Final year project report
OITP (Japan, Nara)

YEAR 2019 SEMESTER 1

Jin Nanri (174804P) | Mechatronics Engineering | 12/08/2019
174804p@mymail.nyp.edu.sg
Supervisor: Dr Edwin Foo

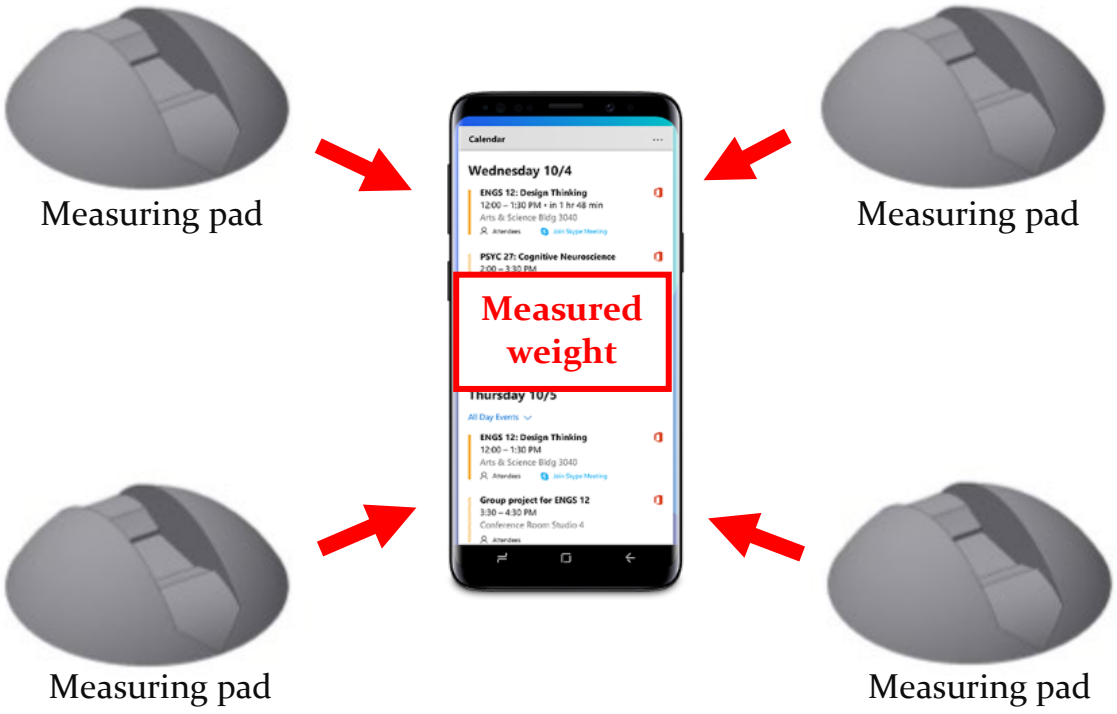
CONTENT

iPortable Weighing Device

TTSH-NYP JOINT GRANT PROGRAMME

A Smart weight measurement device that are designed for chair and wheelchair clients.

This device consists of 4 individual pads that can take weight measurements when force is applied on top, the measured weight is than transmitted to user mobile phone wirelessly.



ACKNOWLEDGEMENTS

The internship opportunity I had with Nara College, National Institute of Technology Japan, was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individual as I was provided with an opportunity to be a part of it. I am also thankful for having a chance to meet so many oversea new friends and professionals who led me though this internship period.

Successfully completion of any type of project requires helps from several people. I have also taken help from different people for the preparation of this report. Now, there is a little effort to show my deep gratitude to all the people that helped me in one way or another.

Firstly, I would like to express my very great appreciation to my main supervisor Dr Edwin foo for his valuable and constructive suggestions during this planning and development of this research project that enabling me to complete this project on “Final year project: iPortable Weighing Device”.

Secondly, I would like to express my gratitude & respect to my oversea hostel director Mr. Uchida for providing us clean rooms and my Supervisor in Japan, Dr Shigeki Doi for his help and encouragement to make the internship successful.

Thirdly, thanks to our lab members and friends for their guidance and tour. Mr. Cheok Chin Seng (OIPT coordinator), Mr. Jinzenji (lab members), Mr. Kato (lab members), Mr. Kawamoto (lab members), Mr. Tsujimota (lab members), Mr. katayama (lab members), Mr. Wai Jay Lee (lab members), Mr. Itakura (Global Education Center, NIT), Ms. Aya Sawada (Global Education Center, NIT) and Mr. Nakanishi (Japanese language teacher) for their constant guidance, support & valuable suggestions during the 12 weeks in japan.

Lastly, I wish to thank my family and the school for their support and encouragement throughout this 24weeks of FYP.

ABSTRACT

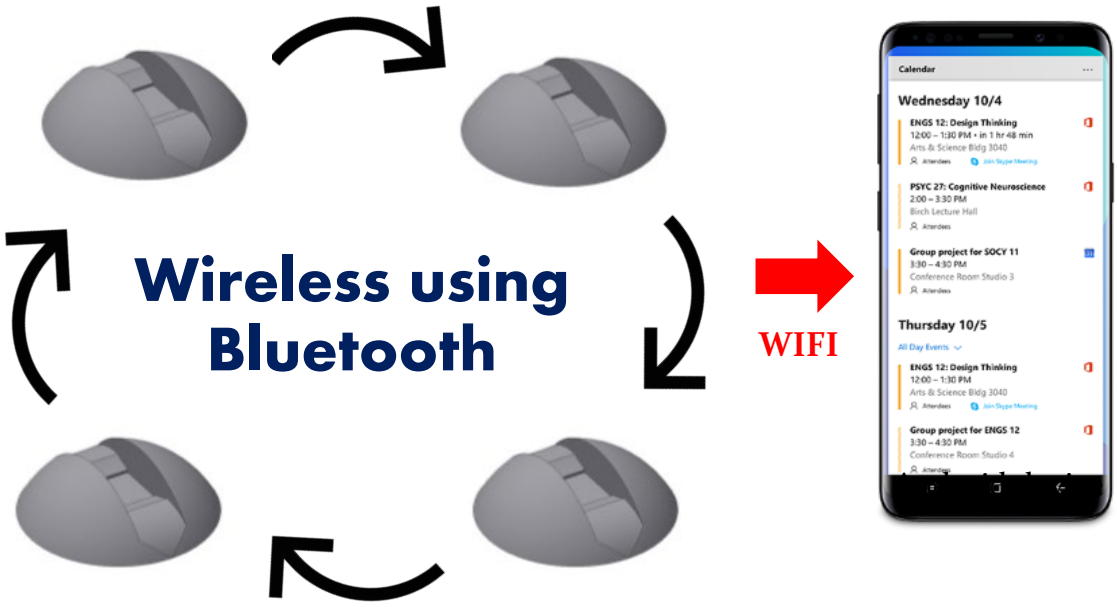
"iPortable Weighing device" It is A Smart weight measurement device that are specially designed for chair and wheelchair clients and used by house visiting nurse/care takers to allow them to perform their job accurately and efficiently.

The project was originally proposed by Tang Tock Seng hospital and it was taken by Nanyang Polytechnic to develop this device. The device consists of 4 measuring pads and an android device. Each pad can take measurements when force is applied on top, and the measured value can be monitored through mobile phone wirelessly.

Each pad consists of a Particle microcontroller board, an all-in-one IOT board that has built in WIFI and Bluetooth module, a strain gauge load cells, and load cell amplifier that amplify the electrical signal from the loadcell for microcontroller to pick up.

4 pads will be connected in the same Bluetooth mesh network that allows them to transmit data from one to another.

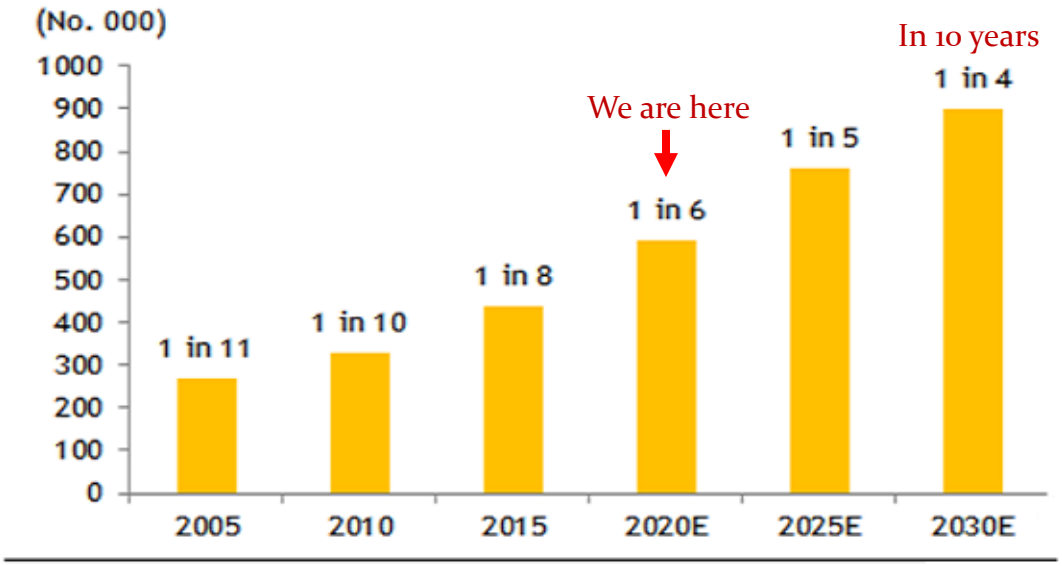
Then the measured value will be calculated and transmitted to mobile application through WIFI.



INTRODUCTION

With rapid ageing population and chronic diseases causing physical impairments more clients will require the weighing scale. Weight measurement is crucial for treatment and management of client's health and well-being. However, in community setting there is a lack of suitable weighing scale for chair bound clients. Thus, cannot administrator accurate medications and treatment and provide timely and early interventions to prevent worsening conditions and admissions. Figure 2 shows the number of Singapore citizens aged above 65.

Fig 2: No. of Singapore citizens aged 65 and above



Source: Singstat, population.sg

In 10 years, the number of Singapore citizens aged above 65 will increase to 1 in 4 (25%) of the population.

BACKGROUNDS

Singapore currently has a pool of about 130 community nurses from three clusters, providing care for residents with different needs across care settings. MOH aims to increase the number of community nurses to 200 by end 2019 cited from the Committee of Supply debates on 7 March 2018. A regular work day for a community senior staff nurse involves home visits to patients under Tan Tock Seng Hospital's (TTSH) hospital to home (H2H) program.

Hospital to Home (H2H) is a nationwide program that supports patients' safe and timely transit back home, so that they can stay well and age gracefully in the community. It is targeted at patients with complex health and social needs, and a high risk of readmissions.

In the H2H program we have a team of healthcare professional's multi-discipline known as Community health team (CHT). CHT healthcare professionals consist of nurses, physiotherapist, pharmacists, doctors and occupational therapist. They visit patients in their homes and in the community. These groups of patients require post discharge care such as rehabilitative, nursing care, symptom management, medication titration and caregiver training. Each CHT nurse has about average 30 patients under their care. They either visit them at home or patients come to the nurse clinic in the community. She moves around with at least two cell phones, iPad, a backpack and a cabin bag full of equipment and supplies including a bathroom scale. One of her routine jobs is to measure the weight of the patient so that they can monitor if the patient has water retention and to appropriately start treatment. Patients with heart failure, renal and liver failure, dialysis and patients on diuretic need constant monitoring to manage their symptoms of breathlessness. Other examples of clients requiring weight monitoring - Patients who are elderly or on special dietary restrictions, weight loss patient, obese patients and patients on medications that require titration according to their weight.

PURPOSE FOR THIS PROJECT

There are currently several ways of taking the weight of the patients. For patients that can stand, a portable weighing scale will suffice. For patients that are wheelchair bound, a weighing device that has a ramp structure as shown in Figure 1 can be used. However, its size (910 mm square) and weight (about 34 kg) make it impractical for use in home visit. For home visit, the community nurse brings along a bathing scale to take the weight of the patients. Unfortunately, this only applies to those that can stand. For patients that cannot stand, their weight is taken while sitting on a wheelchair. Under such circumstances, a commercially available weighing system as shown in Figure 2 can be used. It comprises 4 weighing pads that are placed on the floor. The patient is then wheeled onto the pads and his or her weight is taken. The weight is then transmitted to a propriety handheld remote device, which cannot be connected to a mobile device for telemetric purposes. However, not all patients have a wheelchair and for those without a wheelchair, the only way is to place a chair on 4 weighing pads and sit the patient on the chair to have his or her weight taken. Unfortunately, the commercially available weighing system is only meant for wheelchair bound patients.

Figure 1, Ramp type weighting system average cost is about USD 2000 to 4000

Figure 2, Rice lake D3000 wireless weighing system cost USD 2700

OBJECTIVE AND HYPOTHESIS

The aim of this project is to develop a fully functional portable weighing device prototype that incorporates the following features.

1. **Applicable to wheelchair and chair.**
   This device should be applicable as long as the client is not bedridden.

2. **Provide stability for both wheelchair and chair.**
   A design that provides stability for both chair use and wheelchair usage.

3. **Auto-calibration.**
   A function that allows the device to take measurement itself and able to calibrate itself to ZERO just like standard weighing scale.

4. **Wireless transmission of data to the user hand phone.**
   It must be wireless between each pads and phone.

5. **App to manage the data.**
   Some sort of storage system that stores the measured value, data can be sent to the cloud and accessed by the relevant personnel.

6. **Battery powered.**
   That allows the device to work without the present of a power socket.

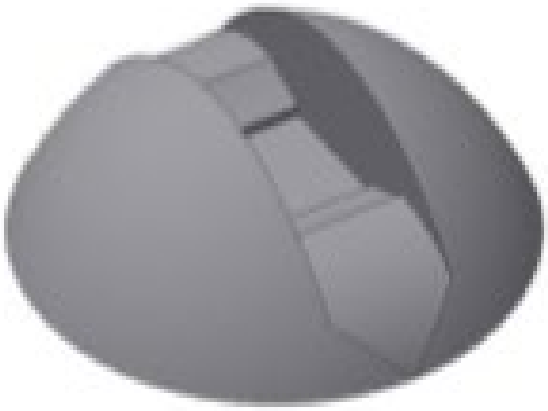
Besides the main objectives that has been listed, we can add in more features to enhance user experience.

For example,

- LED indicator
- Physical buttons (manual calibration)
- Buzzer
- LCD display (for reading)
- Battery indicator

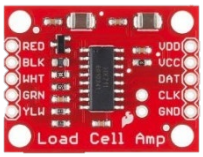
PROJECT IMPLEMENTATION PLAN / RESEARCH METHODOLOGY

Each weighing pad will have a load cell, a load cell amplifier, an IOT ready microcontroller and they are powered by battery. All the electronics will be house internally within each weighing pad.



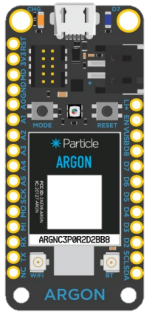
Each Measuring pads

Strain gauge load cell



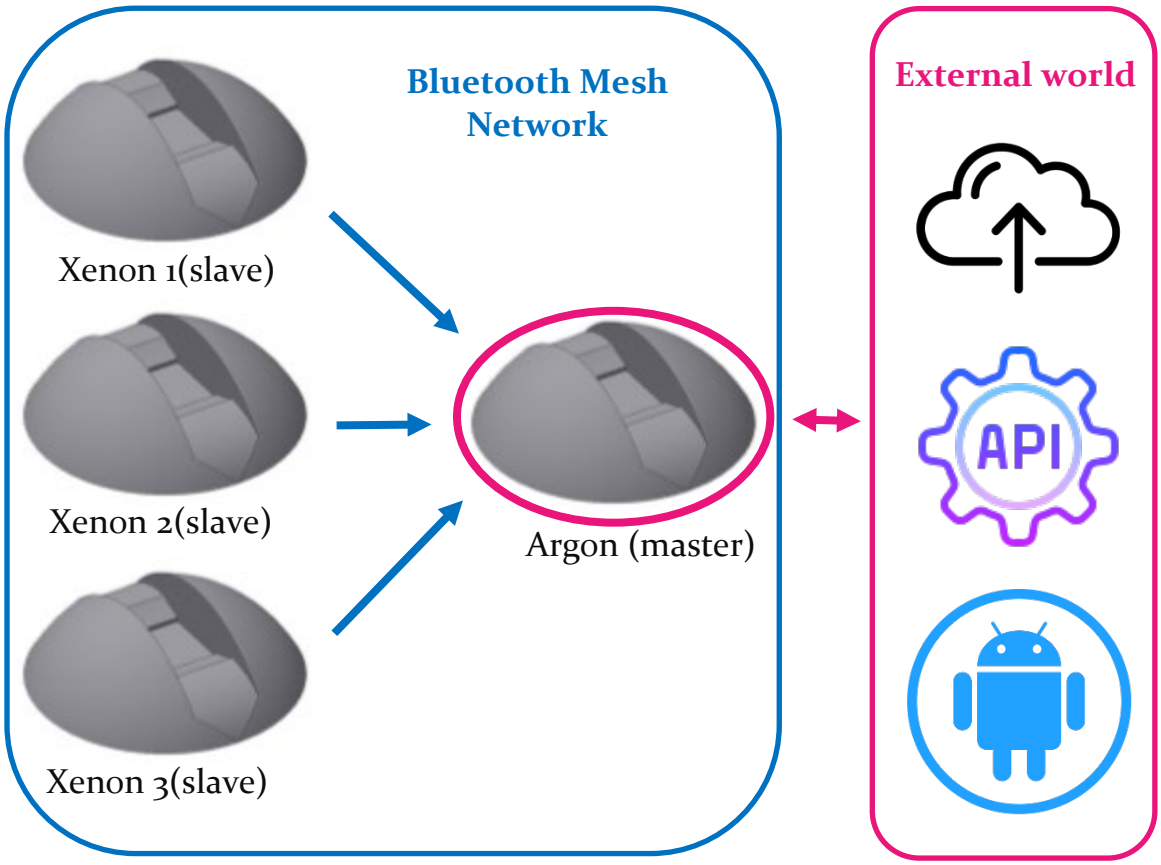
Load cell Amp

Battery



Microcontroller

Three of these pads will be designated as slave pads while one is the master pad. The master pad will be the gateway to the external world and is equipped with WIFI connectivity to the cloud system.



The three slave's pads will be connected to the master pad wirelessly via Bluetooth. With this setup, the weight measurements from all the weighing pads are transmitted wirelessly from Xenon to Argon then to the mobile phone.

To ensure the accuracy and reliability of the measurements, we will benchmark our system with the hospital gold standard after the prototype is developed.

MATERIALS / COMPONENTS

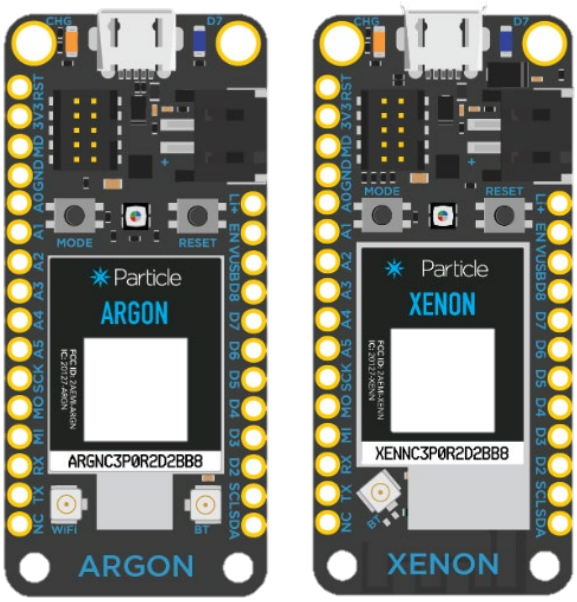
IOT Ready microcontroller.

Particle

Particle ALL-IN-ONE IOT board.

Argon (Master)

Xenon (Slave)



Argon (Master)

The Argon is a powerful Wi-Fi enabled development board that can act as either a standalone Wi-Fi endpoint or Wi-Fi enabled gateway for Particle Mesh networks. It is based on the Nordic nRF52840 and has built-in battery charging circuitry so it's easy to connect a Li-Po and deploy your local network in minutes.
The Argon is great for connecting existing projects to the Particle Device Cloud or as a gateway to connect an entire group of local endpoints.

Features

Espressif ESP32-D0WD 2.4 GHz Wi-Fi coprocessor
Bluetooth 5: 2 Mbps, 1 Mbps, 500 Kbps, 125 Kbps
20 mixed signal GPIO (6 x Analog, 8 x PWM), UART, I2C, SPI
Micro USB 2.0 full speed (12 Mbps)
Integrated Li-Po charging and battery connector
RGB status LED
And many more.

Xenon (Slave)

The Xenon is a low-cost mesh-enabled development board that can act as either an endpoint or repeater within a Particle Mesh network.
The Xenon is mesh only and designed to function as the endpoint of your IOT network. It is based on the Nordic nRF52840 and has built-in battery charging circuitry so it's easy to connect a Li-Po and deploy your local network in minutes. The Xenon is best for connecting sensors, motors, pumps, valves, and points of data-interest. Pair it with an Argon or Boron gateway to get all that great data into the Device Cloud.

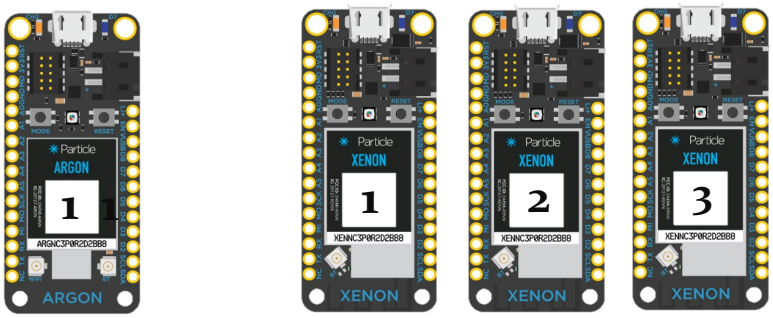
Features

Nordic Semiconductor nRF52840 SoC
Bluetooth 5: 2 Mbps, 1 Mbps, 500 Kbps, 125 Kbps
20 mixed signal GPIO (6 x Analog, 8 x PWM), UART, I2C, SPI
Micro USB 2.0 full speed (12 Mbps)
Integrated Li-Po charging and battery connector
RGB status LED
And many more.

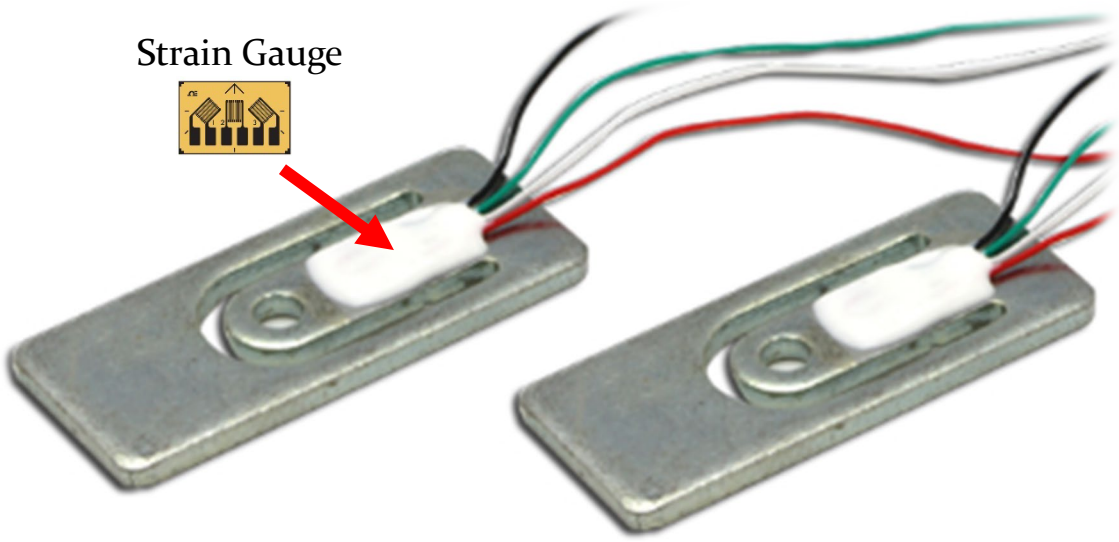
What differs from Argon and Xenon is that, The Xenon is mesh only and designed to function as the endpoint of your IOT network. Whereby Argon act as standalone Wi-Fi endpoint or Wi-Fi enabled gateway for Particle Mesh networks.

Xenon needs the present of Argon whereby Argon can work with or without the present of Xenon.

In our project, we will be using one Argon as the master and three Xenon as the slave.



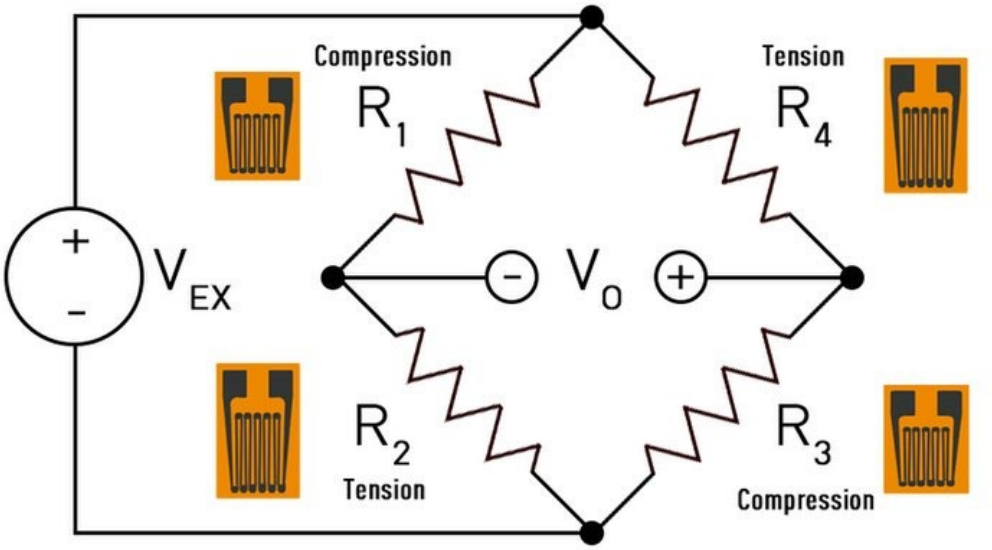
Strain Gauge Load Cell.



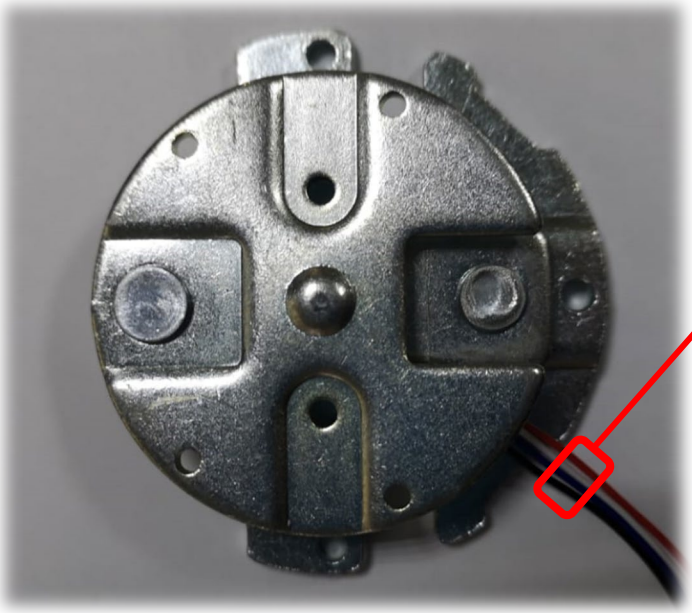
Strain gauge load cells are the kind most often found in industrial settings. This kind of load cell is ideal as it is highly accurate, versatile, and cost-effective. Structurally, a load cell has a metal body to which strain gauges have been secured. The body is usually made of aluminum, alloy steel, or stainless steel which makes it very sturdy but also minimally elastic. This elasticity gives rise to the term "spring element", referring to the body of the load cell. When force is exerted on the load cell, the spring element is slightly deformed, and unless overloaded, always returns to its original shape. As the spring element deforms, the strain gauges also change shape. The resulting alteration to the resistance in the strain gauges can be measured as voltage. The change in voltage is proportional to the amount of force applied to the cell, thus the amount of force can be calculated from the load cell's output.

Since the change in resistance measured by a single strain gauge is extremely small, it is difficult to accurately measure changes. Increasing the number of strain gauges applied collectively magnifies these small changes into something more measurable. A set of 4 strain gauges set in a specific circuit is called Wheatstone bridge.

A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component. The primary benefit of the circuit is its ability to provide extremely accurate measurements.



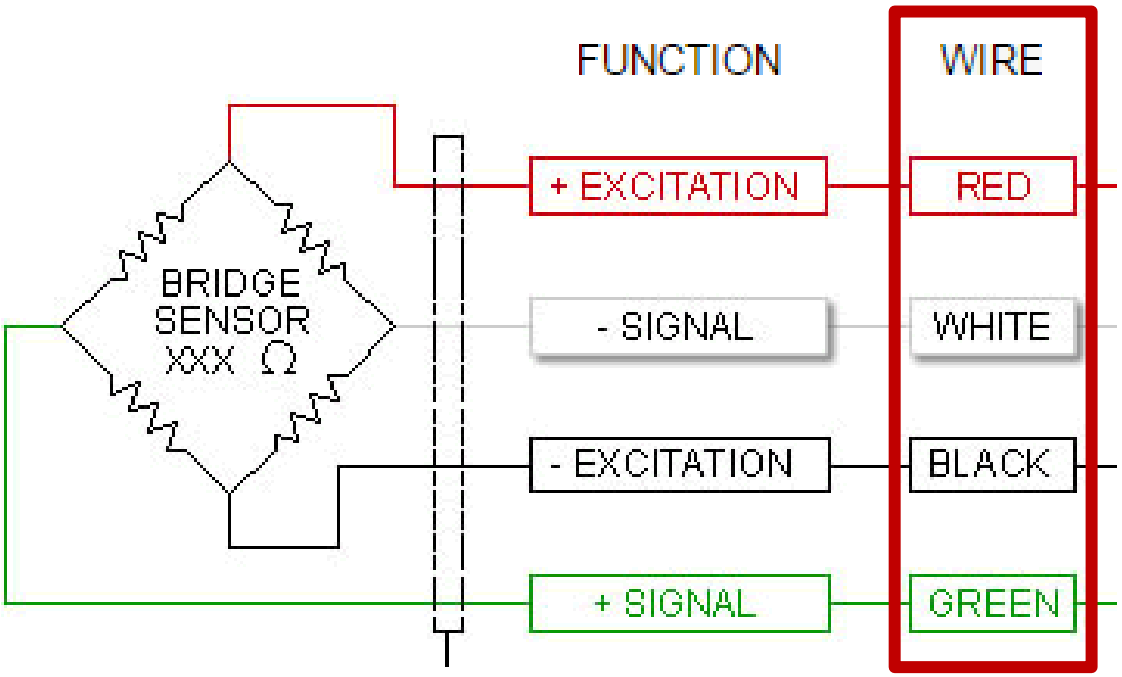
In this project we are using **4 wire load cells**, which has a full Wheatstone bridge.



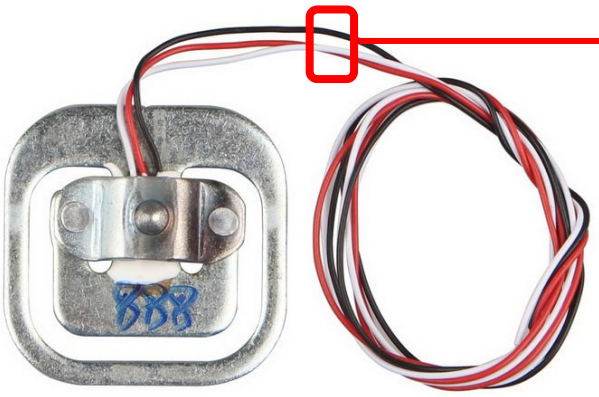
4 wire load cells.

Rated 75kg.

- Red wire
- White wire
- Blue wire
- Black wire



There are half Wheatstone bridge load cells that only give out 3 wires and it is meant to be used in pair or quad.

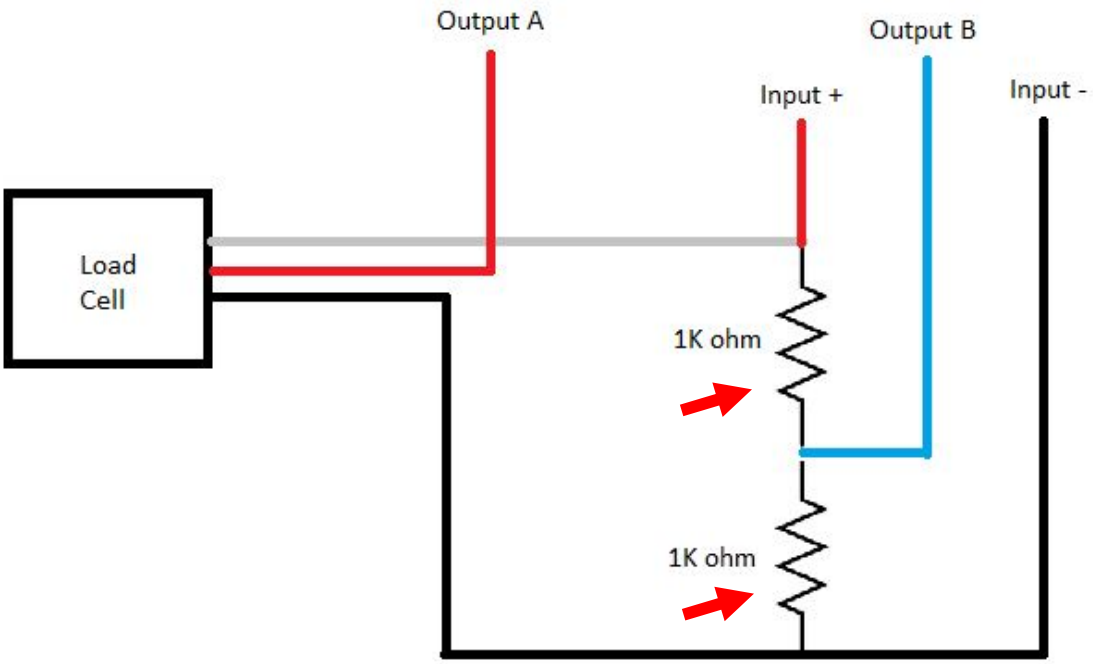


3 wire load cells.

Rated 50kg.

- Red wire
- White wire
- Black wire

When using single 3 wire load cell, there is a need to construct your own half Wheatstone bridge using resisters. Shown in figure below.

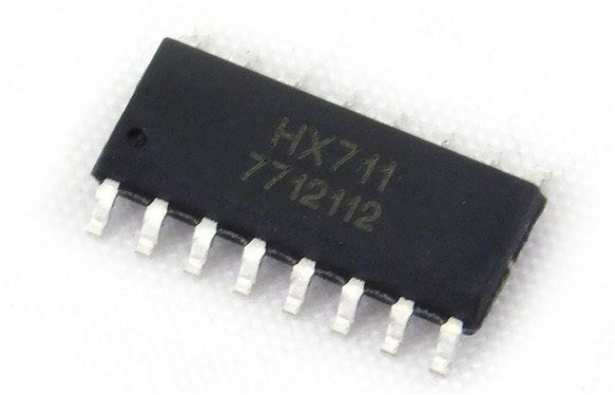


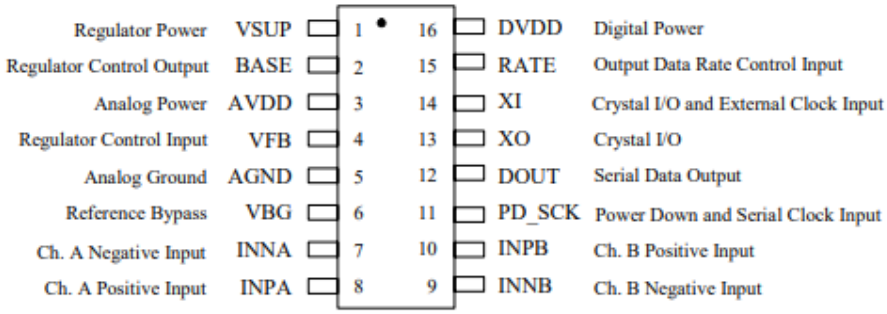
Reasons why I have decided to use the single 4 wire load cell in each pad.

- Takes up smaller space.
- It has simpler wirings.
- More stable readings.
- Rated 75kg per pad, (max 300kg, 4 pads)

HX711 Load cell Amplifier.

HX711 24-Bit Analog-to-Digital Converter (ADC) for Weigh Scales





Descriptions

HX711 is a precision 24-bit analog-to-digital converter (ADC) designed for weigh scales and industrial control applications to interface directly with a bridge sensor.

There is no programming needed for the internal registers. All controls to the HX711 are through the pins.

Features

Two selectable differential input channels

On-chip active low noise PGA with selectable gain of 32, 64 and 128

On-chip power supply regulator for load-cell and ADC analog power supply

On-chip power-on-reset

Simple digital control and serial interface: pin-driven controls, no programming needed, and more.

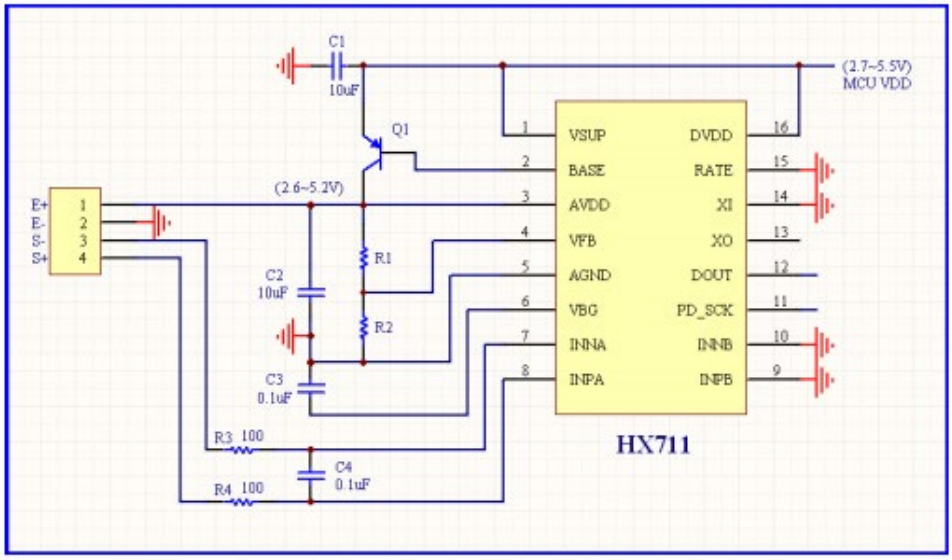
Main Applications

• Weigh Scales

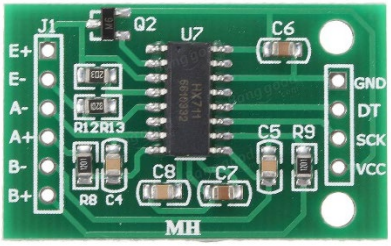
• Industrial Process Control

We could construct our own Load cell amplifier using the schematic diagram that the hx711 datasheet has provided.

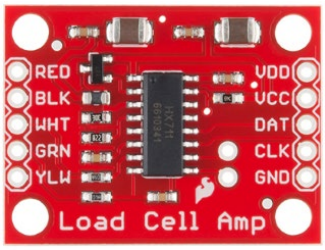
Reference PCB Board (Single Layer)



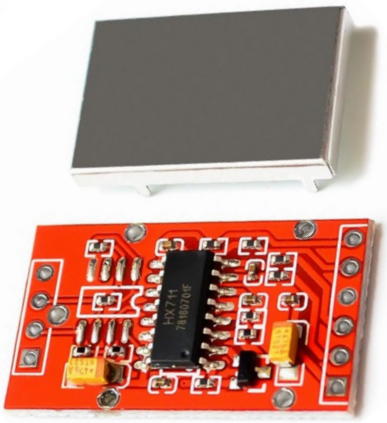
But thankfully there are already made HX711 modules, and all we need to do is to connect the wires together. Here are some of the popular HX711 modules.



Cheap ADC



Spark Fun high quality ADC



Mid-range ADC with shield

I have tested all the 3 popular ADCs in the market, and I have decided to use the Mid-range ADC in this project because,

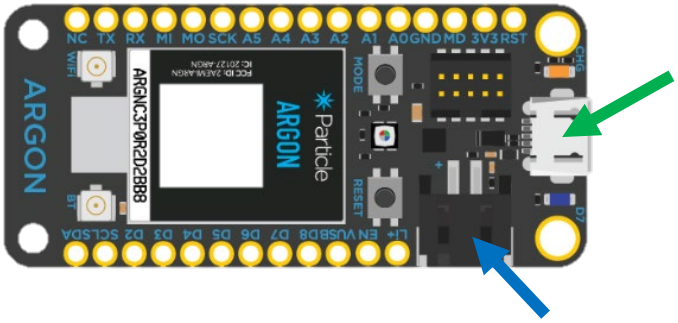
- It is relatively cheap compared to Spark Fun ADC
- Its smaller size and more compact compared with Spark Fun ADC
- It as shield that shield off the components that may help to reduce noise from outside world.
- It has no significant difference in performance compared to Spark Fun ADC.

Hx711 datasheet -> https://cdn.sparkfun.com/datasheets/Sensors/ForceFlex/hx711_english.pdf

Choice of powering the device

There are 2 ways of powering the device,

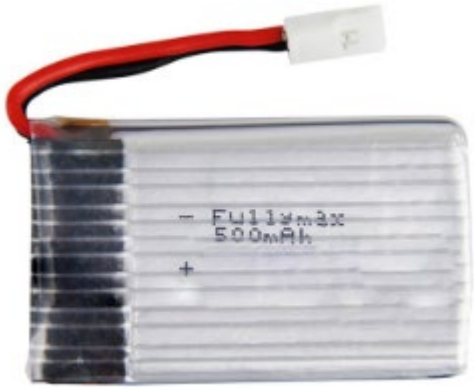
1. **Through USB**
2. **Using of batteries**



Since we are doing wireless device, we cannot have wires plugging in and powering the pad, so the only option left is to power the device using batteries.

The device can be power by both normal disposable alkaline battery and rechargeable LiPo batteries.

Recommended operating conditions is **3v - 3.6v**, Maximum ratings **6.2v.**



3.7V LiPo battery

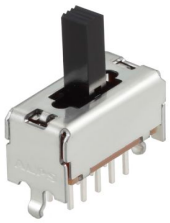
3x AA Alkaline battery

The benefit of using LiPo is that, it can be contained in the housing, no changing of batteries is needed.

But in this project, replaceable batteries are better because AA batteries are available everywhere, it will be a quick fix if the device happens to be low on power. Whereby LiPo batteries will take time to charge.

Other components

Other components can be added to the device as well, such as power switch, LED and buttons.



switch

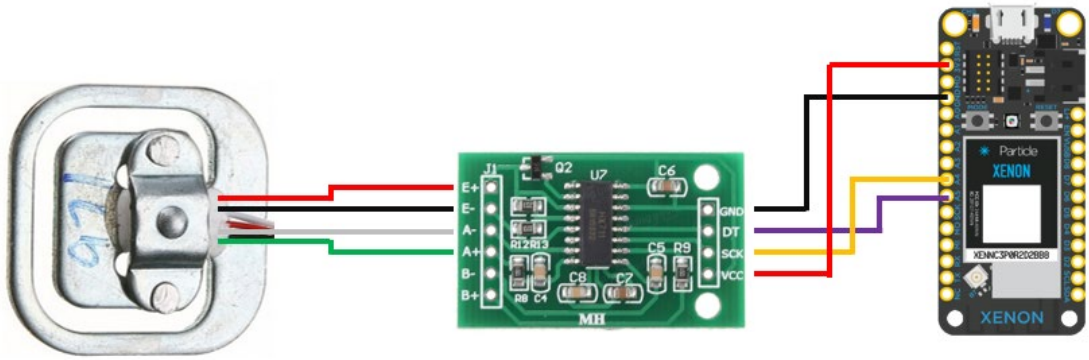
LED

Button

- Switch can be used to power ON & OFF the device.
- LED act as an indicator of the device status, it could be low battery warming or connectivity status etc…
- Button can be used to Tare the reading to Zero / restart the device.
- And more.

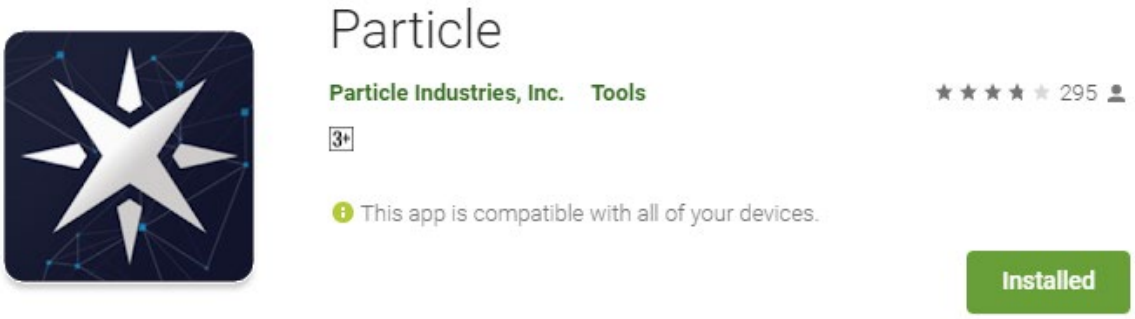
PROCEDURE

First wire up all the essential components.



DT pin and SCK pin can be connected to any of Analog and Digital pins. But it needs to be declared in the program code.

Now, download Particle Application in the google play store.



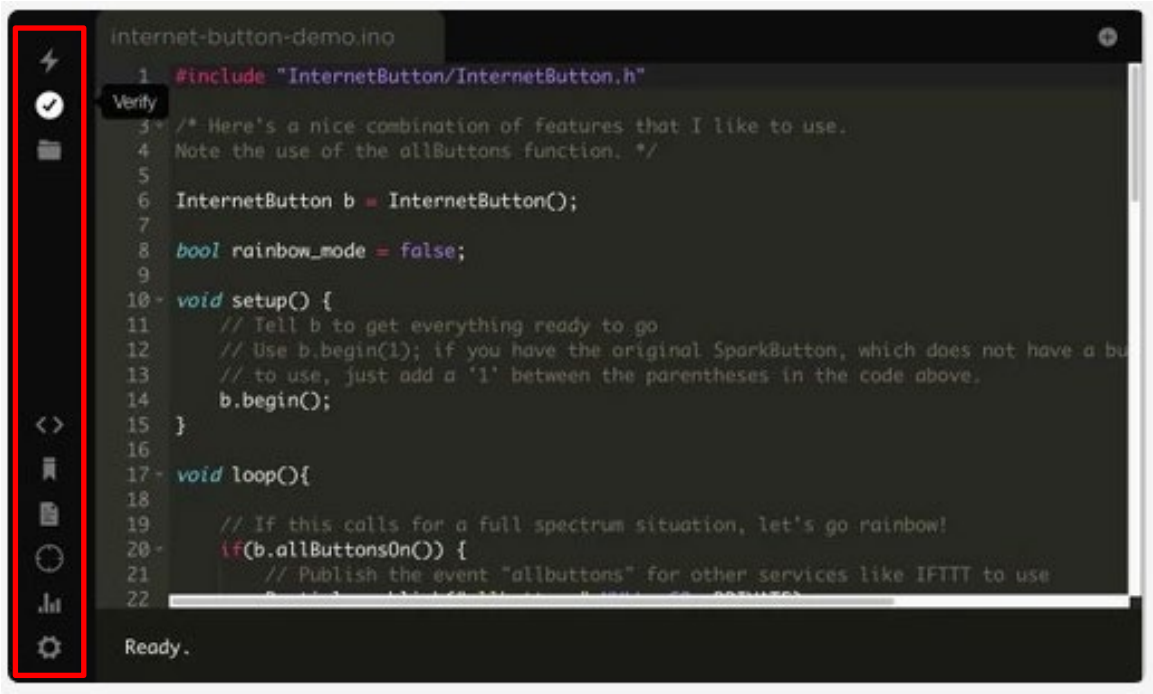
Log-in using particle account, pair Argon first follow by Xenon.

Things to take note while setting up the device.

- Create a Mesh network when pairing with Argon.
- Join Mesh network when its paring with Xenon.
- Follow the steps show in the app and complete the set up.
- Exit and try again if it is showing up errors.

To program the microcontroller, particle has their own development tools.

Web IDE, Create and deploy device apps right from your browser—Fully integrated with Device OS, and Device Cloud.



Codes

library

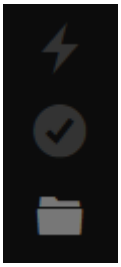
help

Docs

Device

Console

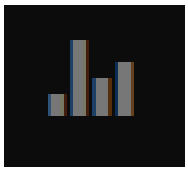
Settings



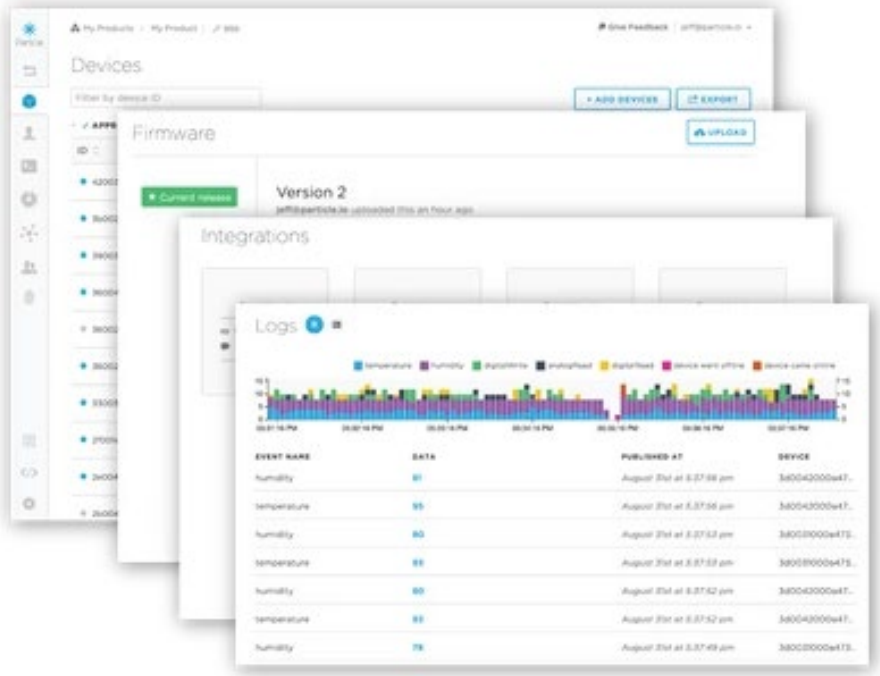
Flash

Verify

Save



Console



Device Console is a powerful yet intuitive interface that makes it easy to manage your fleet of IOT devices

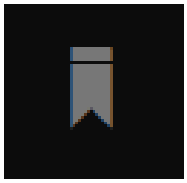
Device registry: Organize and query devices in your fleet

Event logs: See what's happening with devices in real time

Firmware manager: Send firmware updates over-the-air

Remote diagnostics: Actively monitor the health of your devices

Integrations: Send IOT data to business tools seamlessly

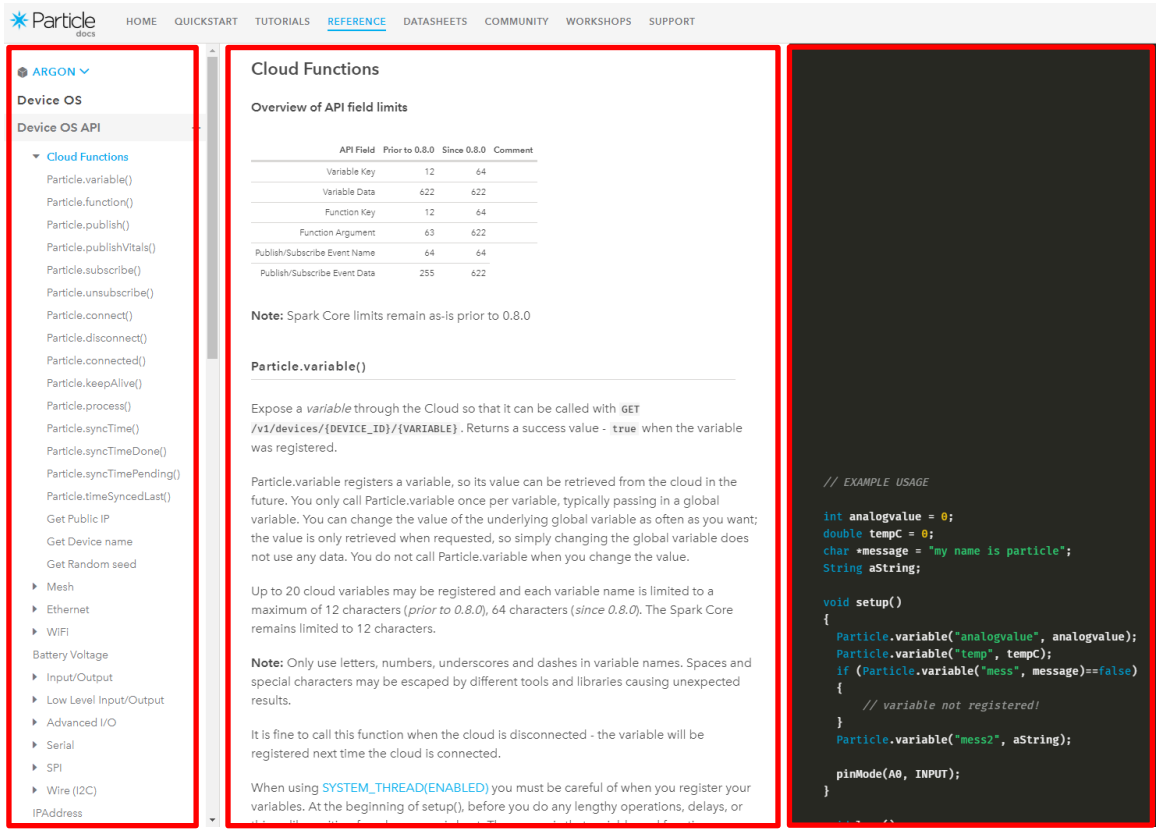


Library

Libraries are files written in C or C++ which provide your sketches with extra functionality (e.g. the ability to control an LED matrix, or read an encoder, etc.)...

Docs is particle device reference documentation | device OS API.

Docs

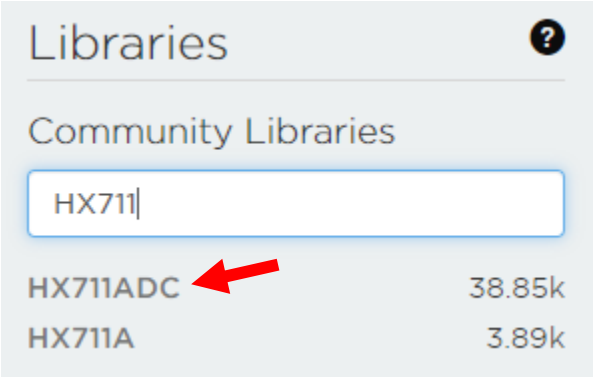


Explanation of each function and command API. Information and notes.

Example usage and example codes for reference.

Reference documentation and command API that can be used during programming of codes.

To test the components, go under libraries and search for HX711 library.

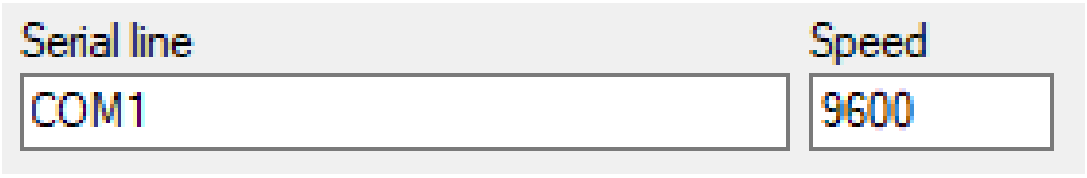


Look through the example code and run the code.

Now, there is a problem, particle Web IDE doesn't have inbuild serial monitor like Arduino IDE. So, a 3rd party software is needed to monitor serial com.

We use Putty that is recommended by Particle team.

PuTTY is an SSH and telnet client, developed originally by Simon Tatham for the Windows platform. PuTTY is open source software that is available with source code and is developed and supported by a group of volunteers.



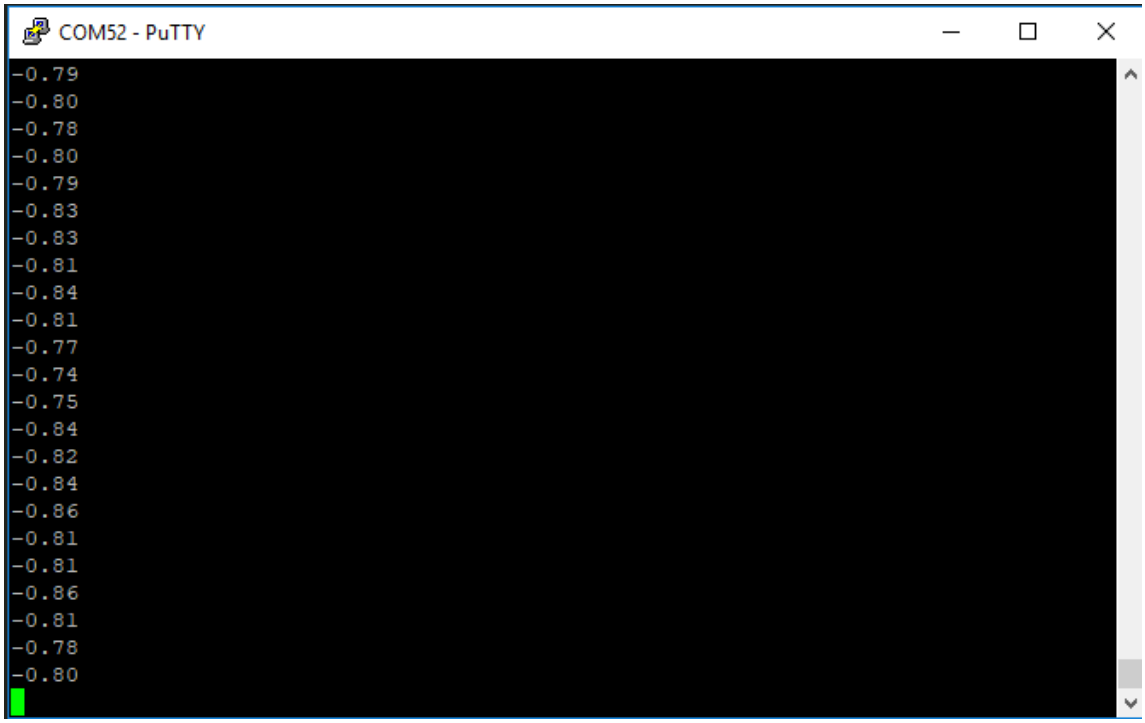
To monitor serial com, type in comm port of the device.

Serial.begin(9600) is needed in the setup when programming codes.

To check com port: Search Control Panel, device manager

After flash the example codes, the device should breath cyan (connected).

Now we can monitor the Weight using Putty.



To check if all the components has been connected correctly, apply pressure on the load cell, the measured value should increase.

To calibrate the Load Cell, we can change the values of this variable in line 27 of the example code.

```
scale.set_scale(2280.f);
```

To Tare (set zero), we can just run the function in line 28 of the example code.

```
scale.tare();
```

Now we can easily measure the weight of any object.

After getting familiar with web IDE and programming, I started to write my own program. As well as contract my own prototype using PCB board.

I added display to show the measured value, this way I don't have to physically connect cables to the computer to read measured values.

Adafruit OLED 128 x 128.

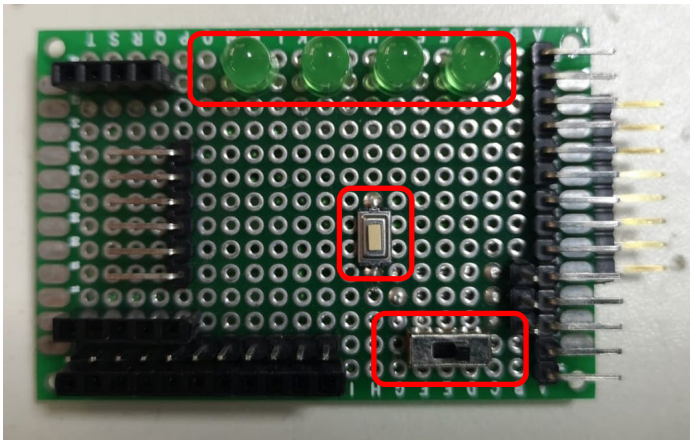
16-bit Color 1.5" display

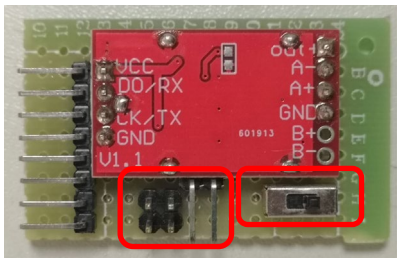
Library used,

Adafruit_SSD1351_Photon (0.0.6)

Adafruit_mfGFX (1.0.3)

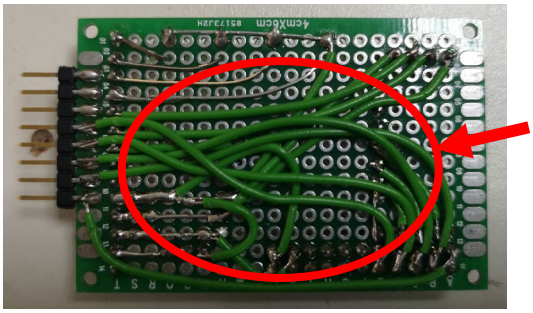
I also added LED, Switch and Buttons for easier control and monitoring.





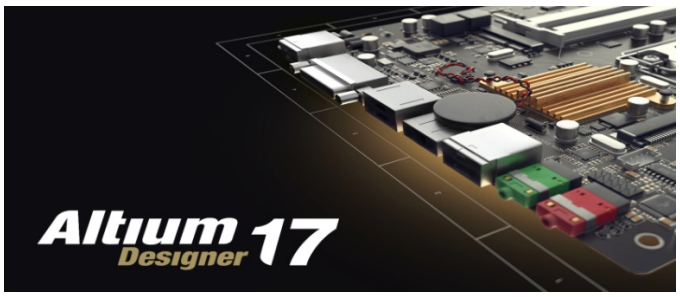
1. Led
2. Button
3. Switch

With this set up, monitoring and control is much easier, but there is a new problem introduced.



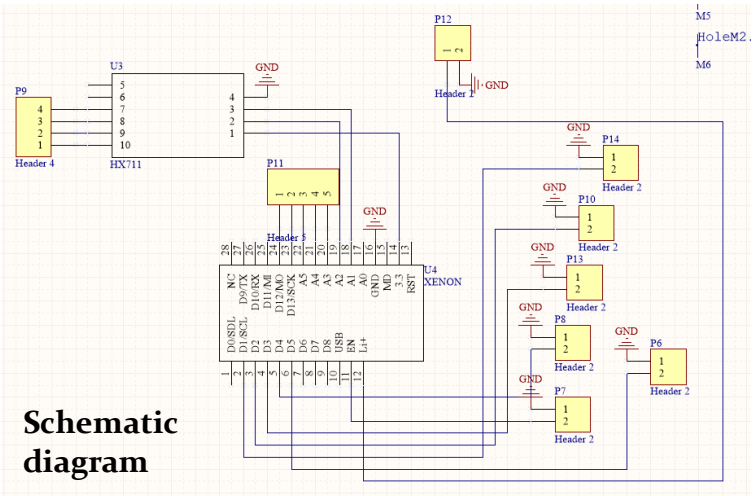
Messy wirings and taking up too much space, it will not be optimal in a long run.

To solve the problem with messy wires and space limitation, I choose to design my own PCB using Altium Designer.



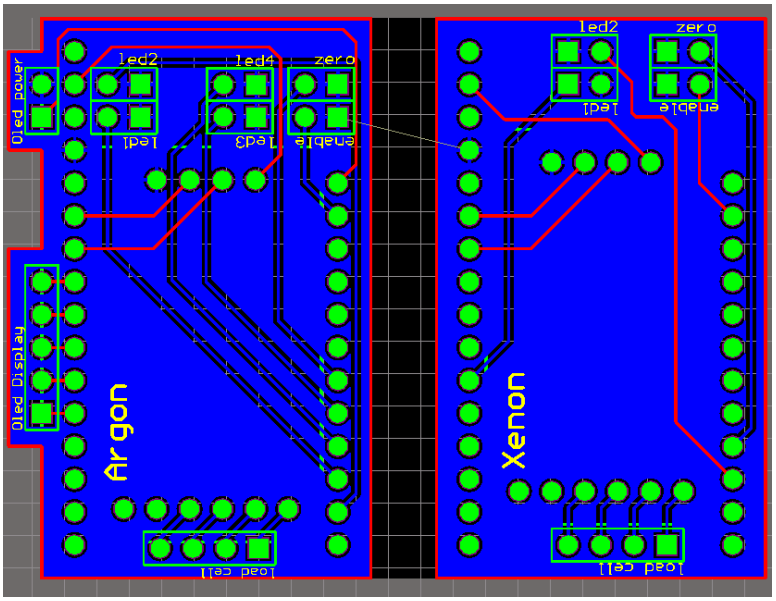
Altium Designer is a PCB and electronic design automation software package for printed circuit boards.

First is to draw my own schematic diagram,

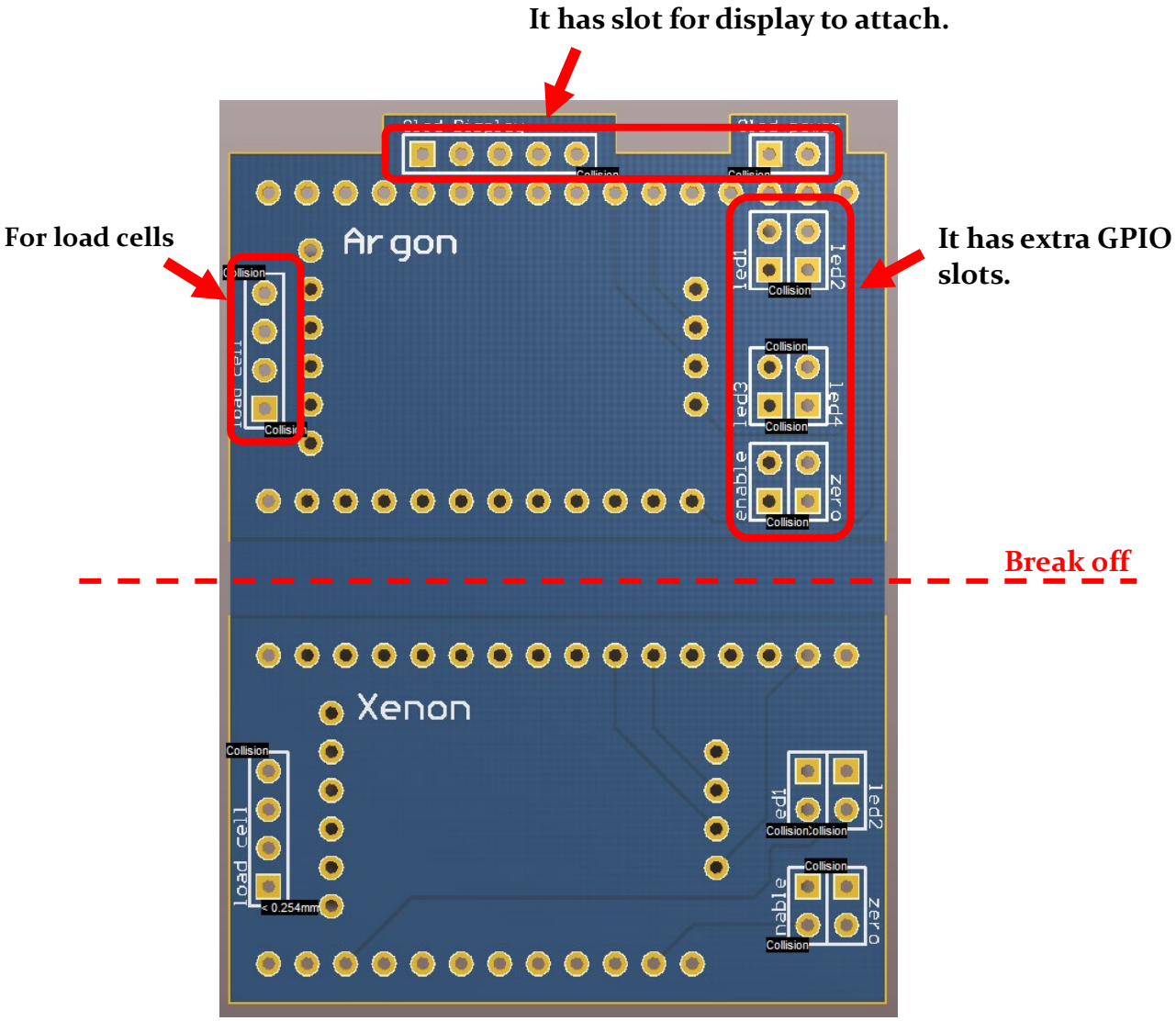


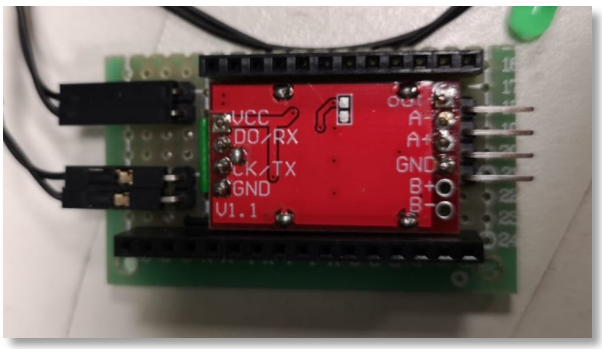
Schematic diagram

Follow by laying route and arranging headers and components.



The designed PCB board can be break into half, one is for Argon and another one is for Xenon.





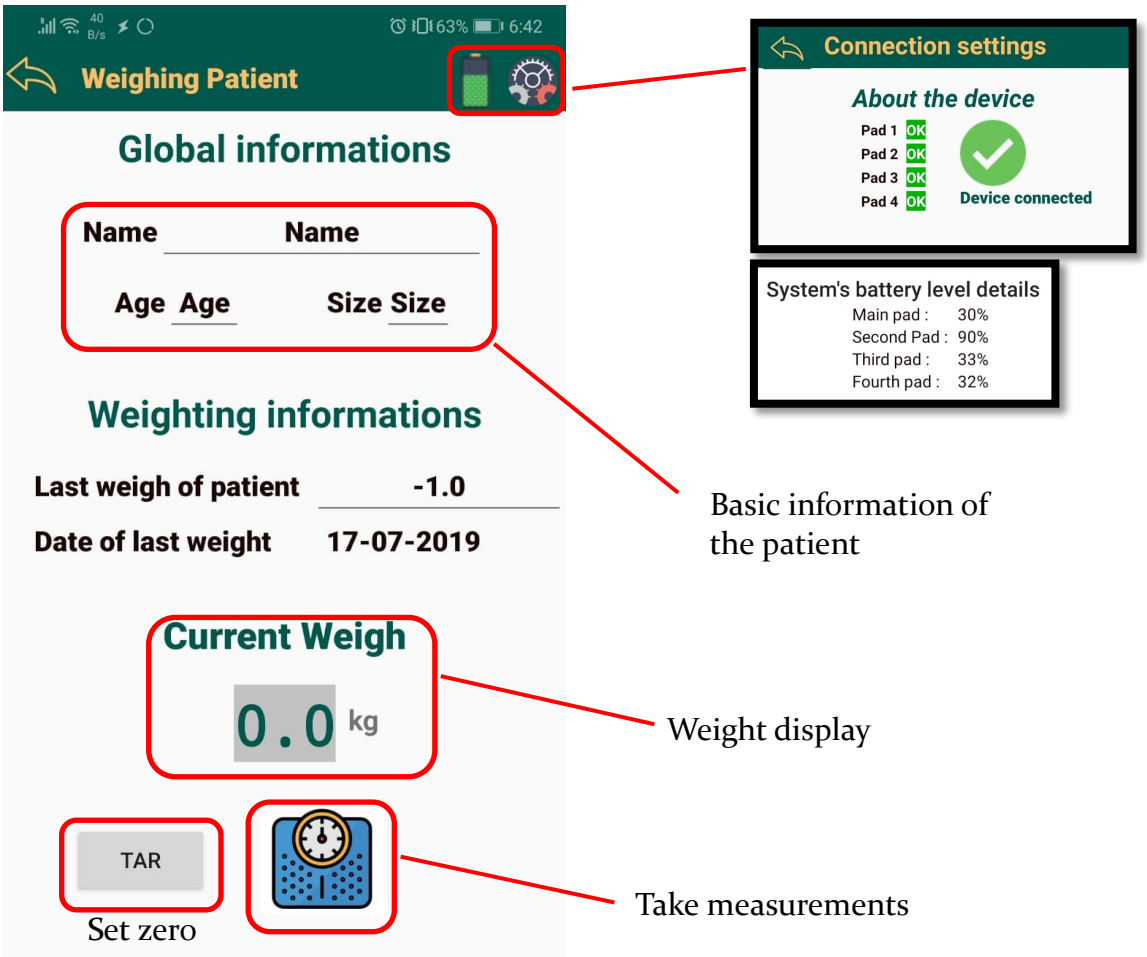
Prototype

After contracting the hardware and writing software, now is to link the system to a mobile application, so that the measured values on the device can be transmitted to mobile phone.

- Pierre
- French student doing internship in NYP
- Developer of the App
- We are working closely together to finish this finish this project.

The device is connected to the mobile application using mobile Hotspot.

Currently this application can only operate on android OS.



To connect the device to the mobile application, we must change the system mode of the device to **SEMI_AUTOMATIC**. System modes controls how the device manages the connection with the cloud.

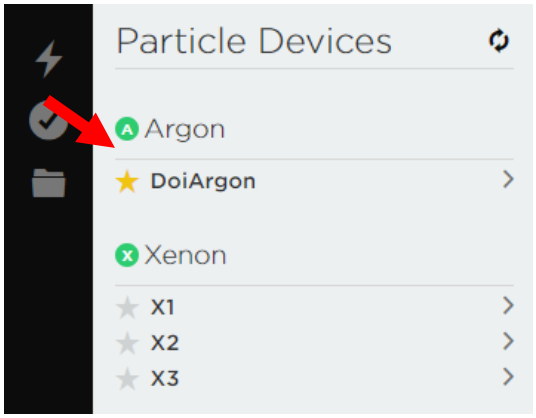
```
SYSTEM_MODE(SEMI_AUTOMATIC);
```

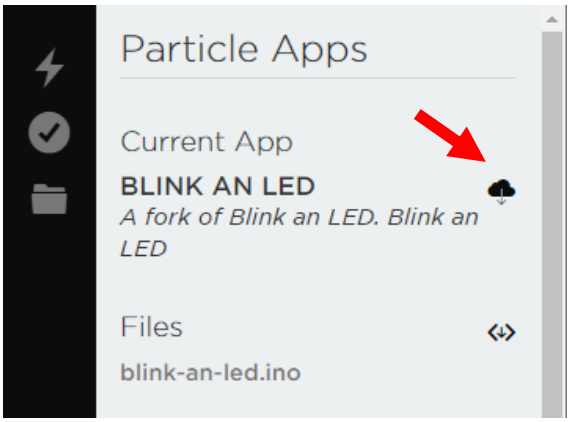
In this mode, the device will breathe Green for Argon and fast blinking green for Xenon.

In this mode, we can't flash new codes through web IDE, we must flash code through terminal, so we need to install particle CLI from the official website.

https://docs.particle.io/tutorials/developer-tools/cli/

First, we need to download the code in binary format.





1. Choose which device to flash. Argon or Xenon (important)
2. Click the "Cloud" to download binary file of the code.

Open command prompt. Type "particle flash --usb <name of the file>"

```
C:\Users\J\Desktop>particle flash --usb argon.bin
```

Make sure the device is in DFU mode. (Device Firmware Upgrade)

Flashing Yellow

To enter DFU Mode:

1. Hold down BOTH buttons
2. Release only the RESET button, while holding down the MODE button.
3. Wait for the LED to start flashing yellow (it will flash magenta first)
4. Release the MODE button

To check all the status LED and Device Modes.

https://docs.particle.io/tutorials/device-os/led/argon/

One important thing to take note is that. We need to key in the mobile hotspot ID and Password in the program for Argon to be able to connect to the mobile app.

```
//If you Want to add a new network add these 2 lines (and change the 2 parameters in the second)
  WiFi.clearCredentials();
  WiFi.setCredentials("OPPOA73","12345678");
```

What this mean is that, the weighing device can only connect to one specific phone. It will not be recognizable to another mobile hotspot.

OBSERVATION AND OUTCOME OF THE PROJECT

Device with mobile application

Working together with Pierre, I was able connect the weighing device to the mobile application, the application works just like Pierre described, and it is very easy to operate. He has added some features to make the application more user friendly, one is to save the IP settings, so it only requires one-time configuration.

The application can receive measured values of the weighing pad when “measure icon” is pressed. It also can Tare the reading so zero as required.

The application can also show the battery level of each pad when “battery icon” is pressed and the connectivity of each pad.

The application is good but not perfect, we can continue to work on storing the measured data directly to mobile phone. Improve the UI of the app.

Device with display

When the device is not used with mobile application, it can be to turn it into a standard wireless measuring pad with display.

The measured data can be stored in cloud storage service, one popular option is Microsoft Azure. particle has integrations that can Send IOT data to business tools seamlessly.

I can also add more slave device to monitor gas, temperature etc....

PROBLEMS ENCOUNTERED / SOLUTIONS

Issue with pairing device with the particle App.

For some reason, there have been issue with pairing device with the particle App or can't flash new codes through web IDE.

There are few ways of solving the problem.

1. Go into OTA Firmware Update
2. Flash Blink an LED example
3. Factory reset
4. Flash through CLI

Different types of load cells available.

There are load cells with half Wheatstone bridge and load cells with full Wheatstone bridge, usually half Wheatstone bridge come with only 3 wires while full Wheatstone bridge come with 4 wires.

half Wheatstone bridge requires another half Wheatstone bridge which means, 3 wire load cells must work in pair or in four.

For easier installation and less wiring, 4 wires load cell is the solution of this problem.

Different languages required

The language I learnt is C++, and I had experience in coding Arduino, but I soon realize knowing one programming language is not enough to build a whole system from hardware to software to data streaming. A system often requires multiple language from C++, Java script, JSON, Python, HTML or even CSS.

What I did is to read up about the language I need to know, for example I learned Python from the website https://www.w3schools.com/ and bought books from online.

Learn about JSON from online examples and forums where people post their problems and solutions. JSON is needed because Particle integration requires knowledge about JSON.

Communication problems.

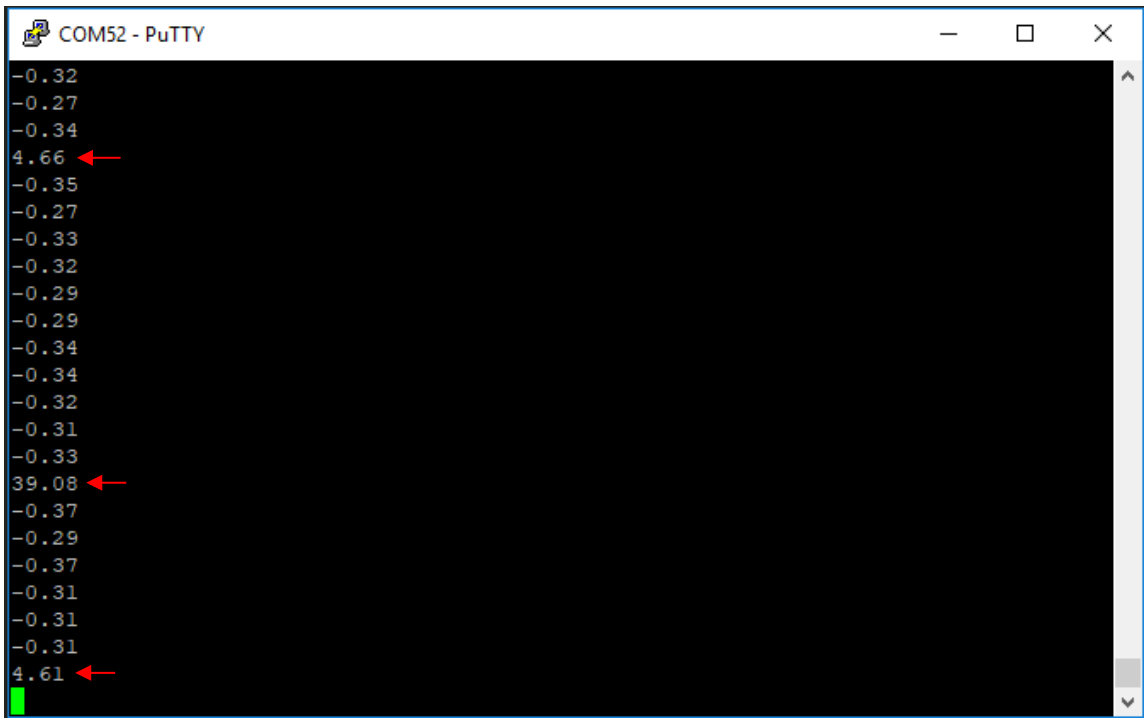
While I was in Japan, Pierre is in Singapore. Since we are both working on a same project, we often have to communicate with each other and work together to develop this project. But I find it very difficult to deliver my thoughts and ideas to him through messaging.

But it turns out okay, we had Skyped together with our supervisor to talk about the project and we use messages and pictures to clarify our doubts.

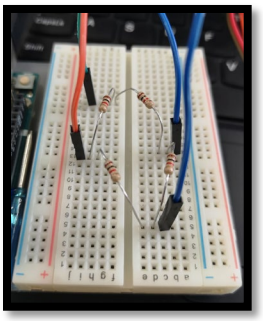
Noise in the measured reading.

The noise in measured reading is one major issue I faced throughout this whole project. Even till now this problem is not completely solved.

The error value will show up randomly, and it can be positive or negative.

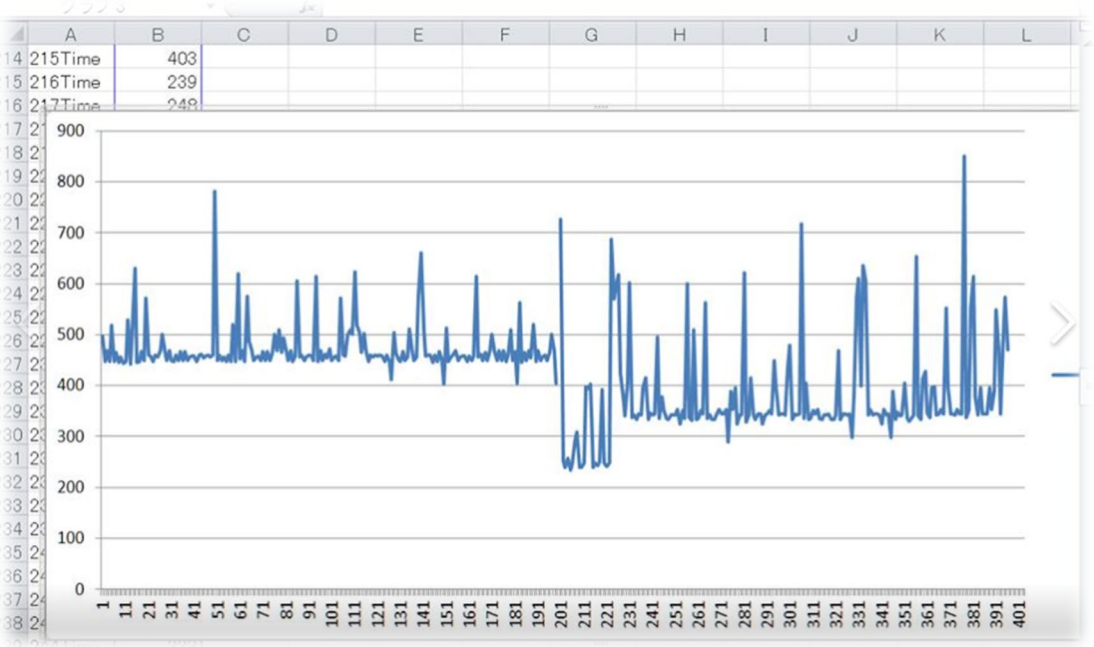


Methods that I have tried to solve this issue.



- Isolating parts by parts
- Different kind of load cells.
- Construct our own Wheatstone bridge using resistors.
- Shielding wires
- Tried different HX711 ADC
- Different microcontroller. (Arduino Uno, Particle Argon)
- Averaging
- Threshold
- Moving average

First, I Logged the date using putty and generate trend in excel to learn and study the behaviour of the errors.



But no specific trend was shown.

Then I proceed with isolating parts by parts, I tried different kind of load cells, 3 wire and 4 wire load cells, I also construct my own full Wheatstone bridge using resistors, and wrap the wires using aluminium foil to shield from outside noise, but the problem remains.

Then I tried different types of ADC, ranging from cheapest to high quality ADC, and the problem remains.

Then I tried different microcontrollers. I tried on Arduino Uno. The problem was solved. When I run the set up on Arduino, there is no error values showing up, this confirms that the problem lays on the Particle device.

It could be the WIFI and Bluetooth that's interfering with the device that cause the errors in the reading. But we can't swap to Arduino because Arduino has no WIFI and Bluetooth modules build in it. So, I have so source other ways to counter this issue.

Using filters like averaging and threshold in the code can eliminate 80% of the errors, first, use averaging to smoothen out the data, what I did is I take 50% of the old value + 50% of the new value and this added up to a new value, then I will do a secondary filter threshold to compare the new value and old value, if the difference is too big, it will take the old value instead of the new value that is the error value.

This way it can filter most of the errors out, but it is still not perfect, as errors could still show up at times.

When I was doing my 12 weeks of internship in japan, I consulted my supervisor Doi sensei about the problems I face, and he suggested to try out moving average filter technic, I wrote the code and tried, it's not very helpful because the gap difference between two values are too big, and its now showing smooth reading.

He then later checks the device with oscilloscope and spot a potential problem that could lead to the errors in measuring. He then wrote his version of code to solve the problem, the results are similar to the filtering method, it's able to filter out most of the error values, but there are still chances of showing up error values.

But I think the solution is good enough for now, maybe we can revisit the problem again soon.

PROJECT BENEFITS AND IMPACT / FUTHER EXPENTION

Our proposed system is better than the existing product in the following ways.

- It is portable and small enough to be fitted into the community nurse's trolley bag.
- It is stable for use with both wheelchair and chair.
- It has self-calibration feature.
- It is connected to the nurse's handphone with app to manage the received data.
- It is designed to be reconfigurable

As the data is now able to be streamed to a mobile and cloud, it will be able to perform stream analytics using real-time measurements of the patient's weight data. Machine learning algorithms can then be used to forecast if the patient's early intervention is needed and to provide timely appointment with doctors and nurses to visit him by sending push notification to the user mobile.

The expansion of this project is endless.

We could always connect a new slave device to do other monitoring. It could be the temperature, gas monitoring or alarms.

All of this can be built up to a smart home system to monitor the wellbeing of an elderly or child.

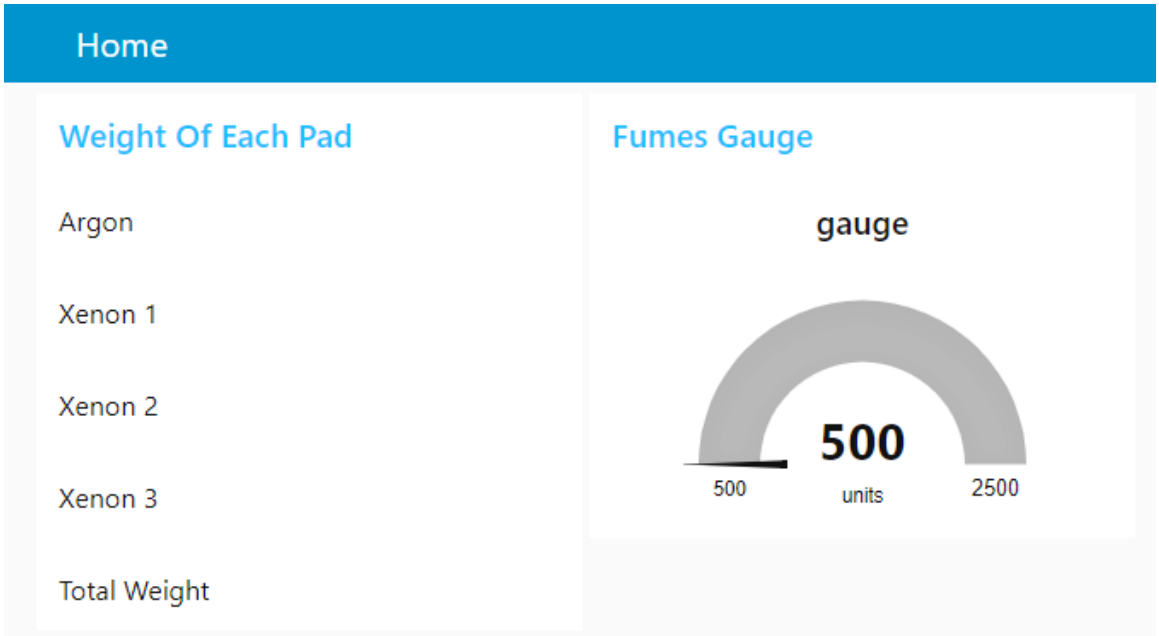
We can also connect the device to popular cloud service like Microsoft Azure. A platform that has all the storage, streaming and service we need. Thanks to the particle integration.

We could also use this system to build a smart grocery app that keep track of the food at home. To track the number of eggs in the egg tray or even how much milk has left in the milk jug.

IOT EXPANTION PROJECT

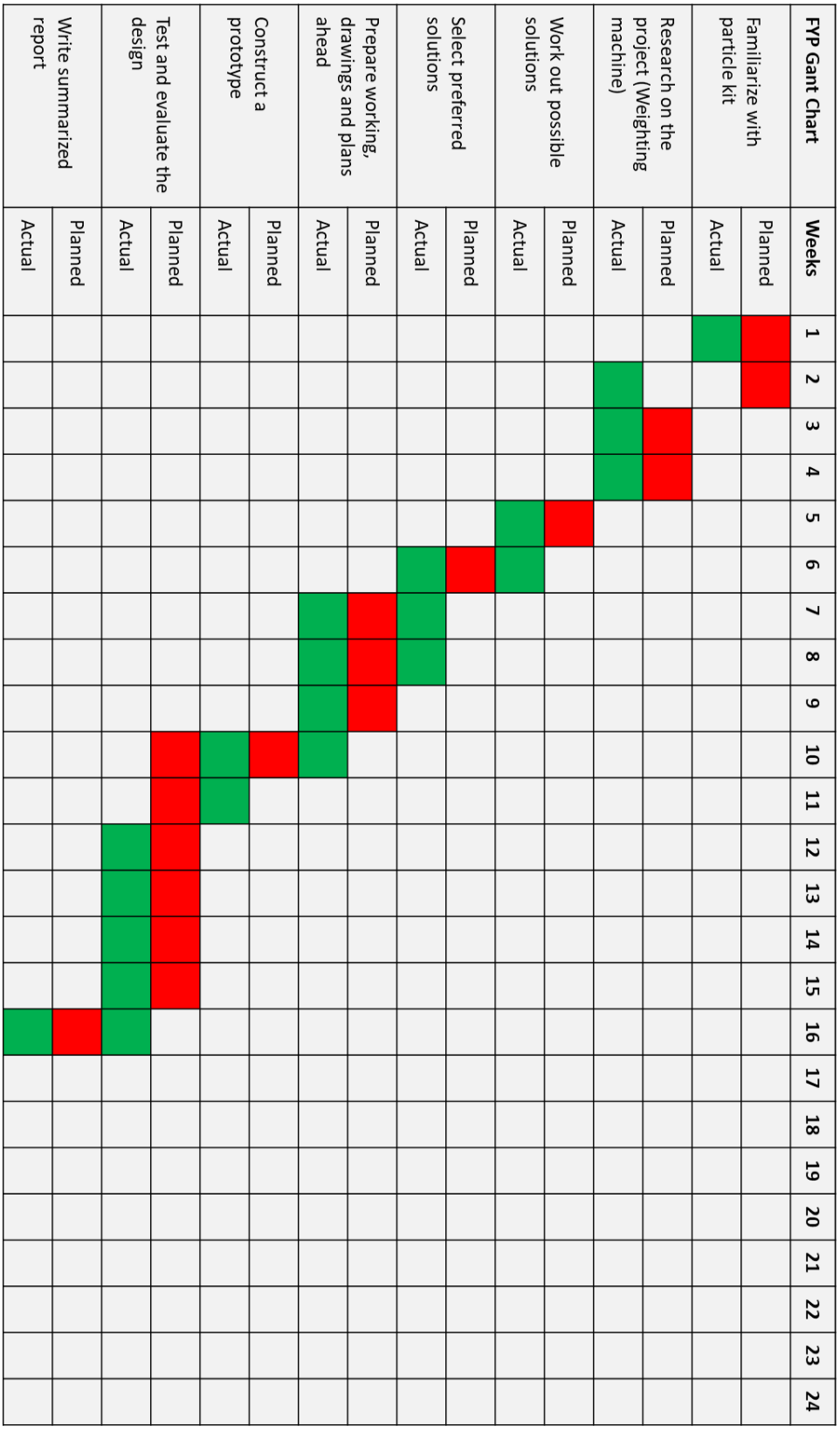
Project expansion I did using Azure web service that is hosting Node-red.

- Node-RED is a flow-based development tool for visual programming.
- Developed originally by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things.

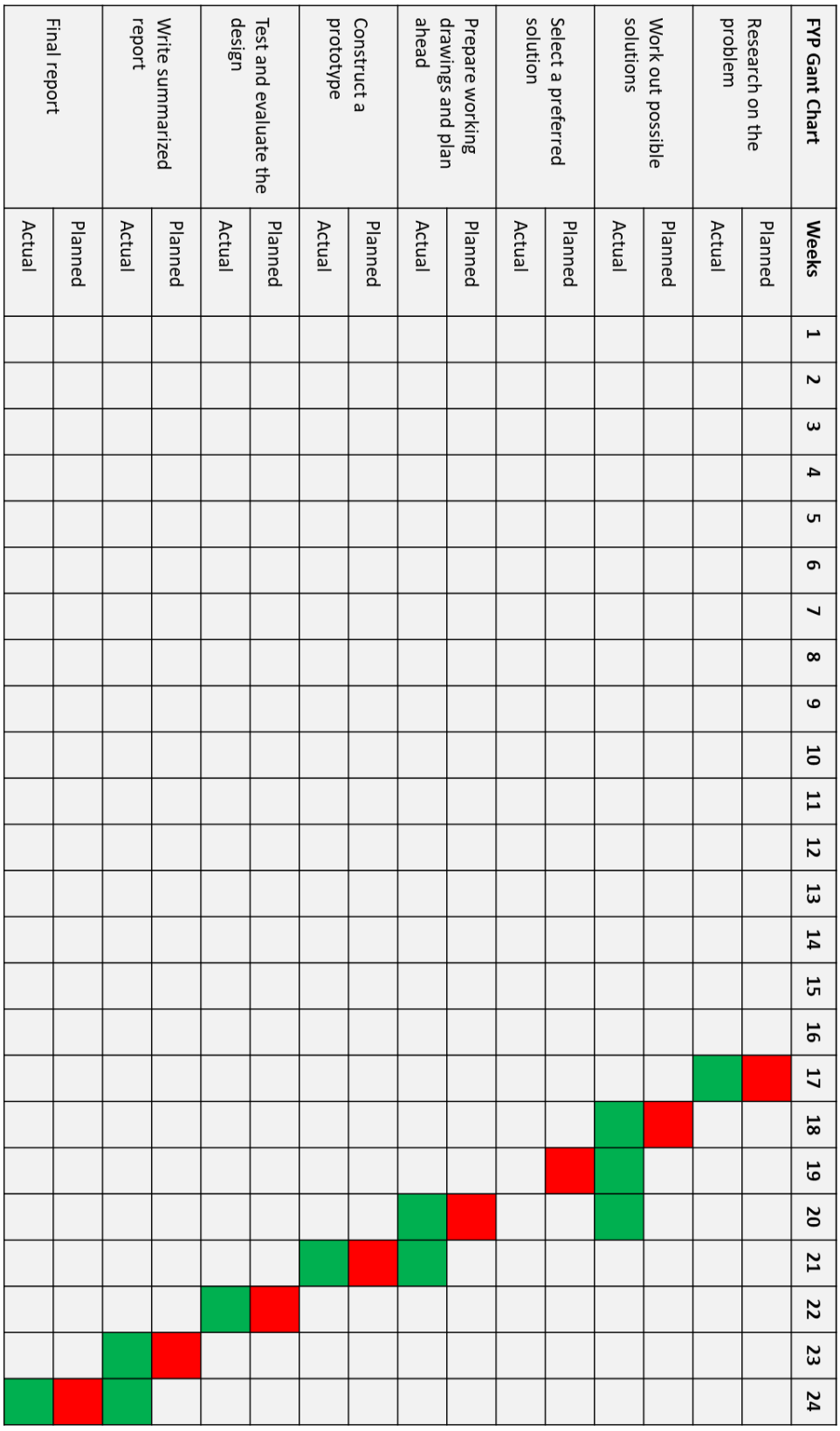


I added a new slave device (Xenon) as a gas detector that detects the flammable gas content in the air. I then generate a dashboard that displays the measuring pad weight and gas gauge using node-red. Since Azure is a global cloud service, the dashboard can be viewed at anywhere as long there is an internet connection.

GANTT CHART


FYP Gant Chart
Weeks
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Familiarize with particle kit
Planned
Actual
Research on the project (Weighting machine)
Planned
Actual
Work out possible solutions
Planned
Actual
Select preferred solutions
Planned
Actual
Prepare working, drawings and plans ahead
Planned
Actual
Construct a prototype
Planned
Actual
Test and evaluate the design
Planned
Actual
Write summarized report
Planned
Actual

GANTT CHART


FYP Gant Chart
Weeks
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Research on the problem
Planned
Actual
Work out possible solutions
Planned
Actual
Select a preferred solution
Planned
Actual
Prepare working drawings and plan ahead
Planned
Actual
Construct a prototype
Planned
Actual
Test and evaluate the design
Planned
Actual
Write summarized report
Planned
Actual
Final report
Planned
Actual

CONCLUTION

I have learnt that completing any kind of project requires knowledge from different fields, I often have to research for solutions online through forums or watch tutorials on YouTube, or even pick up new languages and software that I'm unfamiliar with. It's tough, but in the end it's worth it.

I also enjoy working together with French exchange students, even though we are separated throughout this whole project, but we are able to work together and finish the project as requires. This projects will not have completed without him developing the application for this device.

During the 3 months of stay in Japan, I have made new friends, learned new languages, new sports, and new knowledge. It's an enjoyable experience at Nara College which I will never forget in my life.

Through these 6 months of FYP in Singapore and Japan, I have learned many new skills and knowledge, many of this skill are very particle and can be apply in daily life.

REFERENCES

Acknowledgement template.

http://bankofinfo.com/sample-acknowledgement-for-internship-report/

https://elc.polyu.edu.hk/fyp/html/ack.htm

https://acknowledgementsample.com/acknowledgement-sample-for-internship-report/

Reference Links.

file:///C:/Users/J/Desktop/iportable%20weighing%20device%20studnetversion%20(1).pdf

https://en.wikipedia.org/wiki/Load_cell

https://www.singhealth.com.sg/rhs/get-well/Hospital-to-Home

https://docs.particle.io/datasheets/wi-fi/argon-datasheet/

https://docs.particle.io/datasheets/mesh/xenon-datasheet/

https://cdn.sparkfun.com/datasheets/Sensors/ForceFlex/hx711_english.pdf

Images

https://www.makerlab-electronics.com/my_uploads/2018/01/Load-Cell-50kg-01.jpg

https://lh4.googleusercontent.com/xzRM7T4Vi6qn6vvqr9jrcGUmZYpfA8lQBAqj4-_MpEMdZQVaX-py_4hq4bnfres_HRgPgCfzdYkLBD7B2xzq074CMZCz0Re6Mh1uXQ3PRdAvpTKKfleHMGFcpMNe4ABaVADNxFbpvJT1QIBCFQ

https://www.particle.io/wifi

https://sbr.com.sg/healthcare/news/chart-day-ageing-population-comprise-1-in-4-total-citizens

https://www.scalesgalore.com/global/images/product_2/alt/alt_10562.jpg

https://secure.img2-fg.wfcdn.com/im/02962067/compr-r85/4241/4241592/detecto-digital-geriatric-stationary-wheelchair-scale.jpg

https://d2t1xqejof9utc.cloudfront.net/screenshots/pics/9a10523296422f3b6b2b6866fefd80cd/large.jpg

https://desight.pro/upload/img/linerix-free/cloud-577ac11f62e99-big.png

https://img.icons8.com/nolan/2x/api-settings.png

https://png.pngtree.com/svg/20170809/android_1161264.png

https://m.media-amazon.com/images/S/aplus-seller-content-images-us-east-1/ATVPDKIKX0DER/A2J04FO254VRI1/0f43a8e7-c383-4d24-9e78-31c0a90ae217._CR0,0,600,180_PT0_SX600__.jpg

https://www.transducertechniques.com/images/wc1a.png

https://i.stack.imgur.com/xYqBx.jpg

https://galoce.en.alibaba.com/product/60705152065-802747558/GML699_Low_cost_luggage_scales_full_bridge_micro_load_cell_40kg.html?spm=a2700.details.pronpeci14.4.d2aa1820hn2BIj

https://cdn.tindiemedia.com/images/resize/EuUiR2h4YMop-5lfjNeCQEJ3JIU=/p/fit-in/1032x688/filters:fill(fff)/i/44073/products/2018-05-30T18%3A13%3A38.118Z-original.JPG

https://www.sparkfun.com/products/13879

https://robu.in/wp-content/uploads/2016/05/robu-2-1.jpg

https://item.taobao.com/item.htm?spm=a230r.1.14.31.2b692010ZN1r24&id=584981214826&ns=1&abbucket=6#detail

https://cdn1.vectorstock.com/i/1000x1000/33/95/red-led-icon-on-white-background-led-sign-light-vector-18893395.jpg

https://moderndevice.com/wp-content/uploads/images/products/Momentary_Switch.jpg

https://static.thegeekstuff.com/wp-content/uploads/2008/08/putty.jpg

https://www.adafruit.com/product/1431

http://sfwallpaper.com/images/1200-x-1920-wallpaper-15.jpg