Design Of Wireless Sensor Network For Tomato Plants Monitoring

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Outline

01 Background

02 Formulation of The Problem

03 Problem Limitations

04 Design System

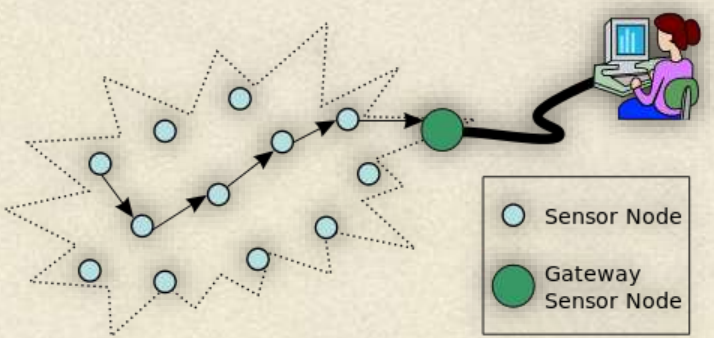
05 Testing

06 Conclusion

Background

Tomato plants

DESIGN OF WIRELESS SENSOR NETWORK FOR TOMATO PLANT MONITORING



Wireless Sensor Network

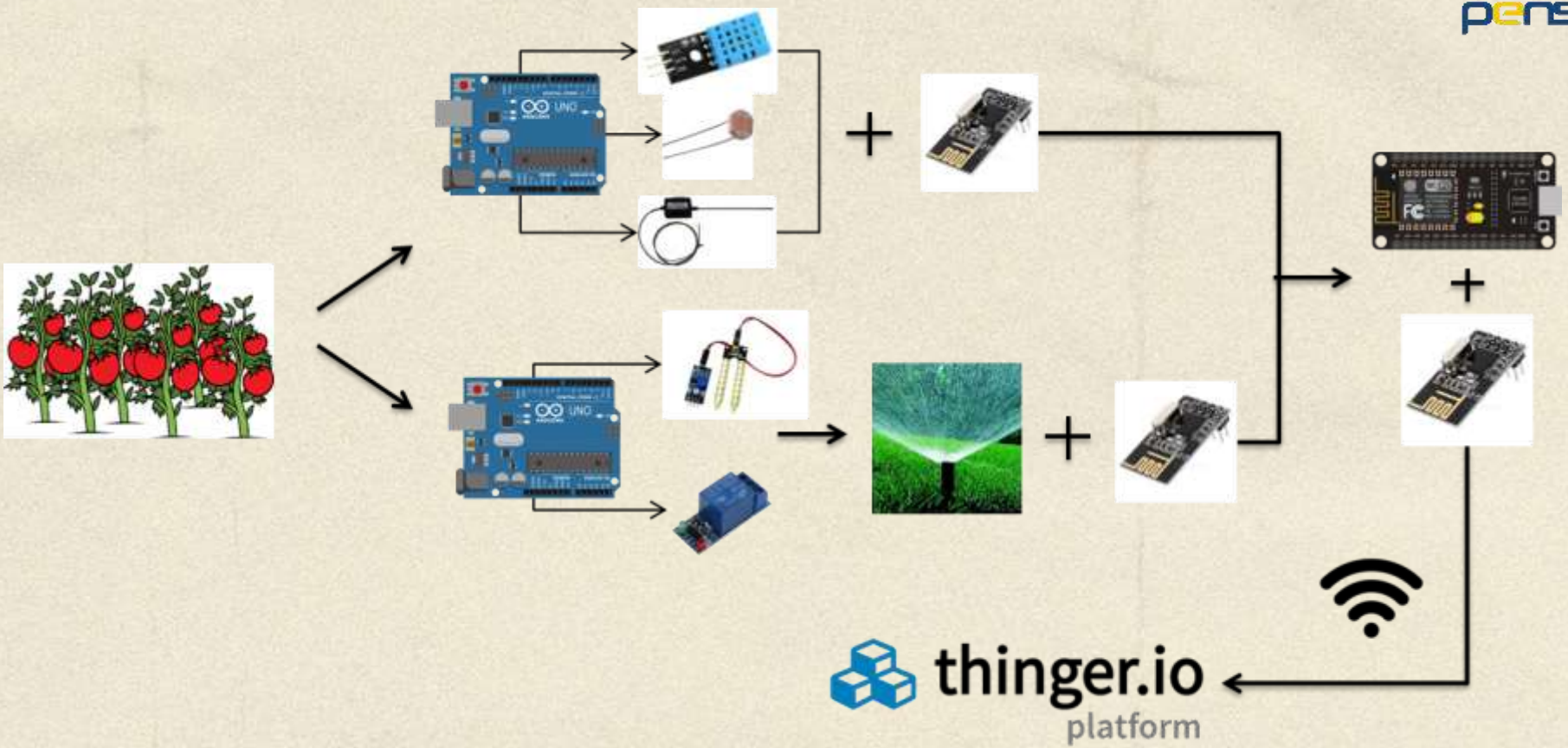
Formulation of the Problem

1. How to design a monitoring device to determine the condition of tomato plants which includes temperature, soil moisture, soil pH, light intensity and automatic watering?
2. How does the device send tomato plant condition data including temperature, soil moisture, soil pH, and light intensity to the web server using the NRF24L01 communication module?
3. How does automatic watering work based on the soil moisture level of tomato plants?

Problem Limitation

1. The node device used is Arduino Uno.
2. The sensors used are temperature sensor, soil moisture sensor, pH sensor, and light sensor.
3. The communication module device is NRF24L01.
4. The programming language is C Arduino.
5. Automatic watering will work if the soil moisture is less than the value specified in the Arduino Microcontroller program.
6. This plant monitoring system is only intended to tomato plants.

Design System



System Testing

01

Node System Testing

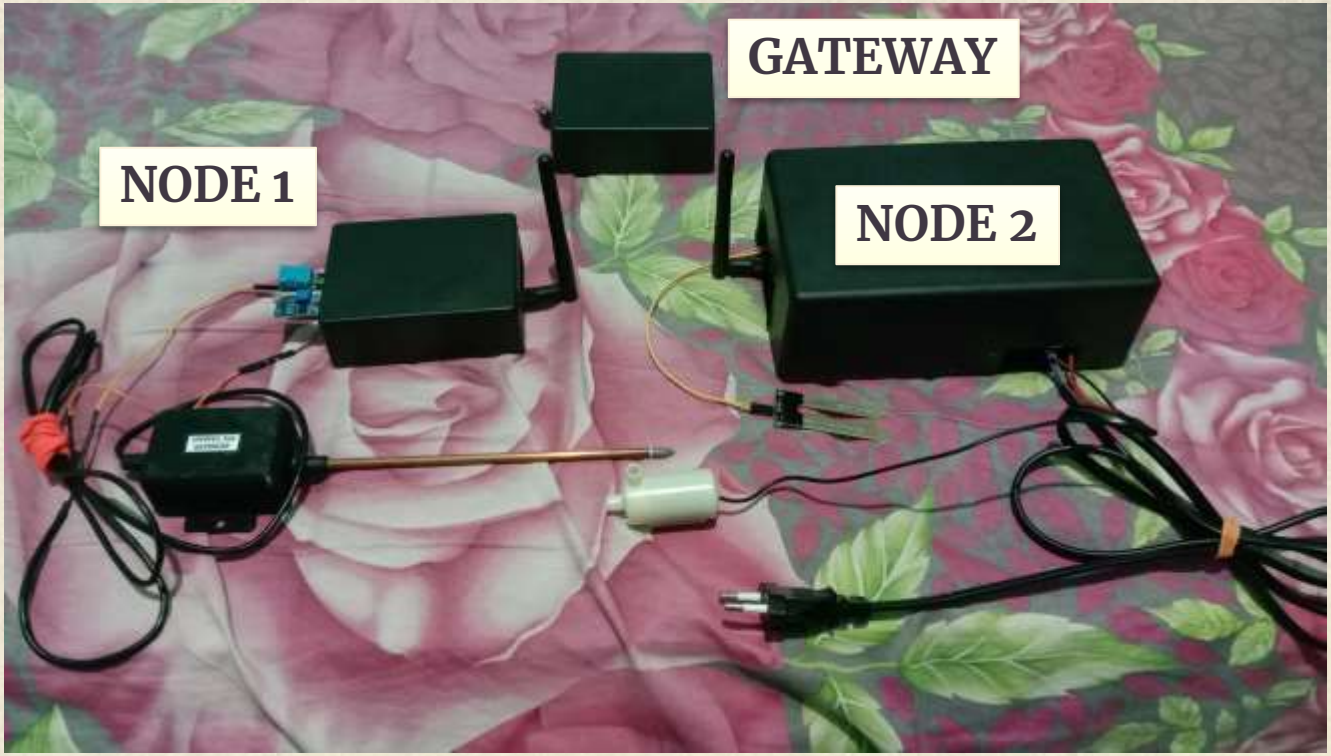
02

Testing of Monitoring Result Data Delivery

03

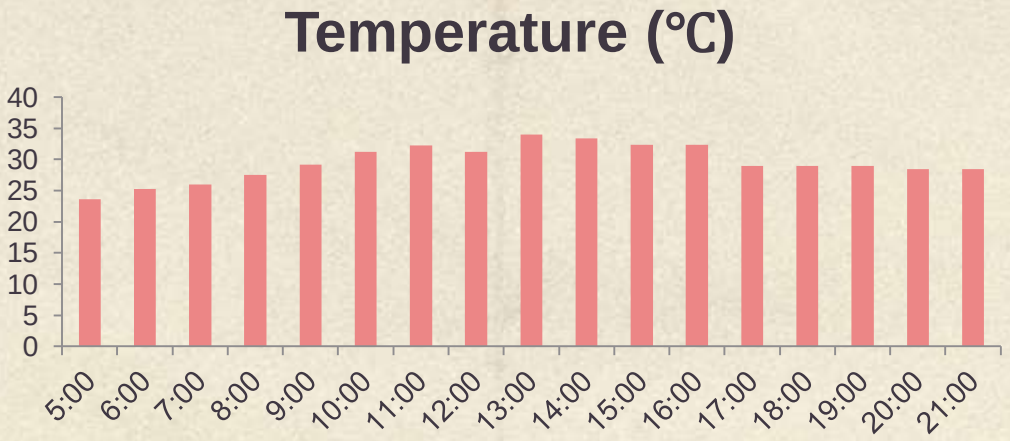
NRF24L01 Testing

Physical Shapes of Device



Result by DHT11 Sensor

Number	Time	Temperature (ºC)
1.	05.00	23.6
2.	06.00	25.3
3.	07.00	26
4.	08.00	27.5
5.	09.00	29.2
6.	10.00	31.2
7.	11.00	32.2
8.	12.00	31.2
9.	13.00	34
10	14.00	33.4
11.	15.00	32.4
12.	16.00	32.4
13.	17.00	29
14.	18.00	29
15.	19.00	29
16.	20.00	28.4
17.	21.00	28.4

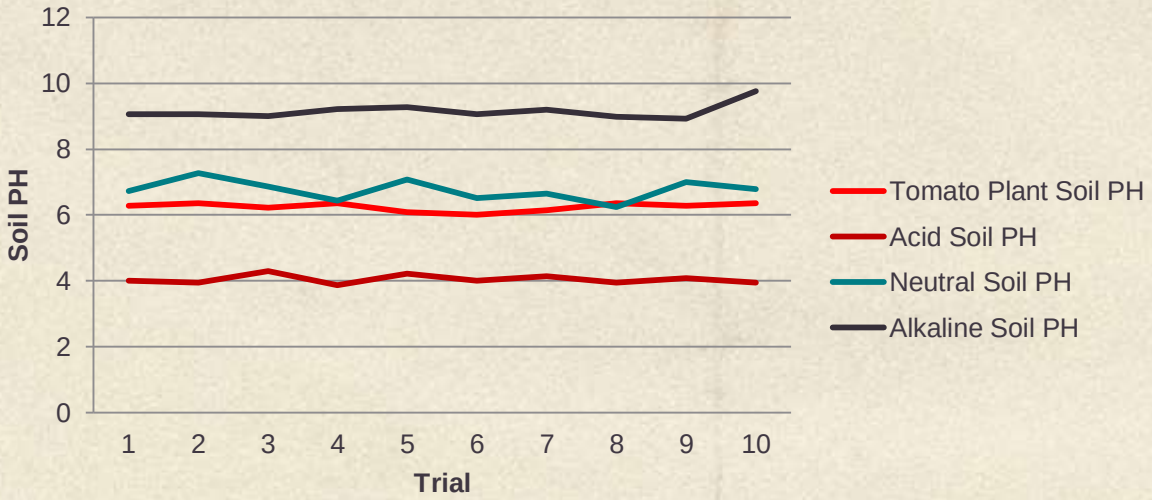


Result by Light Intensity Sensor

Number	Time	(%) Light Intensity	Information
1.	05.00	12	Foggy
2.	06.00	70	Sunny
3.	07.00	88	Sunny
4.	08.00	89	Sunny
5.	09.00	90	Sunny
6.	10.00	90	Sunny
7.	11.00	88	Cloudy
8.	12.00	89	Cloudy
9.	13.00	92	Sunny + Cloudy
10	14.00	88	Sunny + Cloudy
11.	15.00	85	Sunny + Cloudy
12.	16.00	86	Sunny + Cloudy
13.	17.00	57	Sunny
14.	18.00	13	Sunny
15.	19.00	0	Sunny
16.	20.00	0	Sunny
17.	21.00	0	Sunny

Result by Soil PH Sensor

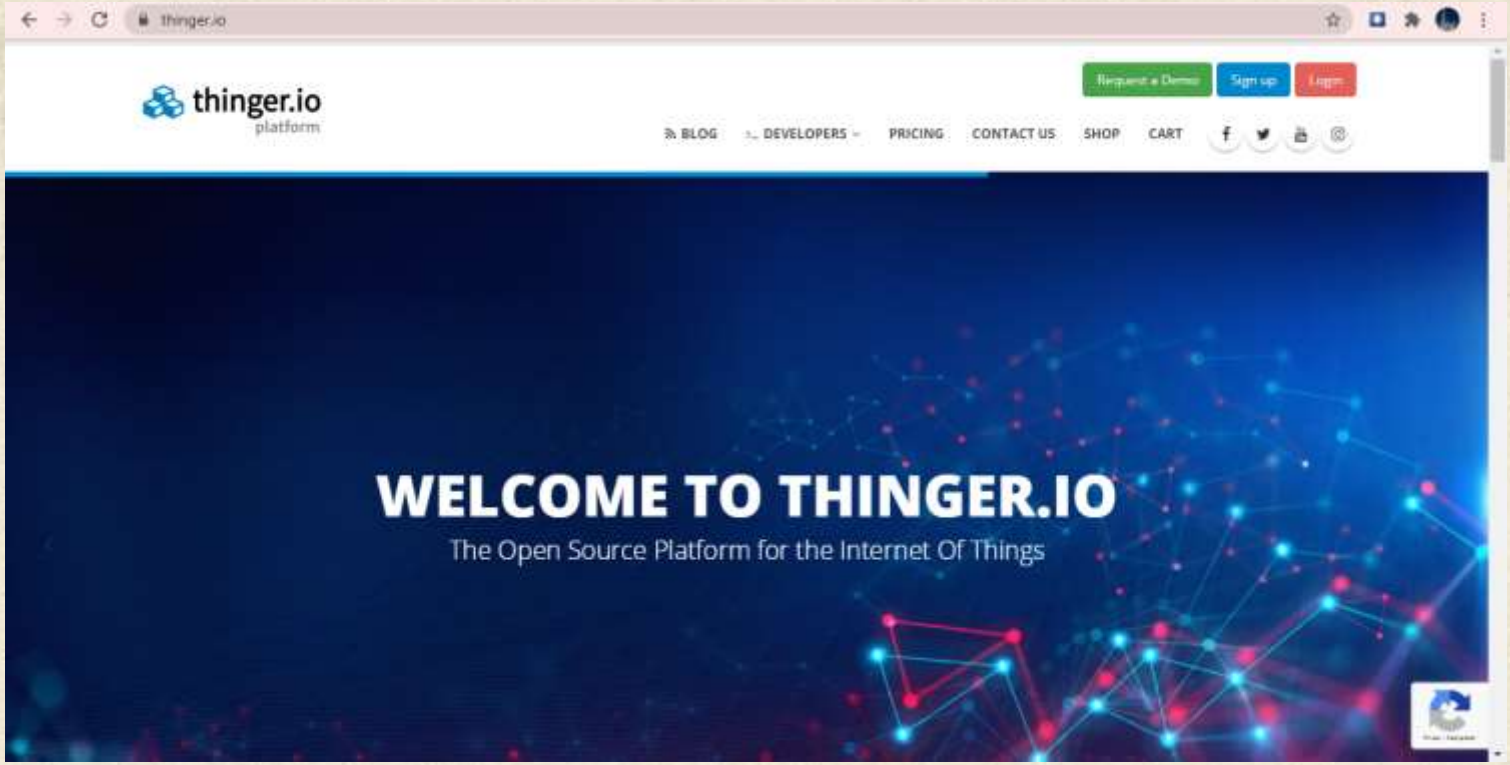
Number	(Soil pH)
1.	6.29
2.	6.36
3.	6.22
4.	6.36
5.	6.08
6.	6.01
7.	6.15
8.	6.36
9.	6.29
10	6.36



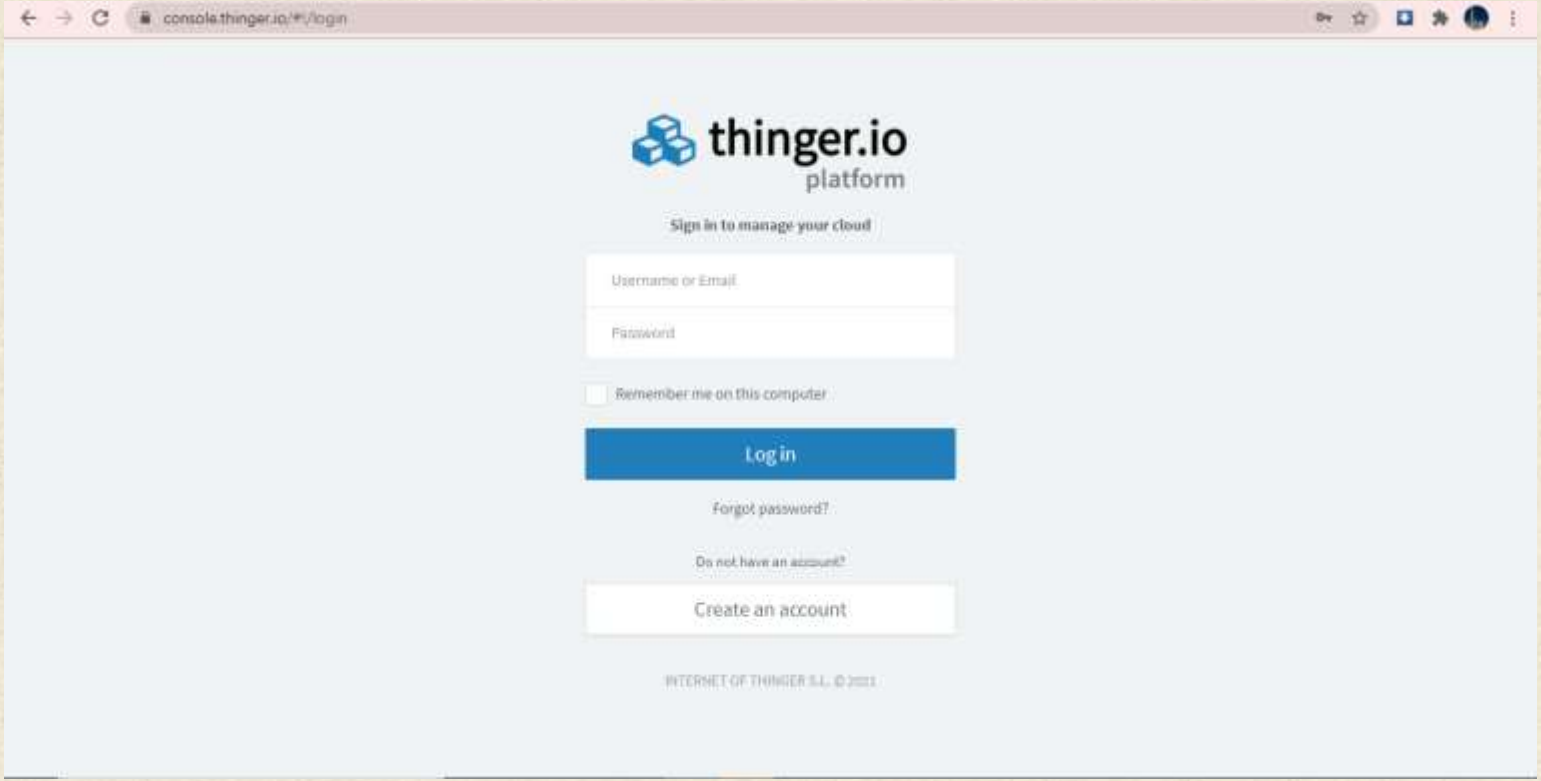
Result by Soil Moisture Sensor

Number	Time	(%) Soil Moisture	Pump
1.	06.00	63	OFF
2.	07.00	65	OFF
3.	08.00	66	OFF
4.	09.00	62	OFF
5.	10.00	60	OFF
6.	11.00	60	OFF
7.	12.00	61	OFF
8.	13.00	59	OFF
9.	14.00	48	ON
10	15.00	58	OFF
11.	16.00	58	OFF
12.	17.00	58	OFF
13.	18.00	59	OFF
14.	19.00	58	OFF
15.	20.00	58	OFF
16.	21.00	57	OFF

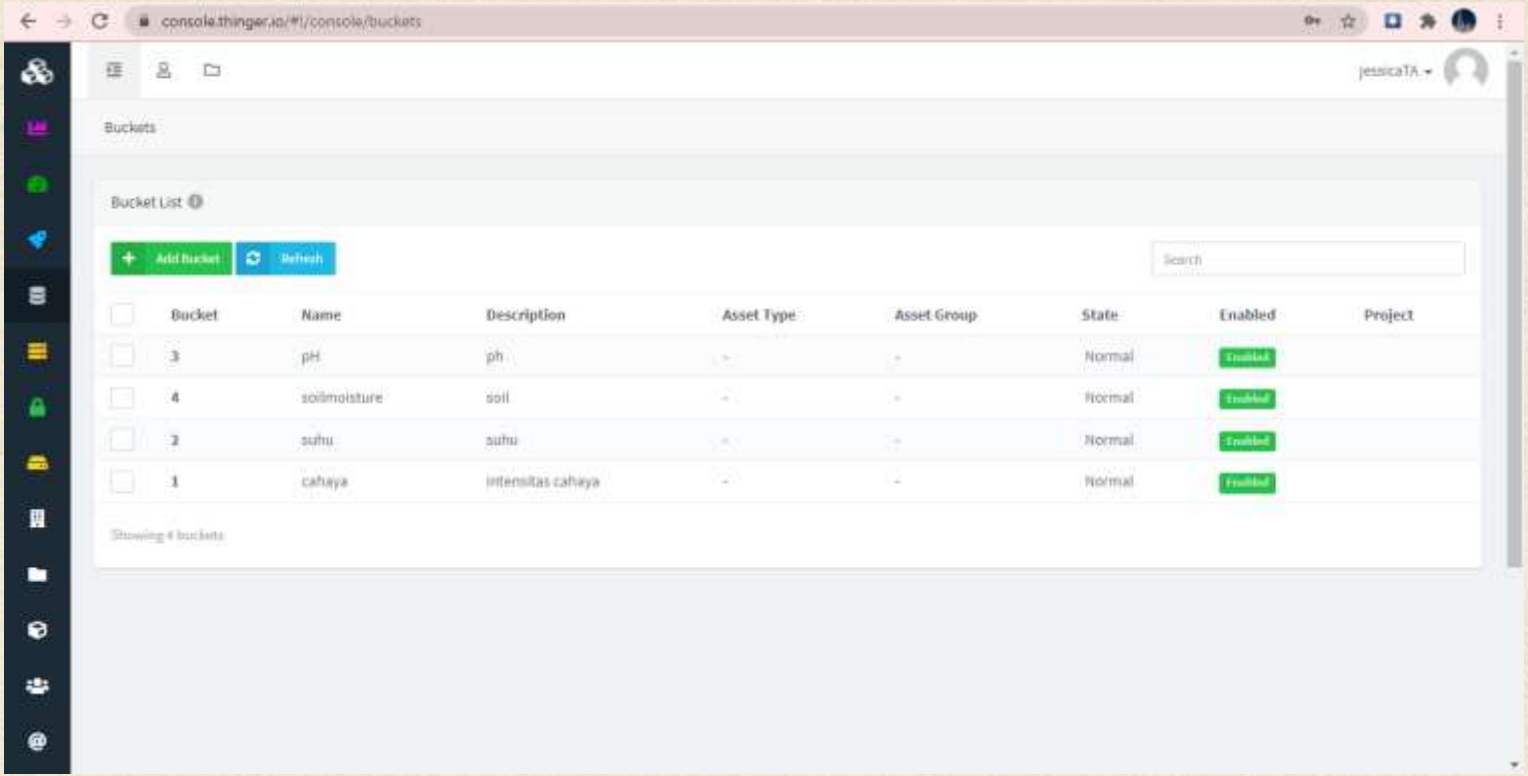
Thinger.io Home Page



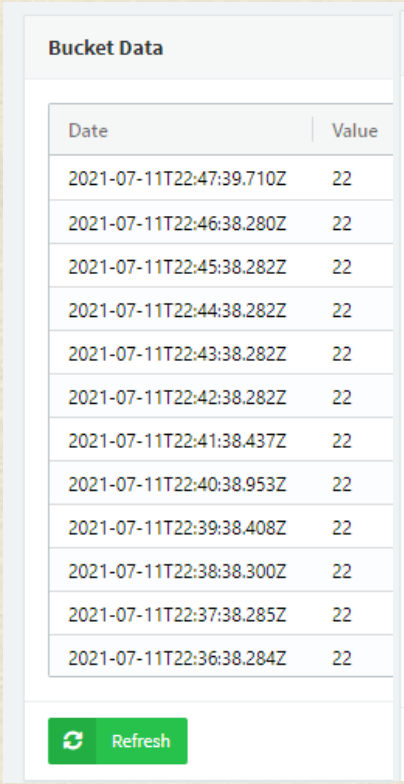
Thinger.io Login Page



Data Buckets Page



Data Buckets Page

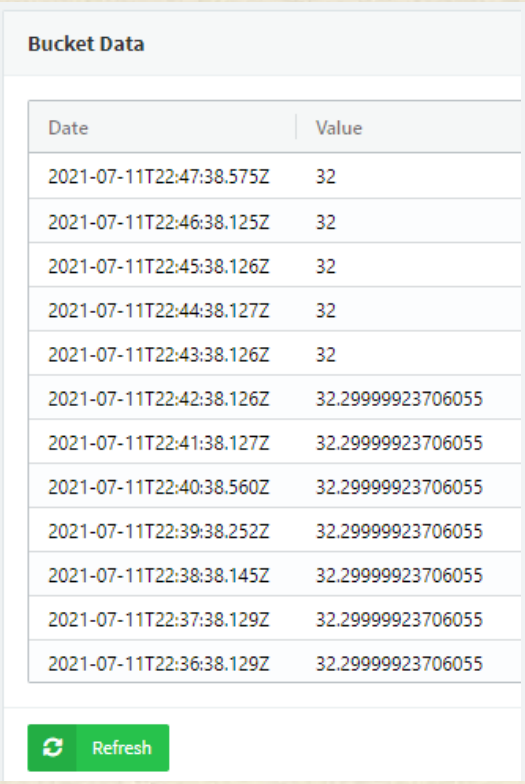


Bucket Data

Date	Value
2021-07-11T22:47:39.710Z	22
2021-07-11T22:46:38.280Z	22
2021-07-11T22:45:38.282Z	22
2021-07-11T22:44:38.282Z	22
2021-07-11T22:43:38.282Z	22
2021-07-11T22:42:38.282Z	22
2021-07-11T22:41:38.437Z	22
2021-07-11T22:40:38.953Z	22
2021-07-11T22:39:38.408Z	22
2021-07-11T22:38:38.300Z	22
2021-07-11T22:37:38.285Z	22
2021-07-11T22:36:38.284Z	22

Refresh

Light Intensity



Bucket Data

Date	Value
2021-07-11T22:47:38.575Z	32
2021-07-11T22:46:38.125Z	32
2021-07-11T22:45:38.126Z	32
2021-07-11T22:44:38.127Z	32
2021-07-11T22:43:38.126Z	32
2021-07-11T22:42:38.126Z	32.29999923706055
2021-07-11T22:41:38.127Z	32.29999923706055
2021-07-11T22:40:38.560Z	32.29999923706055
2021-07-11T22:39:38.252Z	32.29999923706055
2021-07-11T22:38:38.145Z	32.29999923706055
2021-07-11T22:37:38.129Z	32.29999923706055
2021-07-11T22:36:38.129Z	32.29999923706055

Refresh

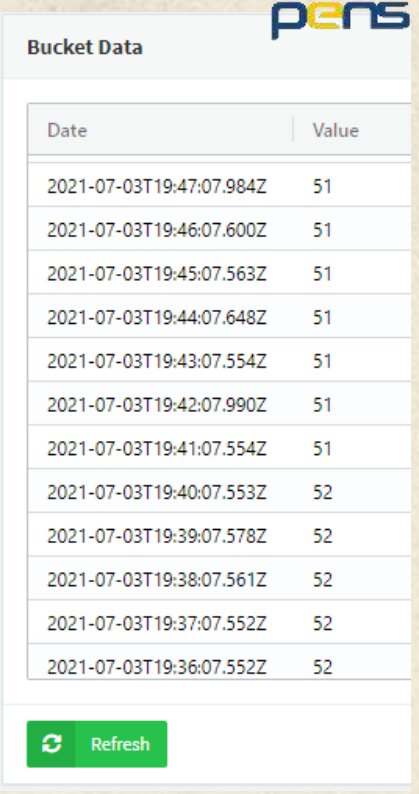
Temperature

Bucket Data

Date	Value
2021-07-09T14:52:23.807Z	5.940000057220459
2021-07-09T14:51:23.638Z	5.940000057220459
2021-07-09T14:50:23.757Z	5.940000057220459
2021-07-09T14:49:23.605Z	5.940000057220459
2021-07-09T14:48:24.062Z	5.869999885559082
2021-07-09T14:47:24.336Z	5.869999885559082
2021-07-09T14:46:24.201Z	5.869999885559082
2021-07-09T14:45:23.801Z	5.869999885559082
2021-07-09T14:44:23.605Z	5.869999885559082
2021-07-09T14:43:23.605Z	6.360000133514404
2021-07-09T14:42:23.693Z	6.360000133514404
2021-07-09T14:41:23.929Z	6.360000133514404

Refresh

Soil PH



Bucket Data

Date	Value
2021-07-03T19:47:07.984Z	51
2021-07-03T19:46:07.600Z	51
2021-07-03T19:45:07.563Z	51
2021-07-03T19:44:07.648Z	51
2021-07-03T19:43:07.554Z	51
2021-07-03T19:42:07.990Z	51
2021-07-03T19:41:07.554Z	51
2021-07-03T19:40:07.553Z	52
2021-07-03T19:39:07.578Z	52
2021-07-03T19:38:07.561Z	52
2021-07-03T19:37:07.552Z	52
2021-07-03T19:36:07.552Z	52

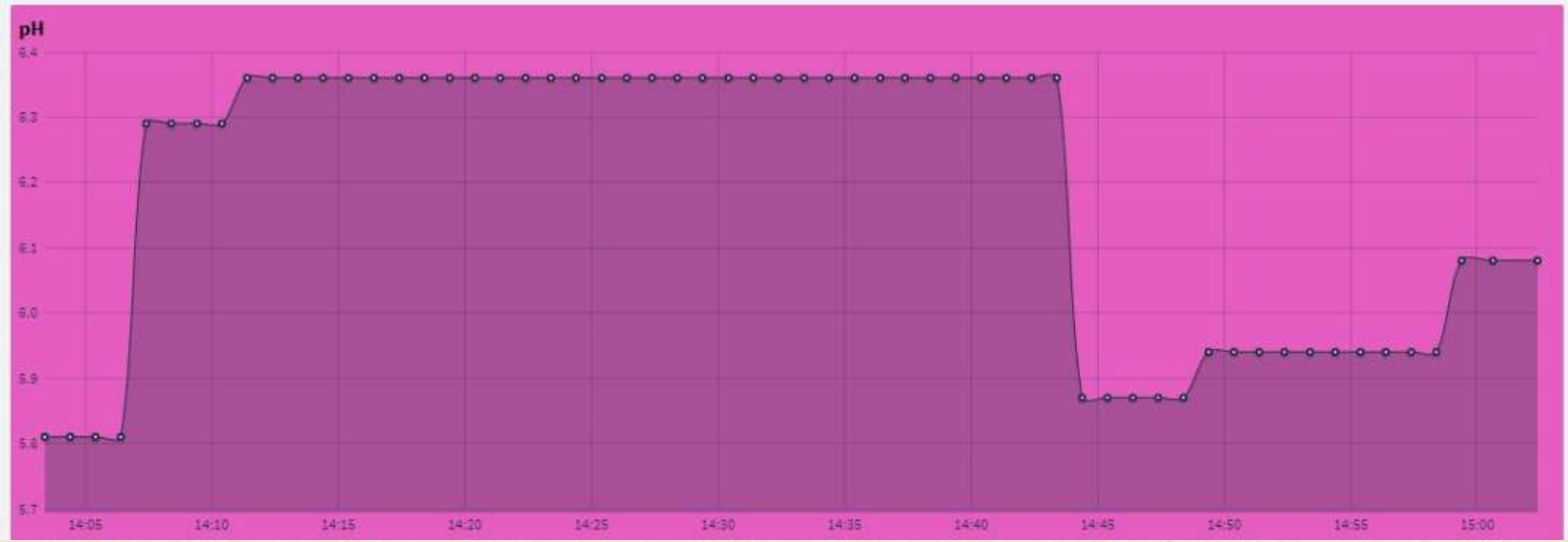
Refresh

Soil Moisture

Temperature's Chart Page

Light Intensity's Chart Page

Soil PH's Chart Page



Soil Moisture's Chart Page

NRF24L01 Testing

Number	Condition	Distance (meter)	Transmission	
			Accepted	Rejected
1.	Non Line of Sight	20	✓	
		40	✓	
		60	✓	
		80	✓	
		100	✓	
		120	✓	
		140	✓	
		160		✓
2.	Line of Sight	100	✓	
		200	✓	
		300	✓	
		400	✓	
		500	✓	
		600		✓

Conclusion

1. The results of tests on the DHT11 sensor, LDR sensor, soil PH sensor, and soil moisture sensor show that the sensor can read temperature, light intensity, soil pH, and soil moisture and can be displayed and accessed on the Thinger.io web Dashboards properly. real time.
2. From 10 times of testing the soil pH sensor, the percent error is less than 10%. So that the sensor is eligible for use.
3. The maximum communication distance of the NRF24L01 module in non-line of sight conditions is up to 140 meters. While the maximum communication distance of the NRF24L01 module in line of sight conditions can reach 500 meters.

Reference

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Thank You