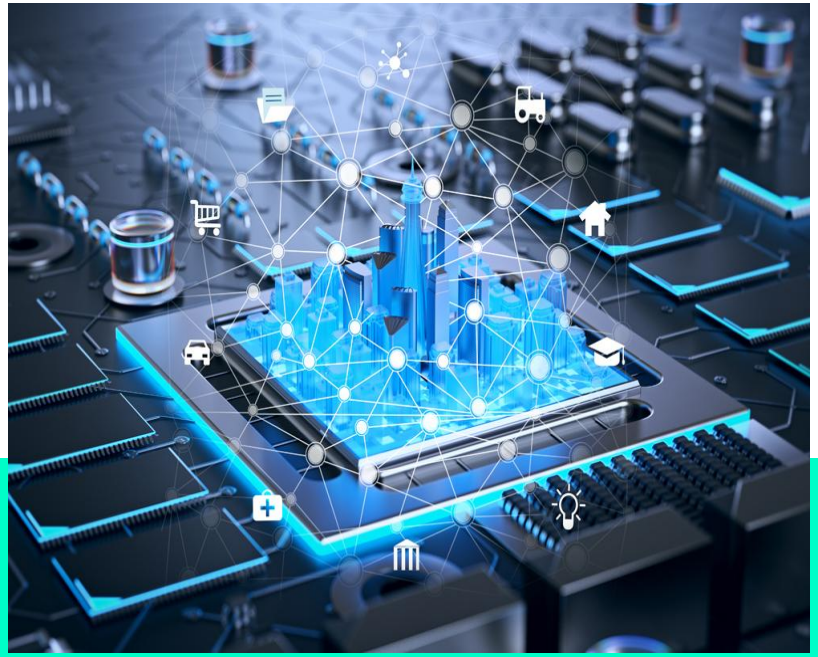
Embedded systems - Water flow monitoring



Team 27

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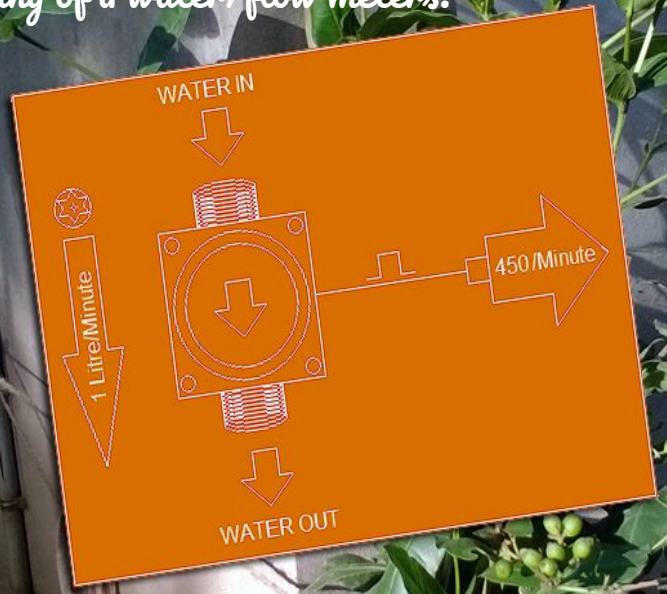
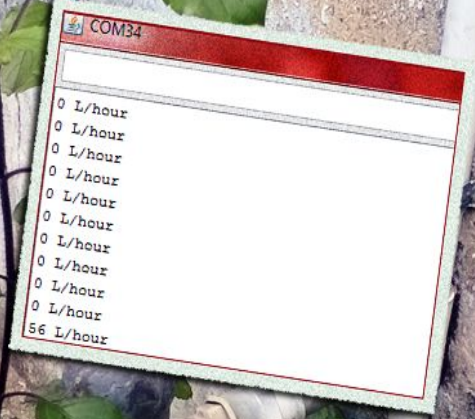
About The project

This work aims to build an Internet based system that enables the remote monitoring of a water/flow meters.





It enables us to detect the flooding or the sudden cut off the water supply at the location where it is deployed.

The Requirements

WATER FLOW METER / SENSOR

ESP32

POWER SUPPLY

A CABLE AND WIRES

WIFI ROUTER

HARDWARE CONNECTIONS

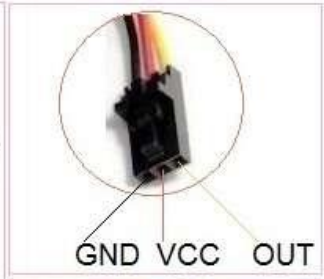
The hardware connection is done by attaching 3 cables (jumper cables) between the flowmeter and the ESP32, in order to get the on/off pulse generated by the flow of water and thus count for the litres .

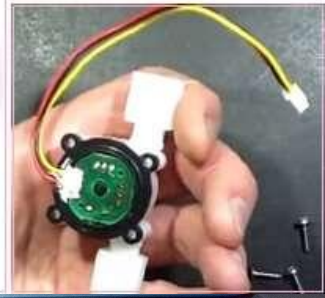
WATER FLOW SENSOR AND ESP32

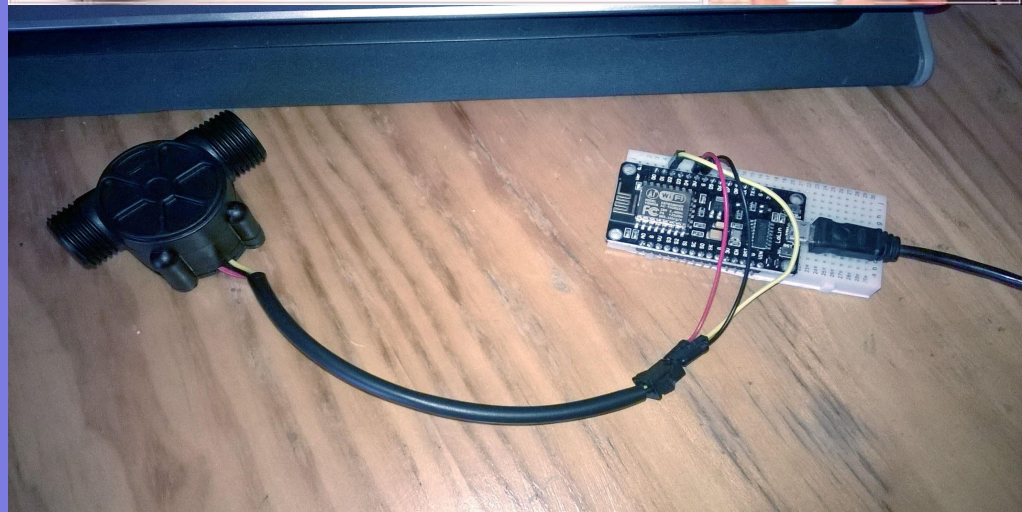
Cable connections (use the breadboard cables):

- Connect the red cable output from the flowmeter to the 5v pin on the ESP32.
- Connect the black cable output from the flowmeter to "ground" of ESP32.
- Connect the yellow cable output from the flowmeter to the control pin on the ESP32 (CONSIDER the pin 27).

  Next step is to code .

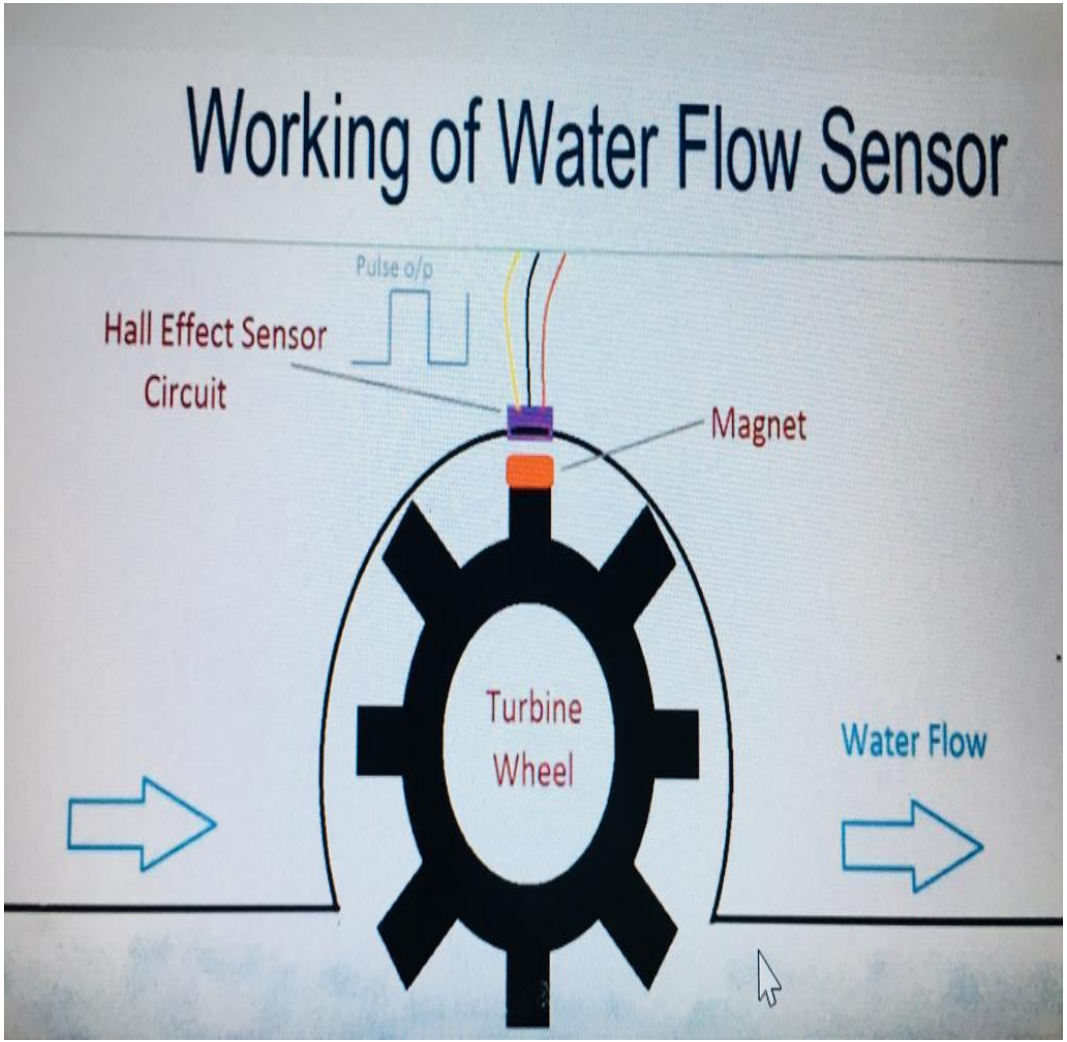






Water flow sensor

Flow meters have proven excellent devices for measuring water flow, and now it is very easy to build a water management system using the renowned water flow.This sensor sits in line with the water line and contains a pinwheel sensor to measure how much water has moved through it. There is an integrated magnetic Hall-Effect sensor that outputs an electrical pulse with every revolution. The "YFS201 Hall Effect Water Flow Sensor" comes with three wires: Red/VCC (5-24V DC Input), Black/GND (0V) and Yellow/OUT (Pulse Output). By counting the pulses from the output of the sensor, we can easily calculate the water flow rate (in litre/hour – L/hr) using a suitable conversion formula.



There is a Turbine that rotates when water flows.There is A Magnet on it that generates current with voltage in the form of pulses. These pulses occur at a particular frequency , with the help of these pulses we calculated the flow.

Calculation part of the code

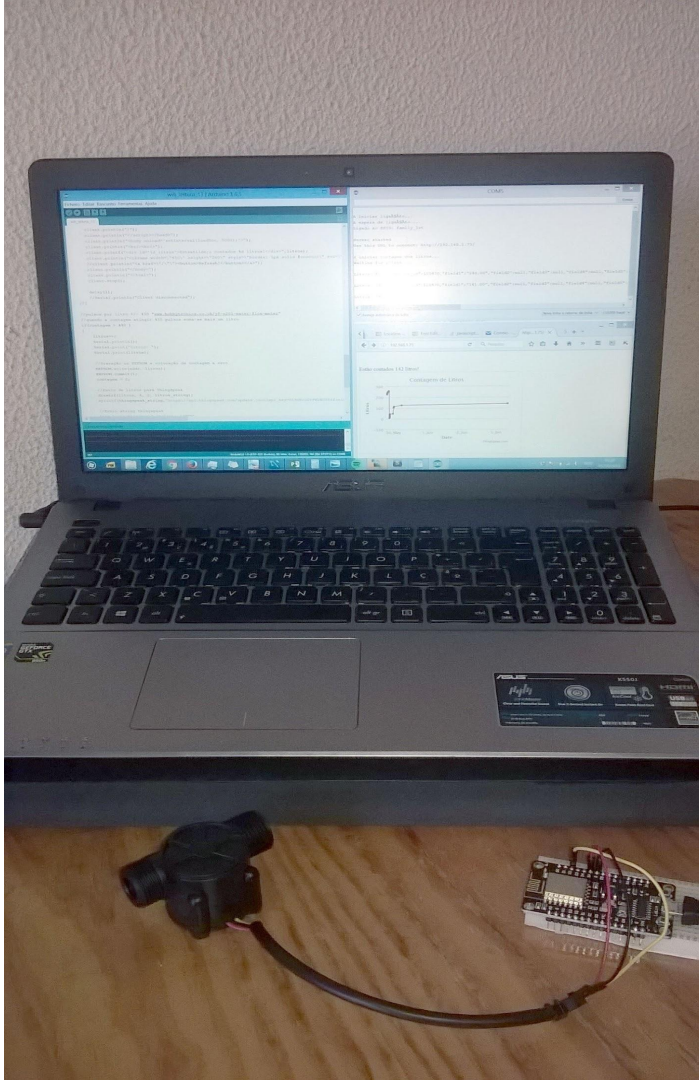
```
    pulse1Sec = pulseCount;

    pulseCount = 0;

    flowRate = ((1000.0 / (millis() - previousMillis))
* pulse1Sec) / calibrationFactor;

    previousMillis = millis();
```

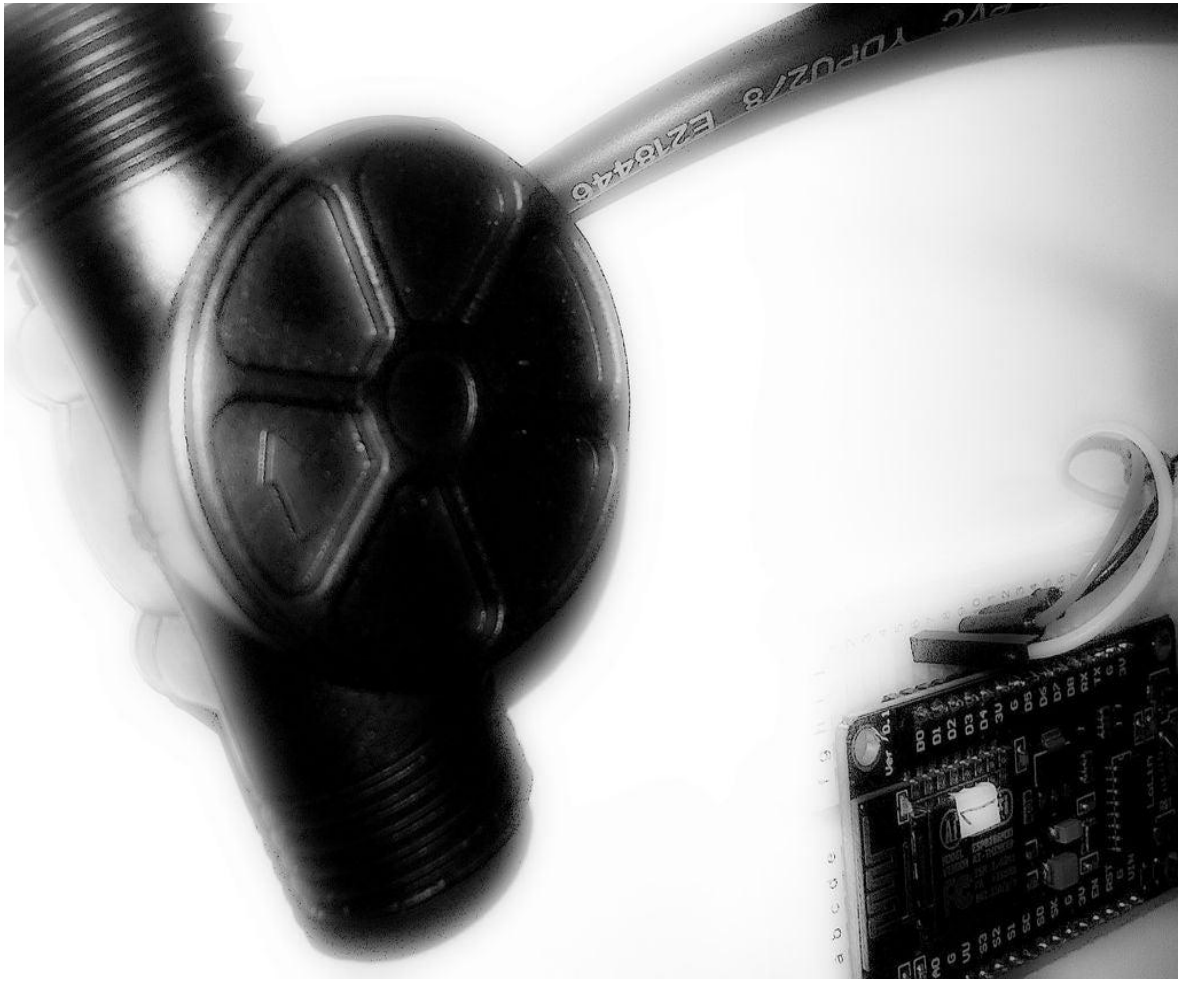
Pulsecount is the total number of pulses. `millis() - previousMillis` **this we do to calculate the pulseduration.** `(1000.0 / (millis() - previousMillis)) * pulse1Sec)` **gives the pulses in one second. Calibration factor is number of pulses per second when the rate of water flow is 1L/min. So we get the flow rate by dividing the pulse rate with calibration factor.**



One M2M

We have sent the data to the oneM2M server in the form of containers every minute.

We have created test server and verified if the containers are being created or not.



Expected problems

1) **Which sensor is to be used?**

This type of sensor can be found on different diameters, water pressure (MPa) and flow rate (L/m) ranges. We need to select one that will cover the needs.

2) **Power Source**

The water flow sensor is not power hungry type. It draws a maximum of 15-20mA at 5V DC input.So, we need to choose a power source satisfying its needs.

3) **Network**

Network is needed to upload the data to the oneM2M server.

DEPLOYMENT

We have uploaded our code to the board and connected the board to a sensor that has already been deployed near the faculty quarters.

We have faced a few issues during the deployment.

Deployed sensor

Its calibration factor is 8.

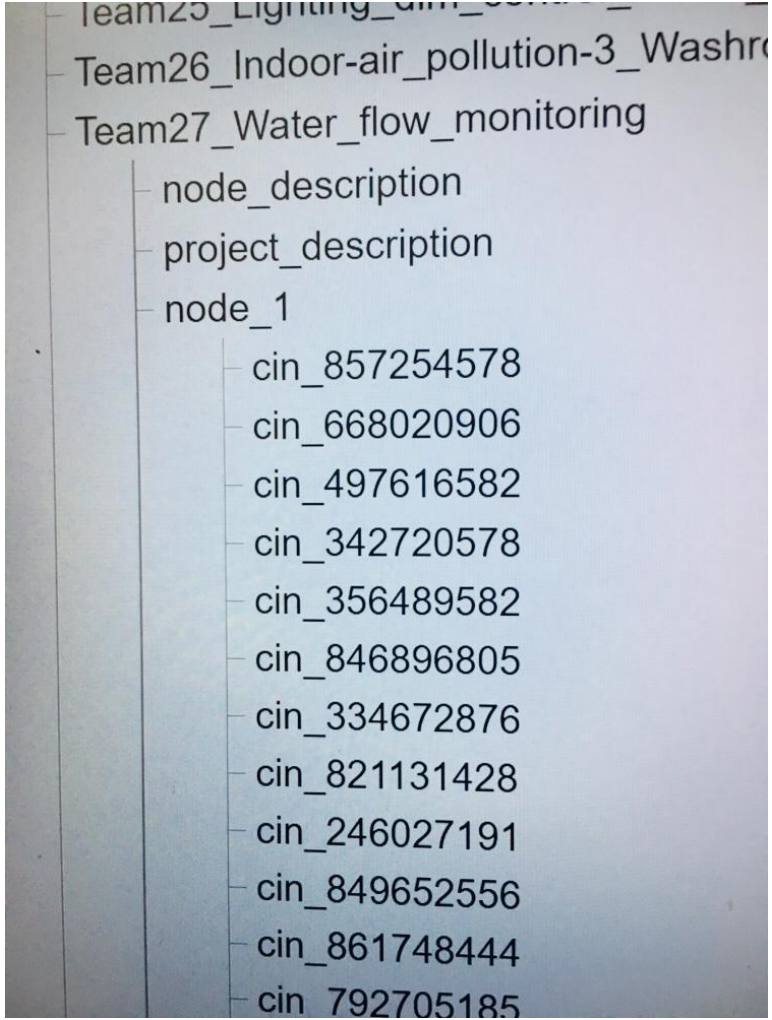
We found it on the internet and verified by calculating the number of pulses per second that it is giving when flow rate is 1 L/min.

Issues faced during the deployment

- The sensor we have used to work on(YF-S201) and the sensor that was deployed are different(BT-DFS700). We have found out the calibration factor of the deployed sensor from the internet and verified.
- Water flow is not continuous in the pipe to which the sensor was attached. It is only switched on when it is required(when tank is empty).So,our data consisted of very few non-zero values.
- The network problem is solved by putting a jio-fi and there was no problem with the power. There would be a problem only if there are power-cuts.
- Influence due to the wind would always be there.
- We have faced problems due to the One-M2M server. We were afraid that the server would crash as we were sending the data every minute that would create a lot of containers. We couldn't scrape off the whole data as the server was stopped.

Scraping the data from onem2m server

We scraped the values from the containers using a simple python script that finds each of the container ids and uses those to send GET requests to the server using the python ‘requests’ library. The value is then taken from the json object generated and sent to and stored in a text file. We then dumped them into an excel sheet and made a graph.



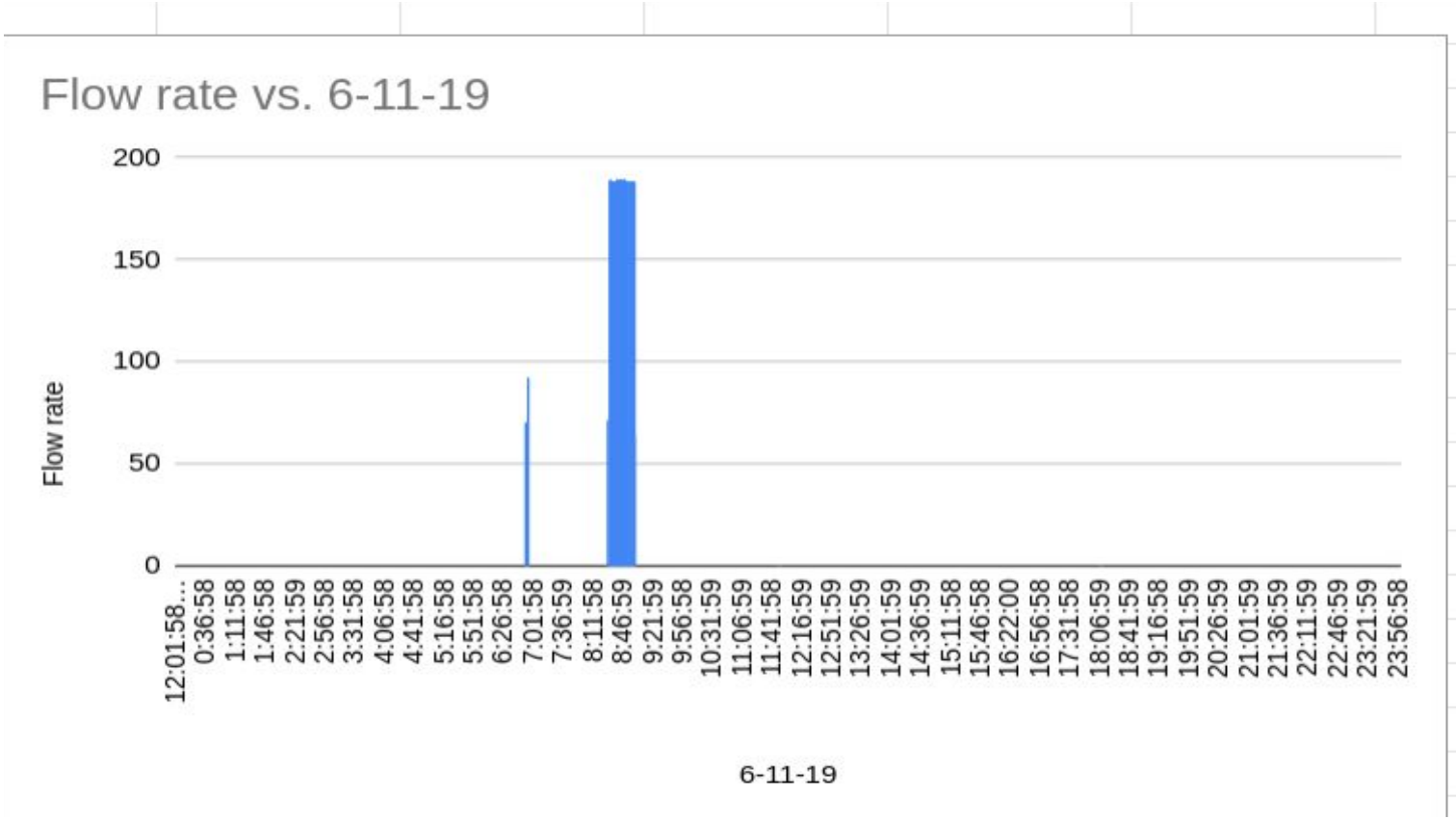
Data

We have deployed and started getting the data from 6/11.

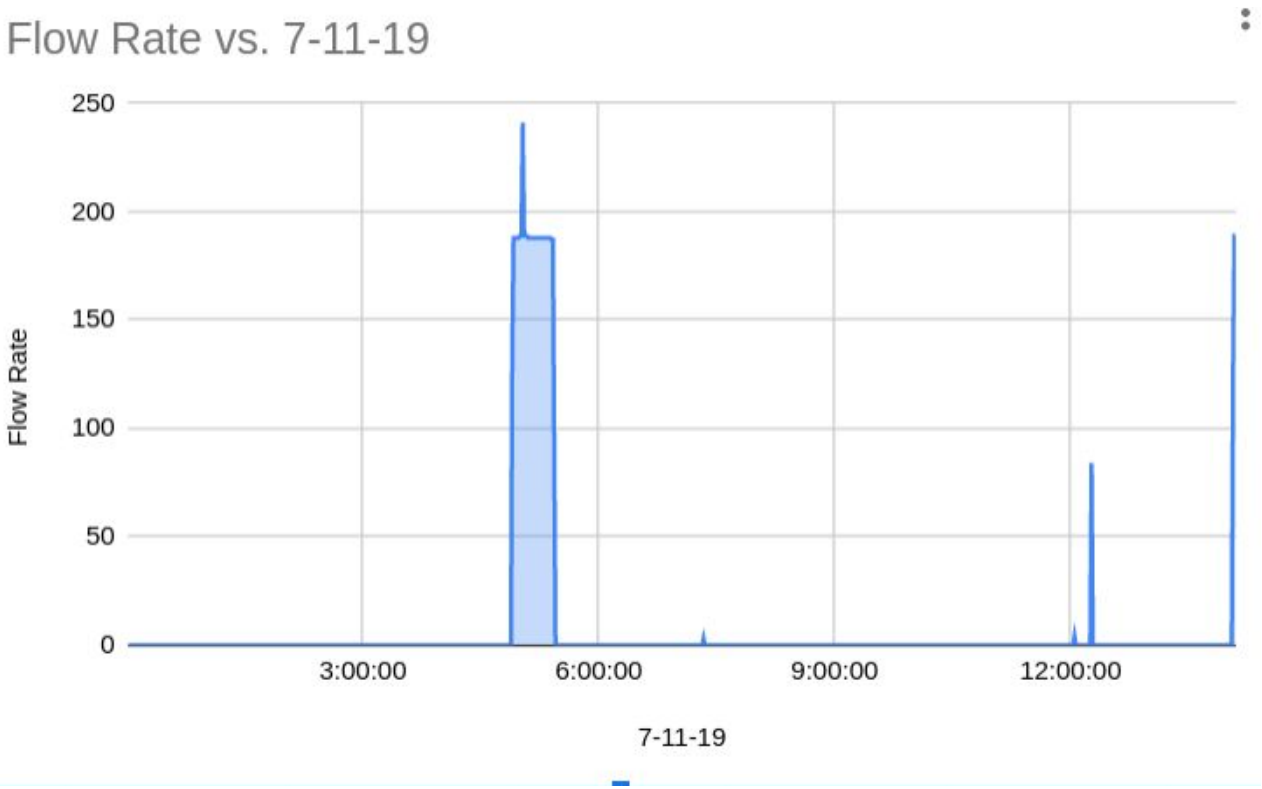
There were routine problems with the server. We also lost some data.

We faced a problem of containers not uploading for a certain period of time and started working if we switched them off and then on again.

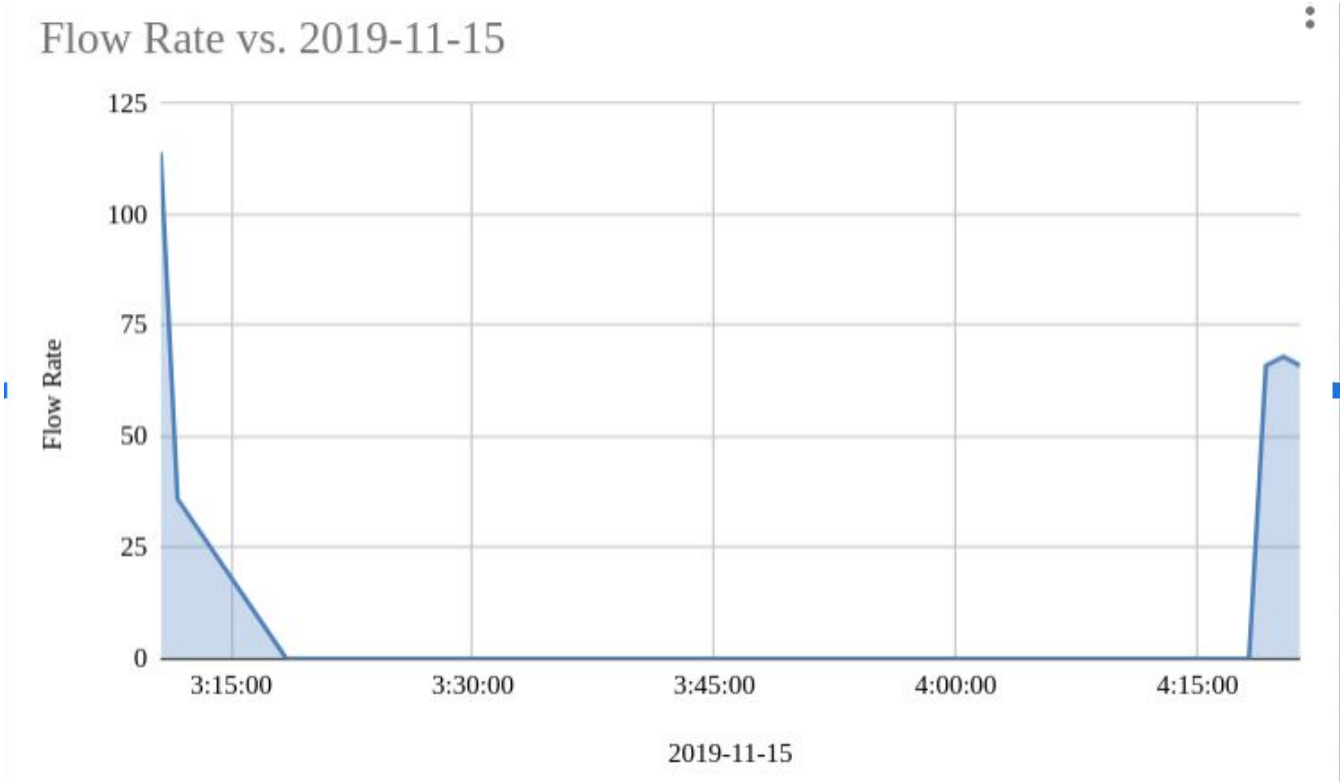
6/11/19


Flow rate vs. 6-11-19
Flow rate
200
150
100
50
0
12:01:58...
0:36:58
1:11:58
1:46:58
2:21:59
2:56:58
3:31:58
4:06:58
4:41:58
5:16:58
5:51:58
6:26:58
7:01:58
7:36:59
8:11:58
8:46:59
9:21:59
9:56:58
10:31:59
11:06:59
11:41:58
12:16:59
12:51:59
13:26:59
14:01:59
14:36:59
15:11:58
15:46:58
16:22:00
16:56:58
17:31:58
18:06:59
18:41:59
19:16:58
19:51:59
20:26:59
21:01:59
21:36:59
22:11:59
22:46:59
23:21:59
23:56:58
6-11-19

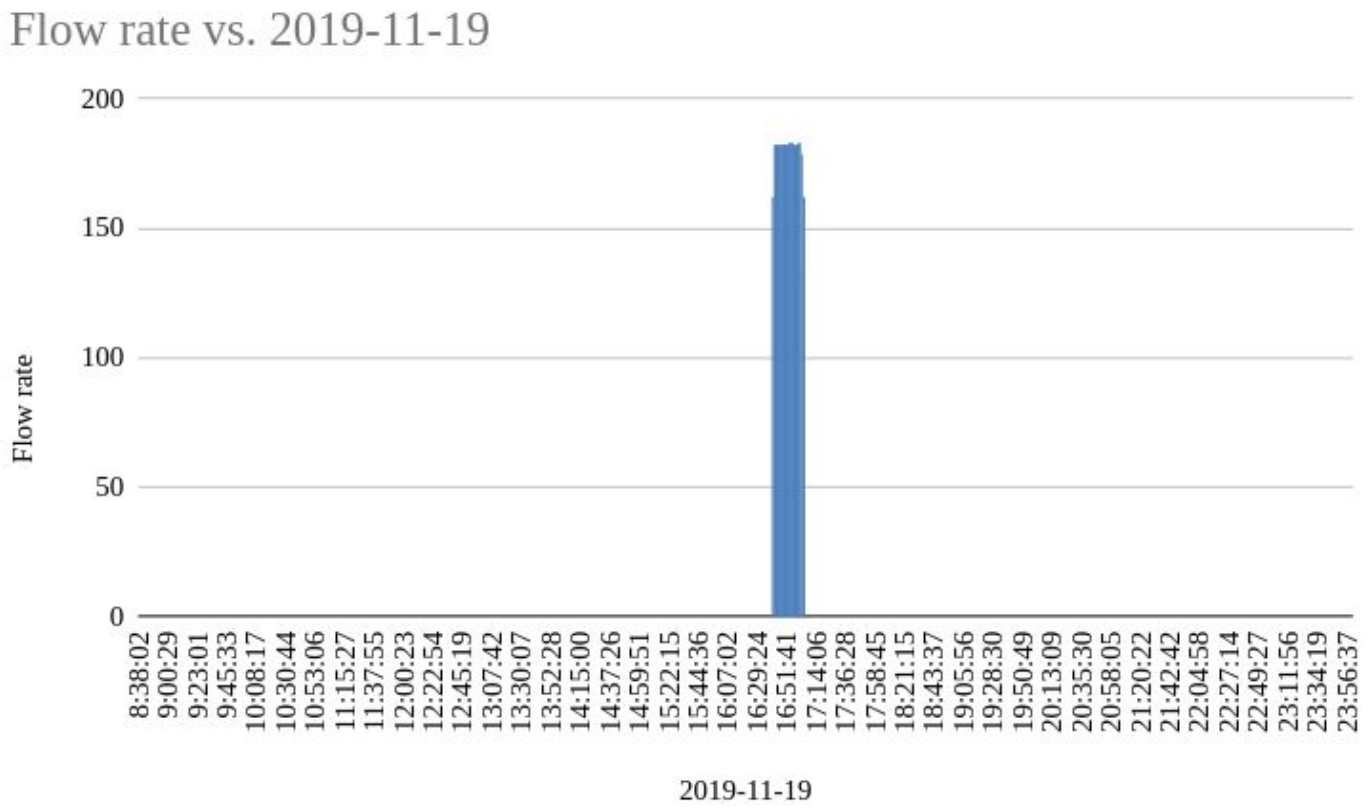
7/11/19


Flow Rate vs. 7-11-19
250
200
150
100
50
0
Flow Rate
3:00:00
6:00:00
9:00:00
12:00:00
7-11-19

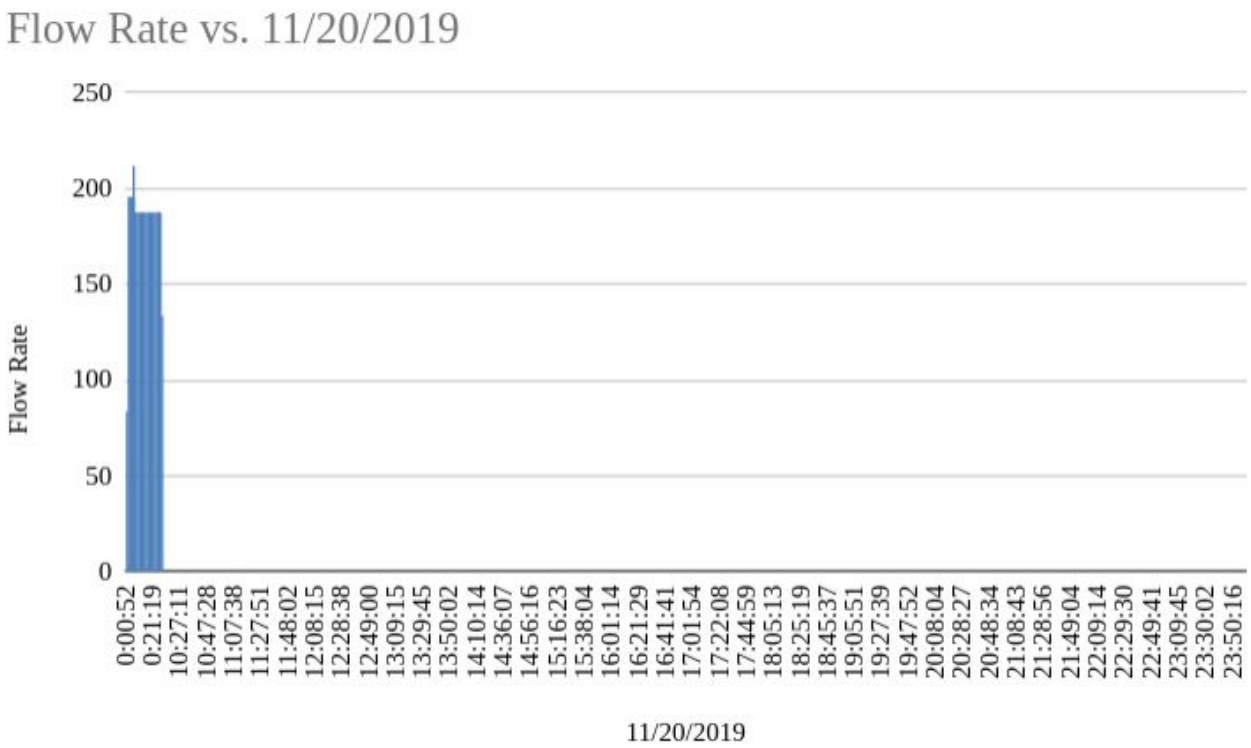
15/11/19


Flow Rate vs. 2019-11-15
125
100
75
50
25
0
Flow Rate
3:15:00
3:30:00
3:45:00
4:00:00
4:15:00
2019-11-15

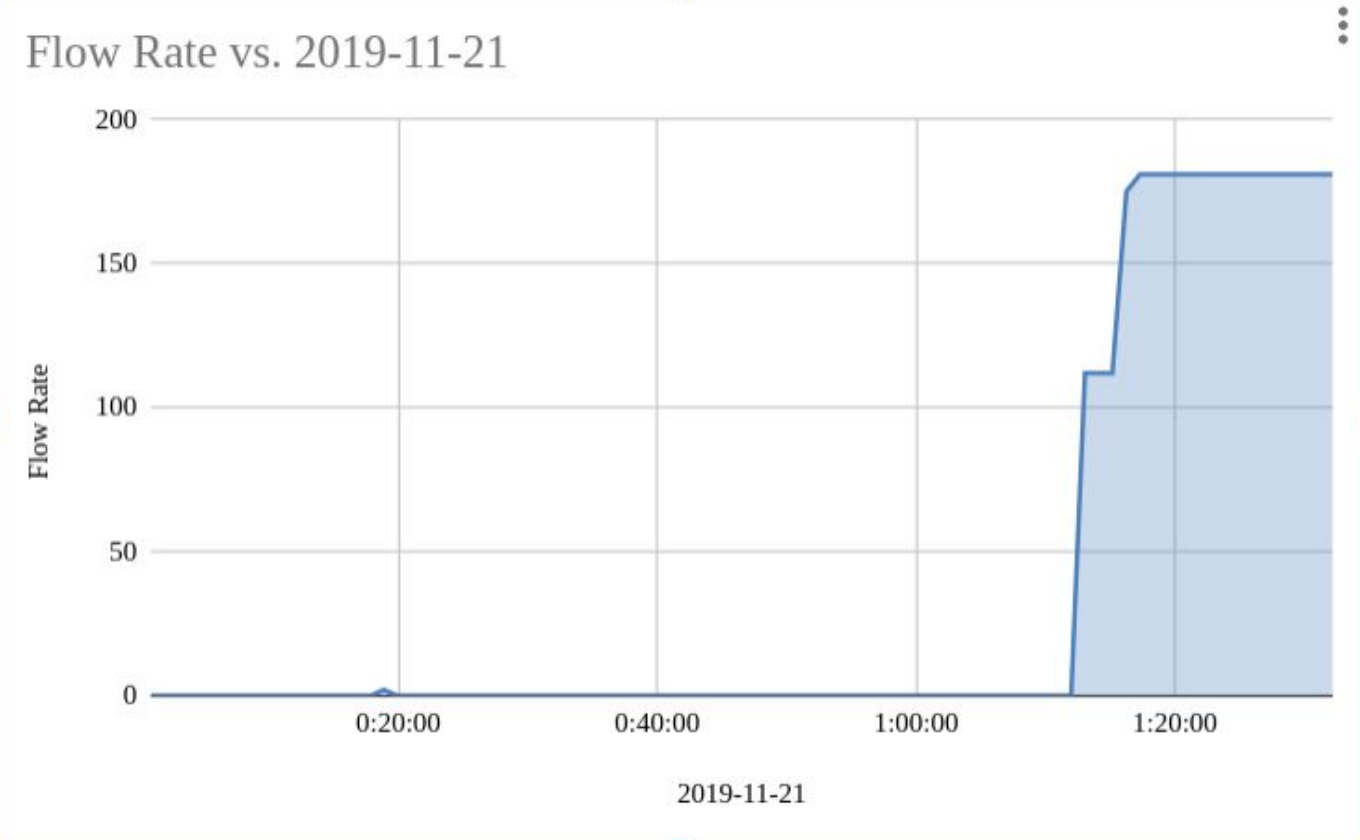
19-11-19


Flow rate vs. 2019-11-19
200
150
100
50
0
Flow rate
8:38:02
9:00:29
9:23:01
9:45:33
10:08:17
10:30:44
10:53:06
11:15:27
11:37:55
12:00:23
12:22:54
12:45:19
13:07:42
13:30:07
13:52:28
14:15:00
14:37:26
14:59:51
15:22:15
15:44:36
16:07:02
16:29:24
16:51:41
17:14:06
17:36:28
17:58:45
18:21:15
18:43:37
19:05:56
19:28:30
19:50:49
20:13:09
20:35:30
20:58:05
21:20:22
21:42:42
22:04:58
22:27:14
22:49:27
23:11:56
23:34:19
23:56:37
2019-11-19

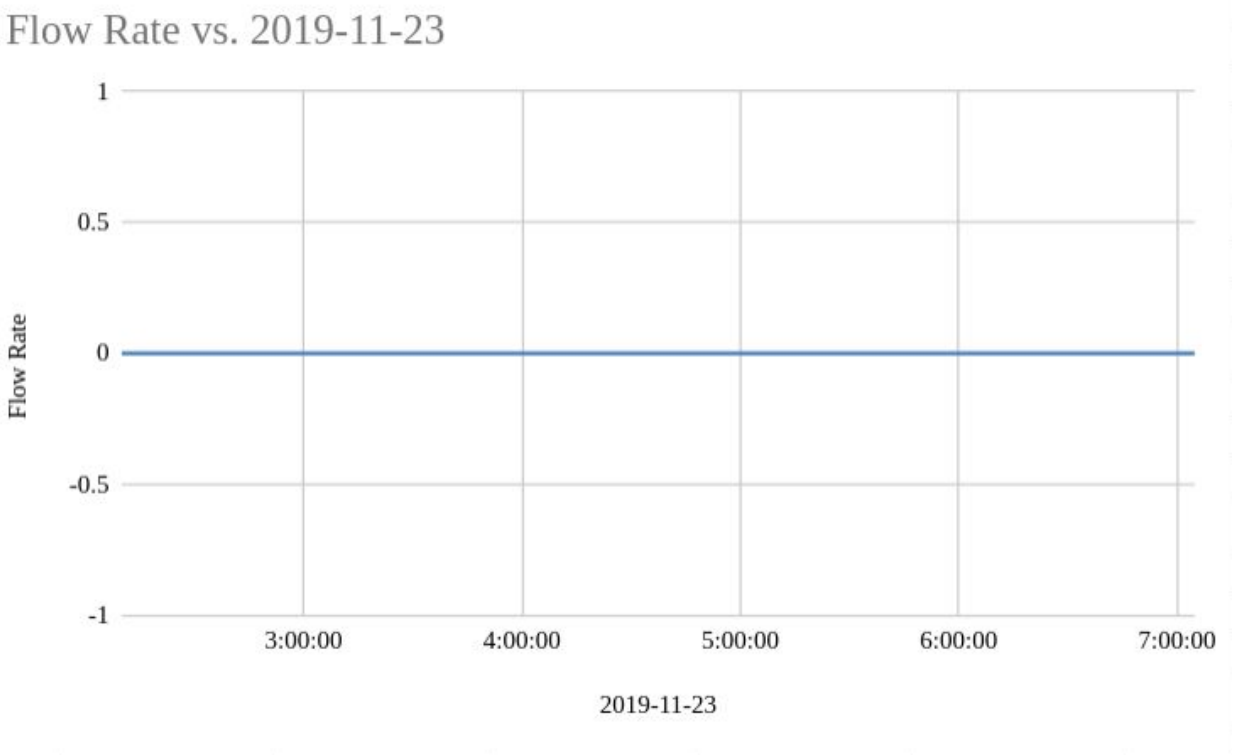
20-11-19


Flow Rate vs. 11/20/2019
250
200
150
100
50
0
Flow Rate
0:00:52
0:21:19
10:27:11
10:47:28
11:07:38
11:27:51
11:48:02
12:08:15
12:28:38
12:49:00
13:09:15
13:29:45
13:50:02
14:10:14
14:36:07
14:56:16
15:16:23
15:38:04
16:01:14
16:21:29
16:41:41
17:01:54
17:22:08
17:44:59
18:05:13
18:25:19
18:45:37
19:05:51
19:27:39
19:47:52
20:08:04
20:28:27
20:48:34
21:08:43
21:28:56
21:49:04
22:09:14
22:29:30
22:49:41
23:09:45
23:30:02
23:50:16
11/20/2019

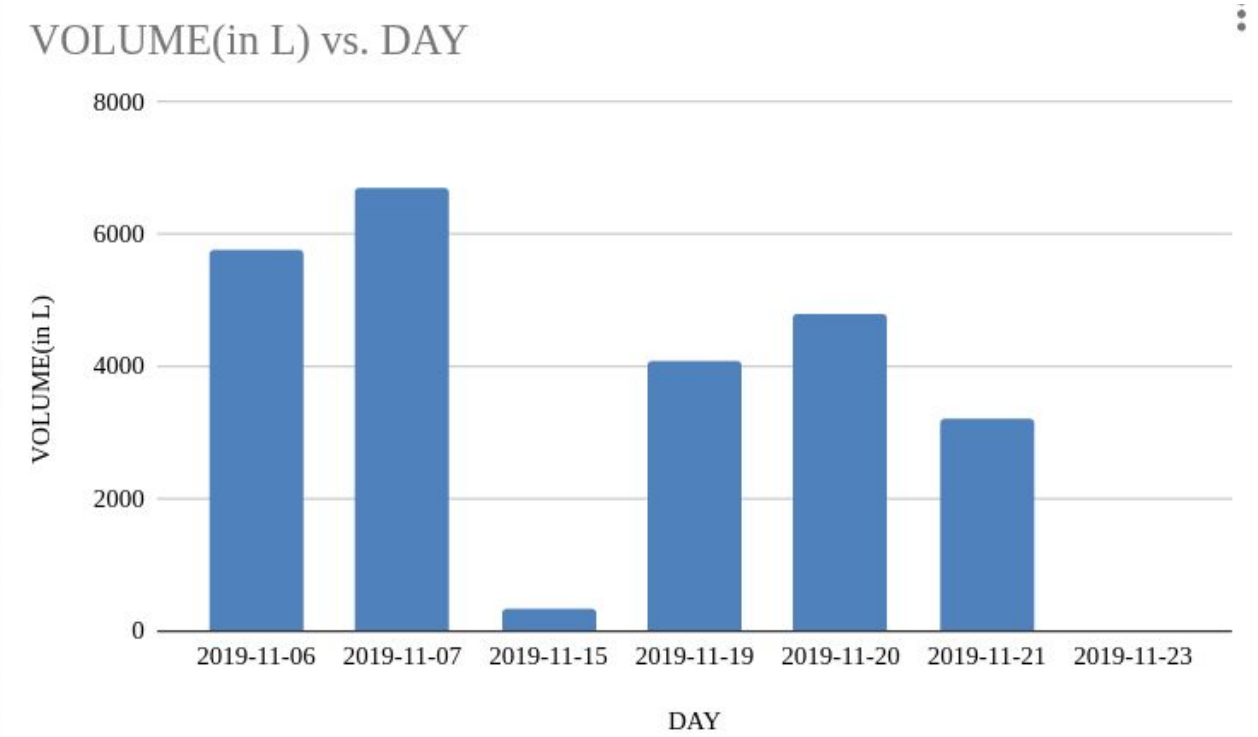
21-11-19


Flow Rate vs. 2019-11-21
200
150
100
50
0
Flow Rate
0:20:00
0:40:00
1:00:00
1:20:00
2019-11-21

23-11-19


Flow Rate vs. 2019-11-23
1
0.5
0
-0.5
-1
Flow Rate
3:00:00
4:00:00
5:00:00
6:00:00
7:00:00
2019-11-23

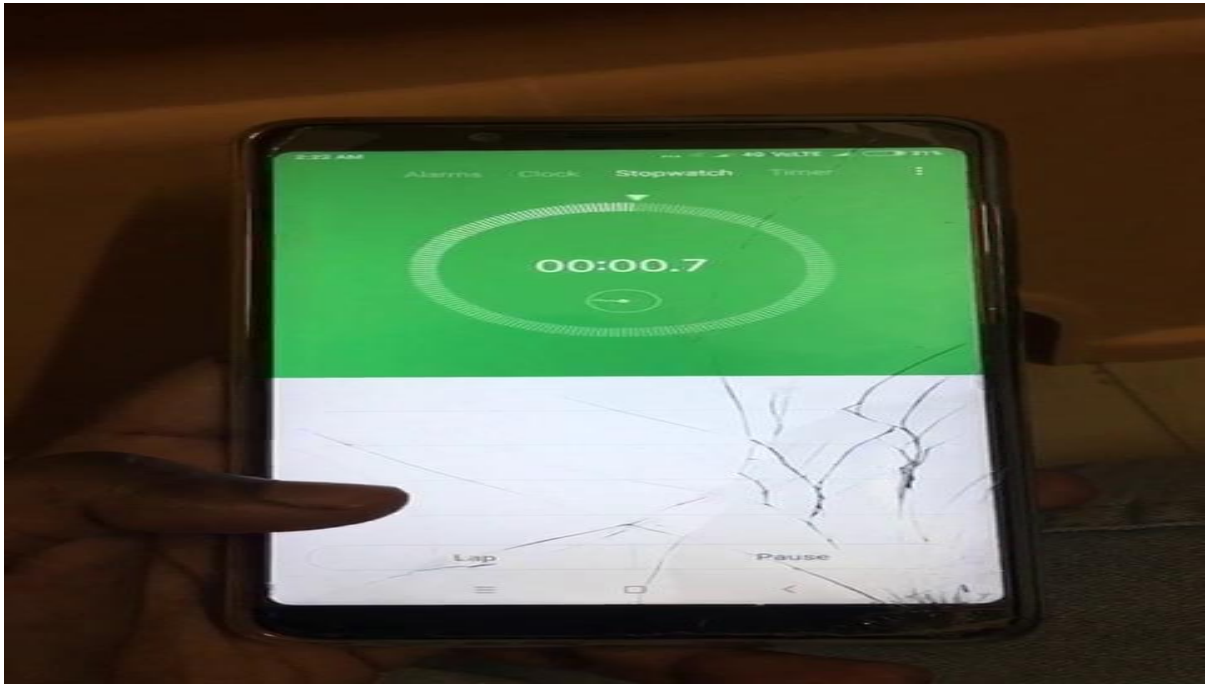
DAY-WISE DATA



CALIBRATION

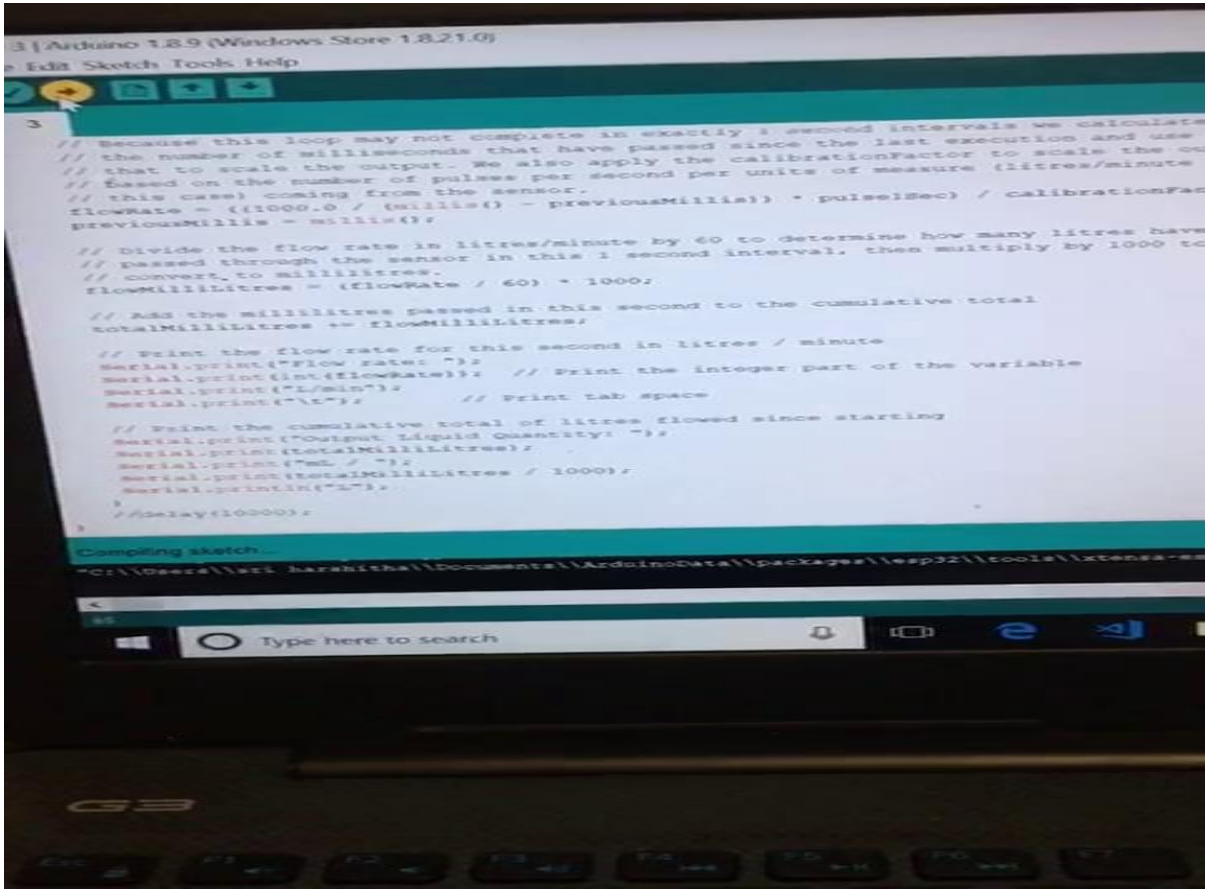
We have done the calibration part by comparing the average rate we got through our code and the actual time taken by the tap to fill a one litre bottle.

It took 7.2 seconds approx to fill a 1L bottle



So when we try to pass water through the sensor and find the rate, we took the average of 0 L/min,7 L/min,9 L/min,9 L/min,11 L/min,10 L/min that is 7.66 L/min. This implies 7.66 L can be filled in 60 seconds.

According to the actual measurement (1 litre in 7.2 seconds) bottle can fill 7.66 L in 7.2x7.66=55.12 seconds.



REASONS FOR THE DIFFERENCE IN ACTUAL VALUE AND MEASURED VALUE

- We have stopped the stop watch with foam left in the bottle leaving it incompletely filled. So , it took a few milliseconds more than 7.2 seconds.
- We tried to turn on the tap and let the water flow with same speed when we filled the bottle and when we make it flow through the sensor. But there should anyway be some difference.
- Air flow also has some influence.


The End.