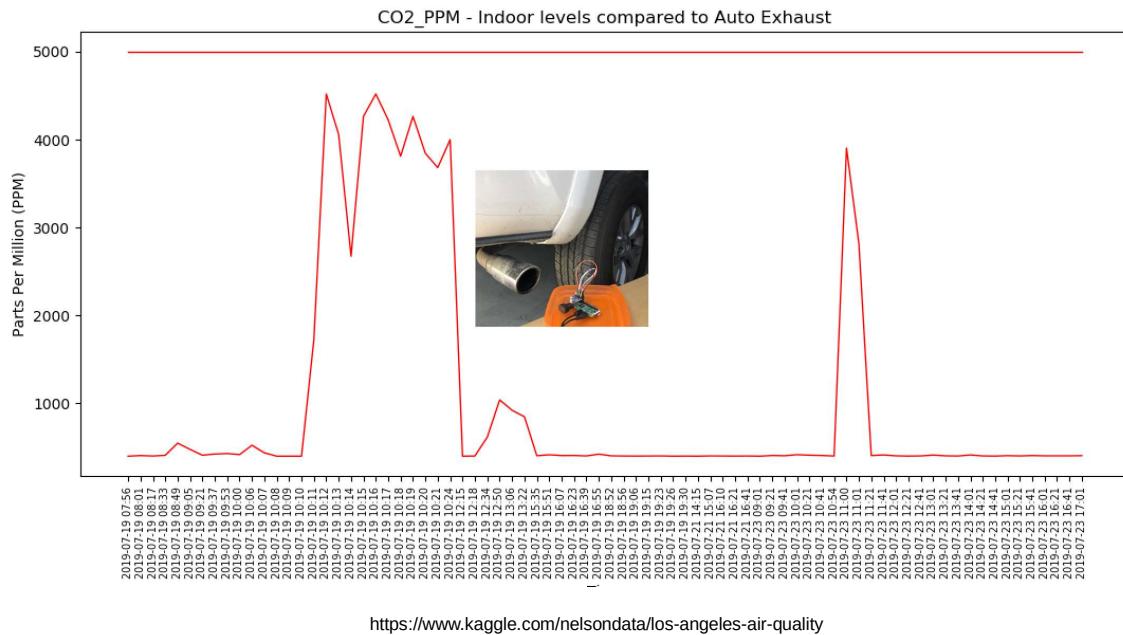
Watering plants twice daily
at GPS 33.89,-118.32



Data shows equipment malfunction -
soil moisture sensor poisoning plants

My community has a community garden and we're using IoT Devices to water plants. The data from my Autonomous Gardener alerted me that a sensor was failing and poisoning my chard plant.

Indoor CO2 levels compared to truck exhaust



Here I'm showing the CO2 levels from the exhaust of my truck. I took these readings outdoors. Don't try this in your garage.

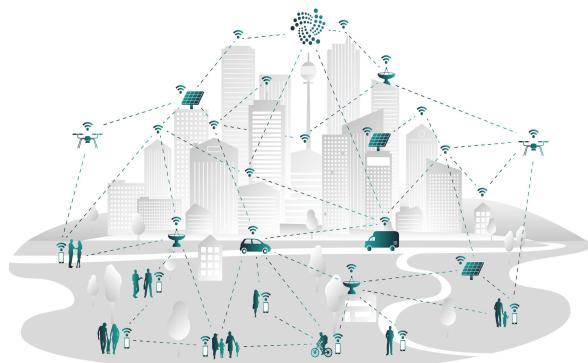


https://github.com/NelsonPython/Connect_IoT_Device_to_I3

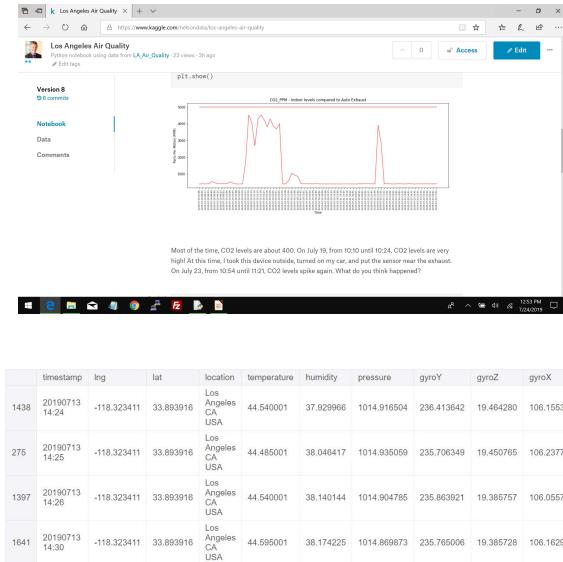
Here's your on-ramp

STEP-BY-STEP GUIDE

1. Develop an IoT Device
2. Add the IoT Device as a product to I3
3. Subscribe to a product on I3 and store the data in the IOTA Tangle
4. Use the data science tools from www.Kaggle.com to evaluate data



<https://www.kaggle.com/nelsondata/los-angeles-air-quality>



<https://www.kaggle.com/nelsondata/astropiota-weather-los-angeles>

Special thanks to the Kaggle team for providing a great platform to evaluate data

Towards the Small Business On-ramp to the I3 Data Marketplace

Aug-2019 Intelligent-Integrated IOT demo of
buying and selling sensor data using the I3 (i-three) Data Marketplace and IOTA

Future Plans



Special thanks to WenChen Mei for tech guidance

Special thanks to WenChen Mei, Auburn University masters student, for tech support creating the graphs

Coming soon: L.A. Foot Traffic data...

Help vendors increase profits?



Coming soon: L.A. Parking data...

Can I rent my driveway?



Phase 2: We're adding camera analytics to identify foot traffic and parking spaces.

I have the camera setup and working. But I need to finetune the neural network before connecting it to I3 data marketplace.

<http://www.nelsonglobalgeek.com/I3/Phase1/Phase1-Demo.htm>



Towards the Small Business On-ramp to I 3 Data Marketplace

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The I3 Data Marketplace is the express lane for buying and selling data in Los Angeles. I've shown one successful on-ramp for small businesses.

Check out the guide along with tutorials for building your own devices plus some helpful utilities.