



A mesh-topological, low-power wireless network platform for a smart watering system

A Progress Report

Jessada KARNJANA, PhD

ASEAN IVO Forum

2018.11.28

Participants

Name	Position/Institution	Expertise/Responsibility
Dr Wida Susanty Haji Suhaili	Senior Lecturer/UTB	Irrigation decision (where the soil moisture is detected at different levels)
Dr Mohd Faizan Ibrahim	Agriculture Engineer/DAA	Agricultural engineering Field-test site
Dr Sharifah Hafizah Syed Ariffin	Associate Professor/UTM	Wireless data transmission Self-configuration Cloud database Optimization algorithm on the valve control
Dr Nurzal Effiyana Ghazali	Senior Lecturer/UTM	
Dr Khin Than Mya	Professor/UCSY	Embedded system technology Field-test site
Dr Thi Thi Soe Nyunt	Professor/UCSY	
Dr Goshi Sato	Researcher/NICT	NerveNet-LoRa technology NerveNet-LoRa communication nodes
Dr Yasunori Owada	Senior Researcher/NICT	
Dr Kanokvate Tungpimolrut	Deputy Executive Director/NECTEC	Oversee the implementation. Experience in distribution automation systems and remote monitoring systems.
Udom Lewlompaisarl	Senior Researcher/NECTEC	
Seksun Sartsatit	Senior Researcher/NECTEC	Hardware design Sensors and weather stations
Dr Rachaporn Keinprasit	Senior Researcher/NECTEC	
Khongpan Rungprateepthaworn	Researcher/NECTEC	Embedded system design Field-test site
Thanika Duangtanoo	Researcher/NECTEC	
Anuchit Leelayuttho	Senior Research Assistant/NECTEC	Database and web service applications
Dr Chalernpol Charmsripinyo	Senior Research Specialist/NECTEC	LoRa technology LoRa with mesh topological network
Wibhada Naruephiphat	Research Assistant/NECTEC	
Theerapong Fongjun	Senior Research Assistant/NECTEC	
Pasakorn Tiwatthanont	Research Assistant/NECTEC	
Dr Jessada Karnjana	Researcher/NECTEC	System integration

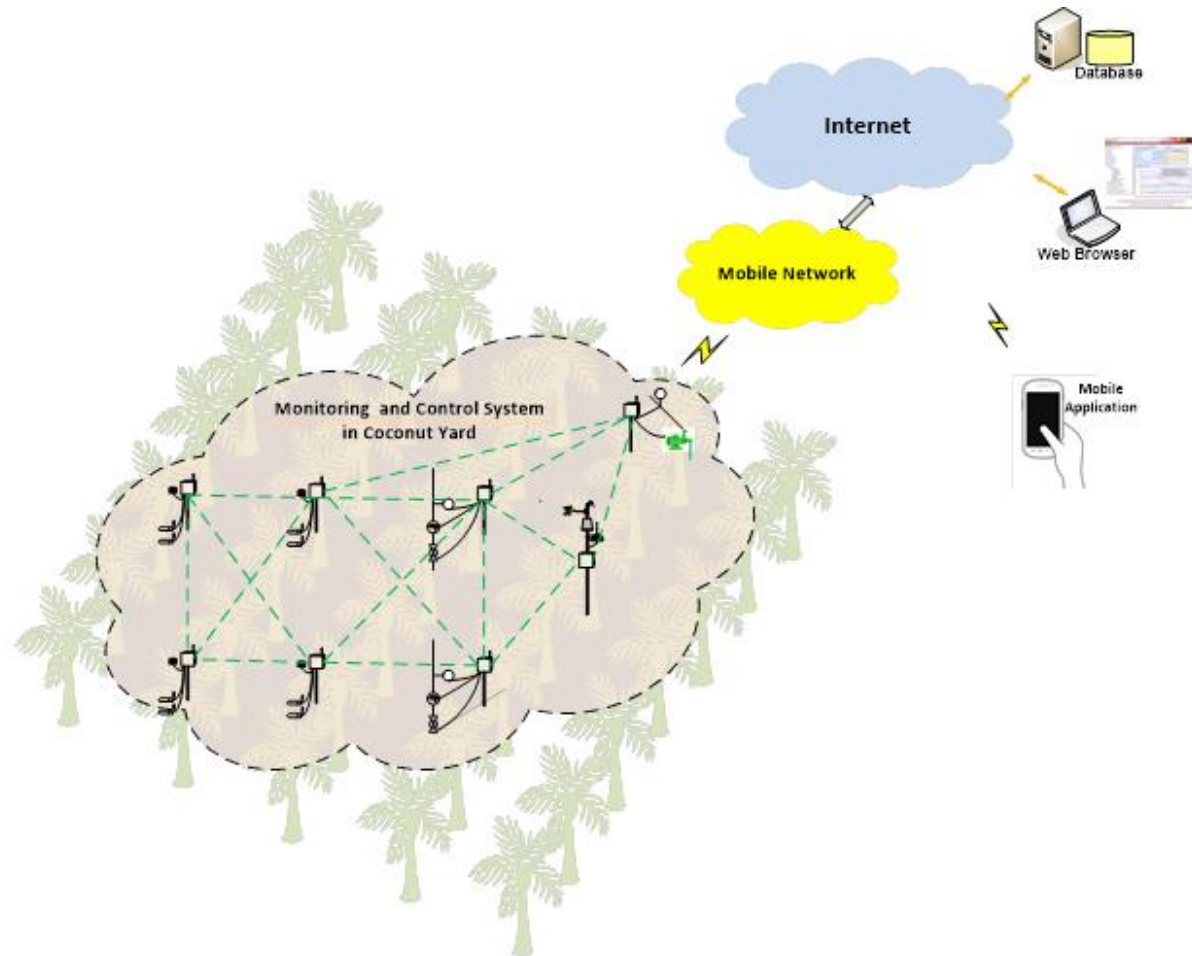


UTM
UNIVERSITI TEKNOLOGI MALAYSIA



Our aim

- Smart watering system based on a mesh-topological, low-power wireless network platform



Summary of the proposed smart watering system

- The prototype of the proposed platform consists of a control node, sensor nodes, and irrigation-valve-controller nodes. Also, this platform includes a gateway that relays collected data to a (cloud) database.
- The platform consists of 4 types of nodes:
 - Sensor node
 - Irrigation-valve-controller node
 - Control node
 - Weather station
- The platform functions as follows.
 - The sensor nodes collect data about environmental parameters, such as soil moisture, temperature, and precipitation, and send them to the control node.
 - The control node analyzes the received data together with the plant profile and sends commands to the irrigation-valve-controller nodes in order to water the plants. A
 - All collected data are relayed via the gateway to the (cloud) database.

Required properties of the WSN

- Robustness
- Reliability
- Low power consumption

3 technological Targets

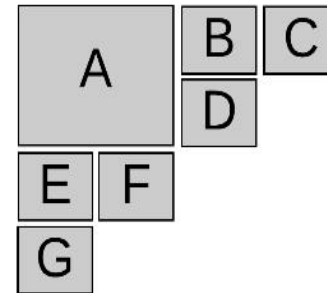
- Developing weather stations, sensor nodes, valve-control nodes, and a controller node
- Developing a smart watering system based on a mesh-topological WSN
- Developing a smart watering system based on a NerveNet-LoRa WSN

Activities

- Kick-off meeting (Jul 2018)
- NECTEC-NICT technical meeting (Aug 2018)
- A draft of CRDA (planned to sign by the end of this DEC and to submit to NICT)
- Experiment with NerveNet/LoRa (Sep 2018)
- Visiting Brunei's site (Nov 2018)

Kick-off meeting

- July 9-10, 2018, at NICT Innovation Center, Otemachi, Chiyoda-ku, Tokyo



- (A) Welcome speech (Dr. Inoue)
- (B) Presentation by UCSY
- (C) Introduction to the Smart FiT
- (D) Group photo
- (E) Presentation by NECTEC
- (F) Presentation by UTB
- (G) Presentation by UTM

Agenda & the output of the kick-off meeting

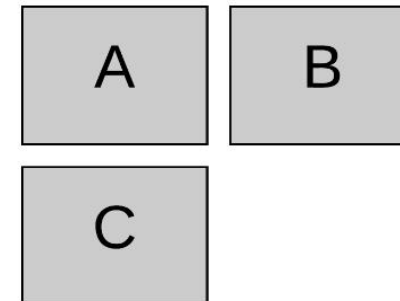
July 9	09:00 – 09:10	Welcome Message (Dr. Masugi Inoue)
	09:10 – 09:30	Who's Who
	09:30 – 10:00	Project Summary by the project leader (Mr. Udom)
	10:00 – 11:00	Smart watering system in Thailand and its demonstration (Mrs. Thanika)
	11:00 – 12:00	Introduction to LoRa/NerveNet Technology (Dr. Owada, Dr. Sato)
	12:00 – 13:00	Lunch
	13:00 – 13:30	Contribution/Responsibility/Support from UTB and DAA (Dr. Wida)
	13:30 – 14:00	Contribution/Responsibility/Support from UTM (Dr. Sharifah, Dr. Nurzal)
	14:00 – 14:30	Introduction to IoT research in UCSY (Dr. Khin, Dr. Thi)
	14:30 – 15:00	Break & move to the experiment sites
	15:00 – 17:00	<ol style="list-style-type: none"> 1. Site visiting (for LoRa/NerveNet experiments) and demo of connection from terminal <ul style="list-style-type: none"> - Shibuya red cross medical center - Hiroo hospital 2. Short summary on NICT's technologies
July 10	09:00 – 10:30	Discussion on technologies we currently possess and on how to combine those technologies to implement the proposed system
	10:30 – 12:30	Work breakdown, brainstorming, and project planning
	12:30 – 13:30	Lunch
	13:30 – 14:30	Move to NICT HQ
	14:30 – 17:00	<ol style="list-style-type: none"> 1. NICT HQ Visit <ul style="list-style-type: none"> - Exhibition room - Visual IoT - NerveNet 2. Landslide-related project discussion

Output

- Work breakdown
- Work plan & action plan
- Report

Summary

- Project introduction and discussion about the contributions from all parties
- Demonstration of the NerveNet/LoRa system



(A) Presentation by Dr. Owada
(B - C) Demonstration by Dr. Owada and Dr. Sato

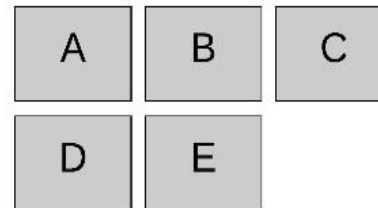
Summary

- Visiting to NerveNet/LoRa test site at the hospital in Shibuya



Summary

- Brainstorming and discussion on the work breakdown and project plan



- (A) Dr. Sato and NECTEC discussed the NerveNet.
 (B) Dr. Wida explained her idea to the group.
 (C) Dr. Khin and Dr. Thi planned for their work.
 (D) Dr. Sharifah explained her contribution to the group.
 (E) Woman power in our group!

Summary

- NICT HQ Visit



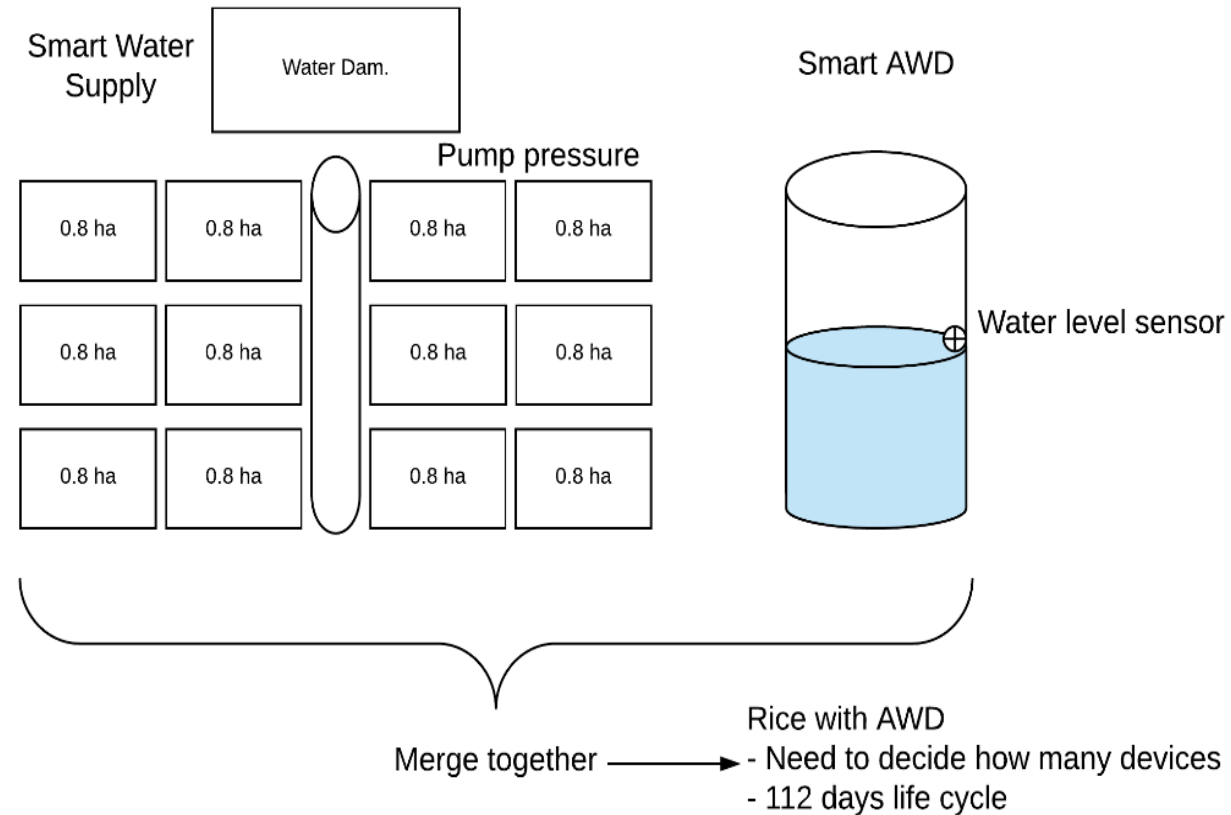
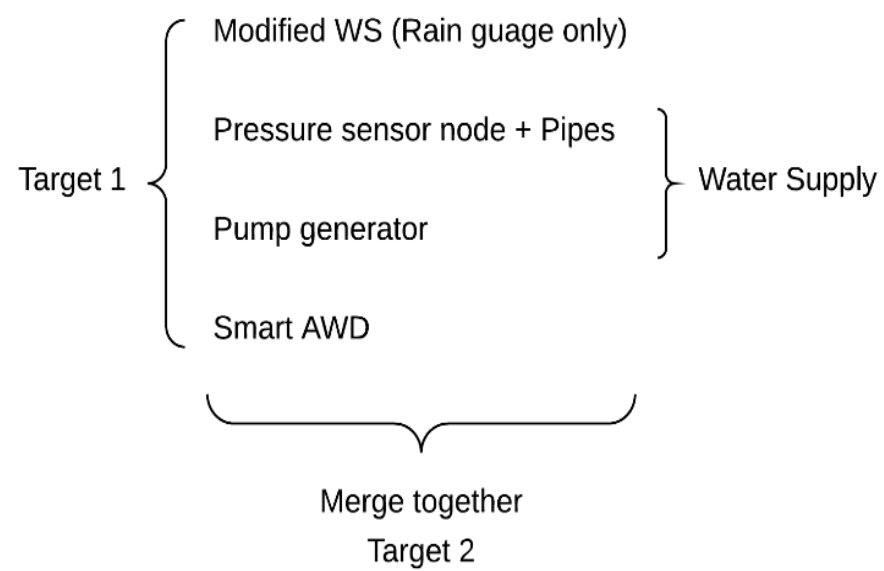
Work breakdown

- NECTEC will implement the Targets 1 & 2 according to the joint research project proposal.
- NICT will provide the NerveNet/LoRa.
- NICT and NECTEC will discuss about the API in November 2018.

UTB, DAA & UCSY

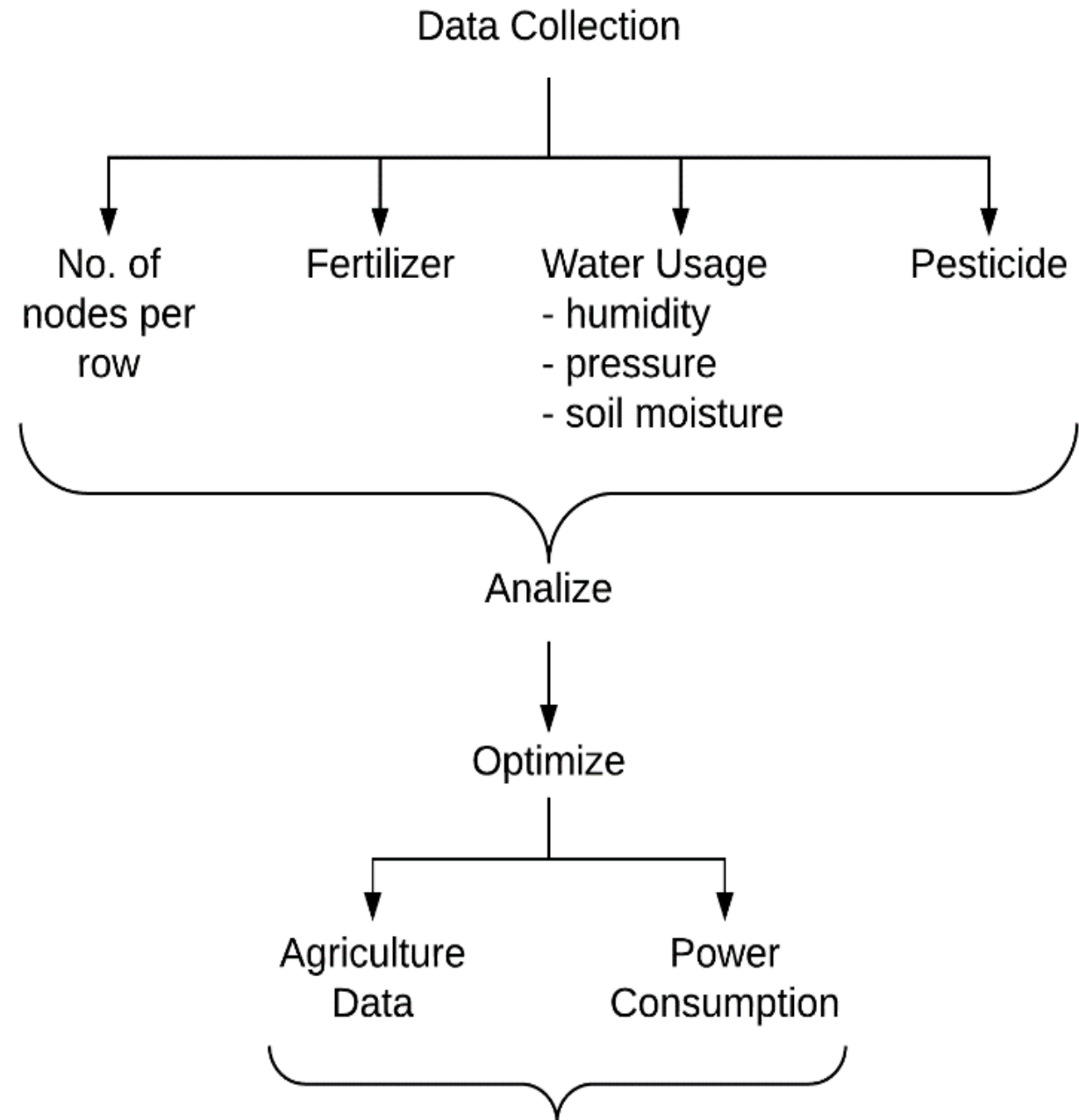
- NECTEC will implement the Target 1 and Target 2 according to the joint research project proposal.
- NECTEC will provide the basic infrastructure of the Target 1 and Target 2 (only the embedded system, not including pumps and pipes), and NECTEC will help to install them at the Brunei and Myanmar sites.

UTB
DAA
UCSY



UTM

- UTM will involve in data collection, data analytics, and optimization.

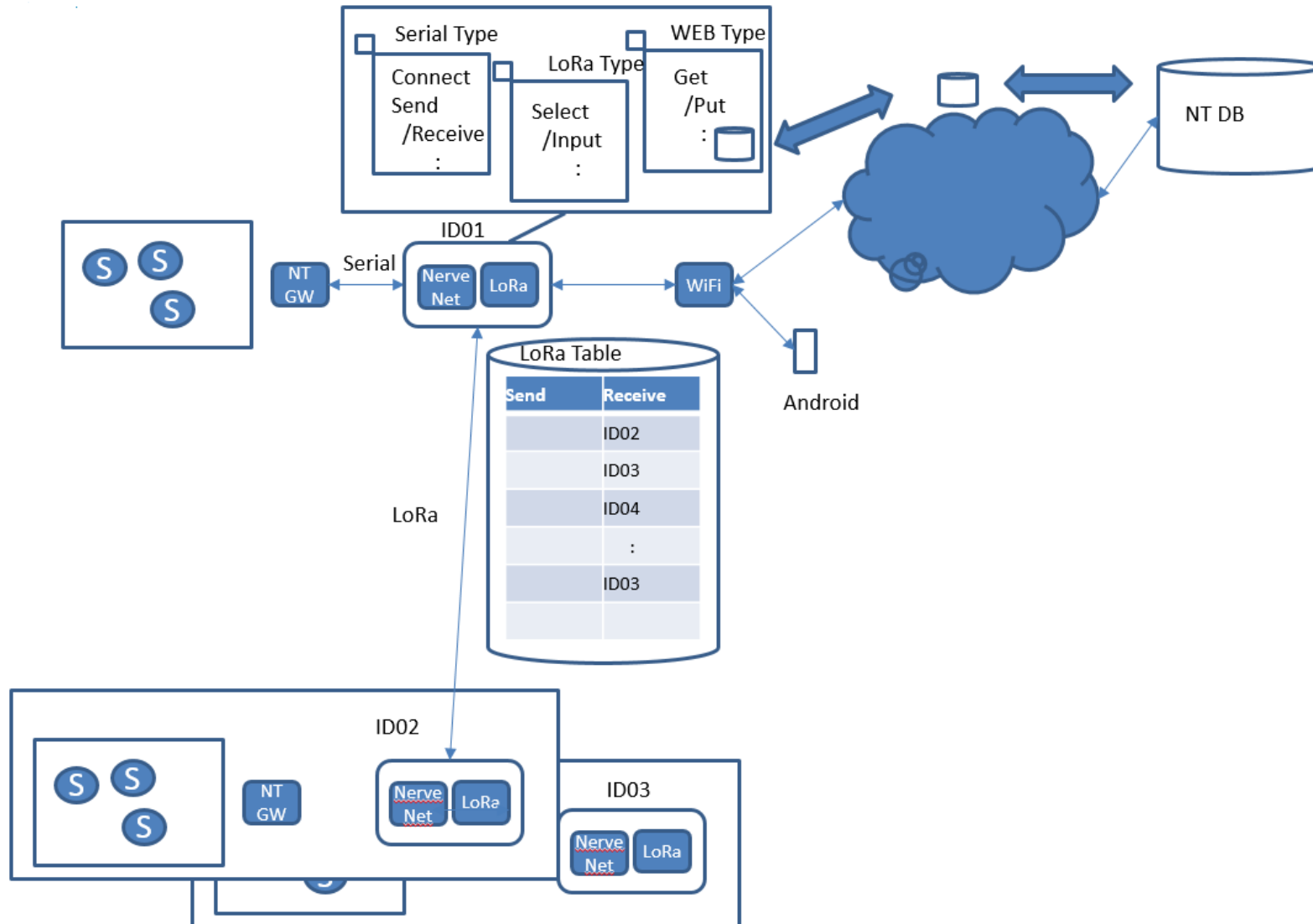


Able to predict cost overhead for farmers

Action plan

Year	Activity	Month											
		01	02	03	04	05	06	07	08	09	10	11	12
2018	NECTEC provides account to access NECTEC database.							Yellow					
	NECTEC installs pressure sensors.								Yellow				
	NECTEC-NICT technical meeting									Yellow			
	Each party collects information/requirements.							Yellow	Yellow	Yellow			
	We will submit purchase form to NICT. (End of Sep.)									Red			
	NICT internal process (after receiving the form).										Yellow	Yellow	
	UTM analyses data for the IVO Forum 2018 (ONLY).							Green	Green	Green	Green	Green	
	IVO Forum 2018 (27-28 Nov.)											Red	
	CIIS 2018 (Thanika/Seksun will attend the conference.)											Yellow	
	Special group meeting in Taiwan.												Blue
NECTEC implements/assembles HW boards.												Yellow	
2019	Meeting #2 in Brunei (hosted by UTB)		Blue										
	NECTEC installs the system at the Brunei site.		Yellow										
	Testing/Evaluation/Data collection and analysis		Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
	Meeting #3 in Myanmar (hosted by UCSY)							Blue					
2020	Meeting #4 in Malaysia (hosted by UTM)		Blue										
	Final meeting in Thailand (hosted by NECTEC)							Blue					

NECTEC-NICT technical meeting

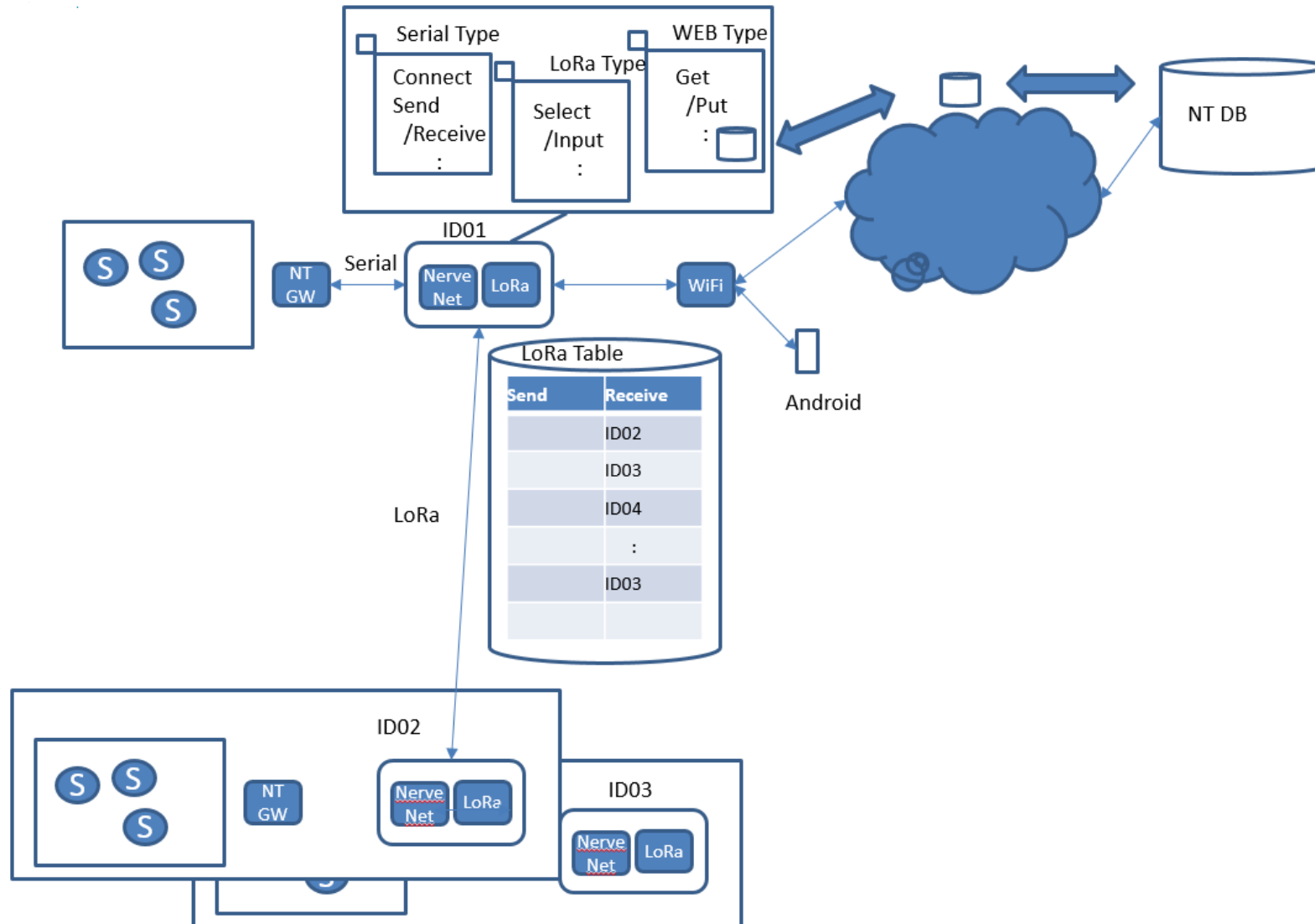


Experiment with NerveNet/LoRa

- NECTEC have got 5 NerveNet/LoRa modules from NICT.

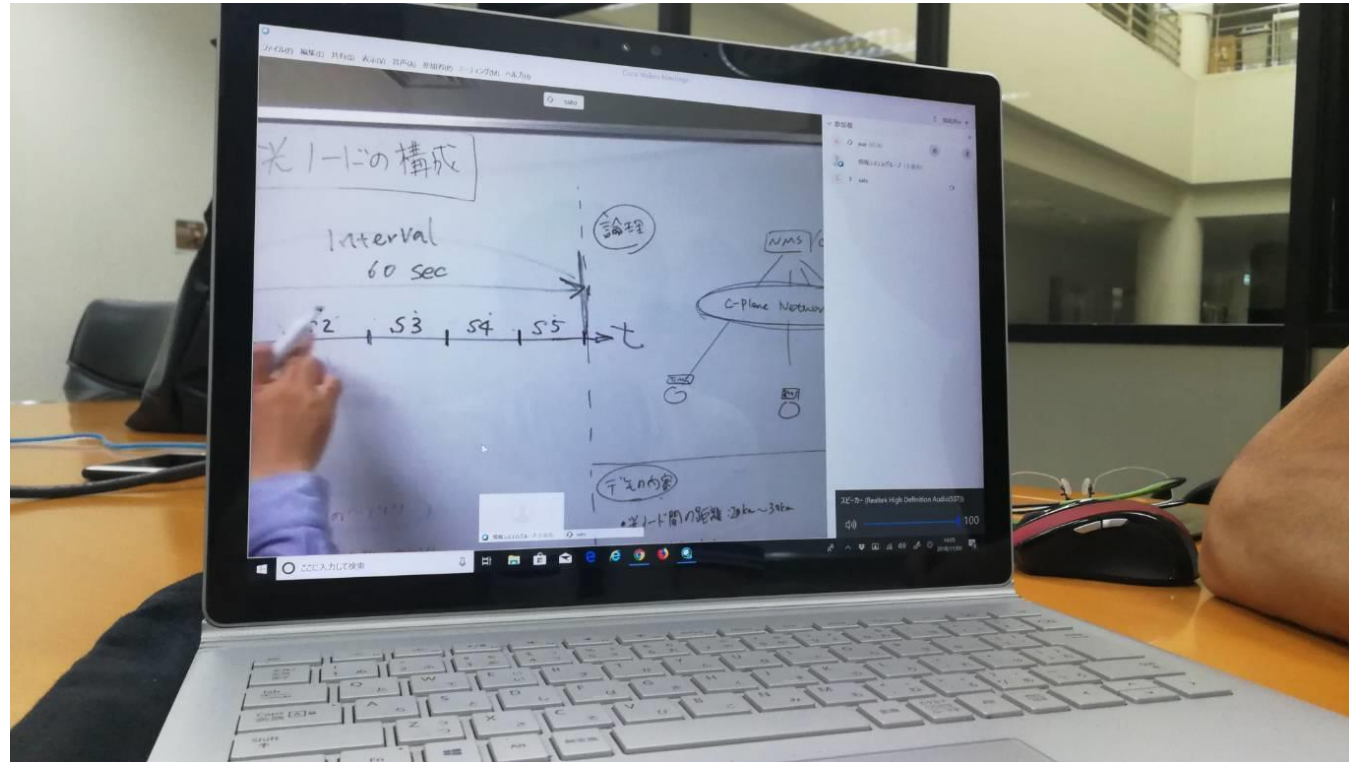


Experiment with NerveNet/LoRa



Experiment with NerveNet/LoRa

```
nict@raspberrypi: ~/NN
2018-11-06 16:52:09 from_NN 001 to everybody 61 @2018-11-06 16:51:58
.....
2018-11-06 16:53:02 from_NN 001 to everybody 62 @2018-11-06 16:52:08
..
2018-11-06 16:53:04 from_NN 001 to everybody 63 @2018-11-06 16:52:18
..
2018-11-06 16:53:05 from_NN 001 to everybody 64 @2018-11-06 16:52:28
..
2018-11-06 16:53:07 from_NN 001 to everybody 65 @2018-11-06 16:52:38
.
2018-11-06 16:53:08 from_NN 001 to everybody 66 @2018-11-06 16:52:48
.....
2018-11-06 16:54:01 from_NN 001 to everybody 68 @2018-11-06 16:53:08
.
2018-11-06 16:54:02 from_NN 001 to everybody 69 @2018-11-06 16:53:19
..
2018-11-06 16:54:04 from_NN 001 to everybody 70 @2018-11-06 16:53:29
..
2018-11-06 16:54:06 from_NN 001 to everybody 71 @2018-11-06 16:53:39
2018-11-06 16:54:07 from_NN 001 to everybody 72 @2018-11-06 16:53:49
..
2018-11-06 16:54:09 from_NN 001 to everybody 73 @2018-11-06 16:53:59
.....
```



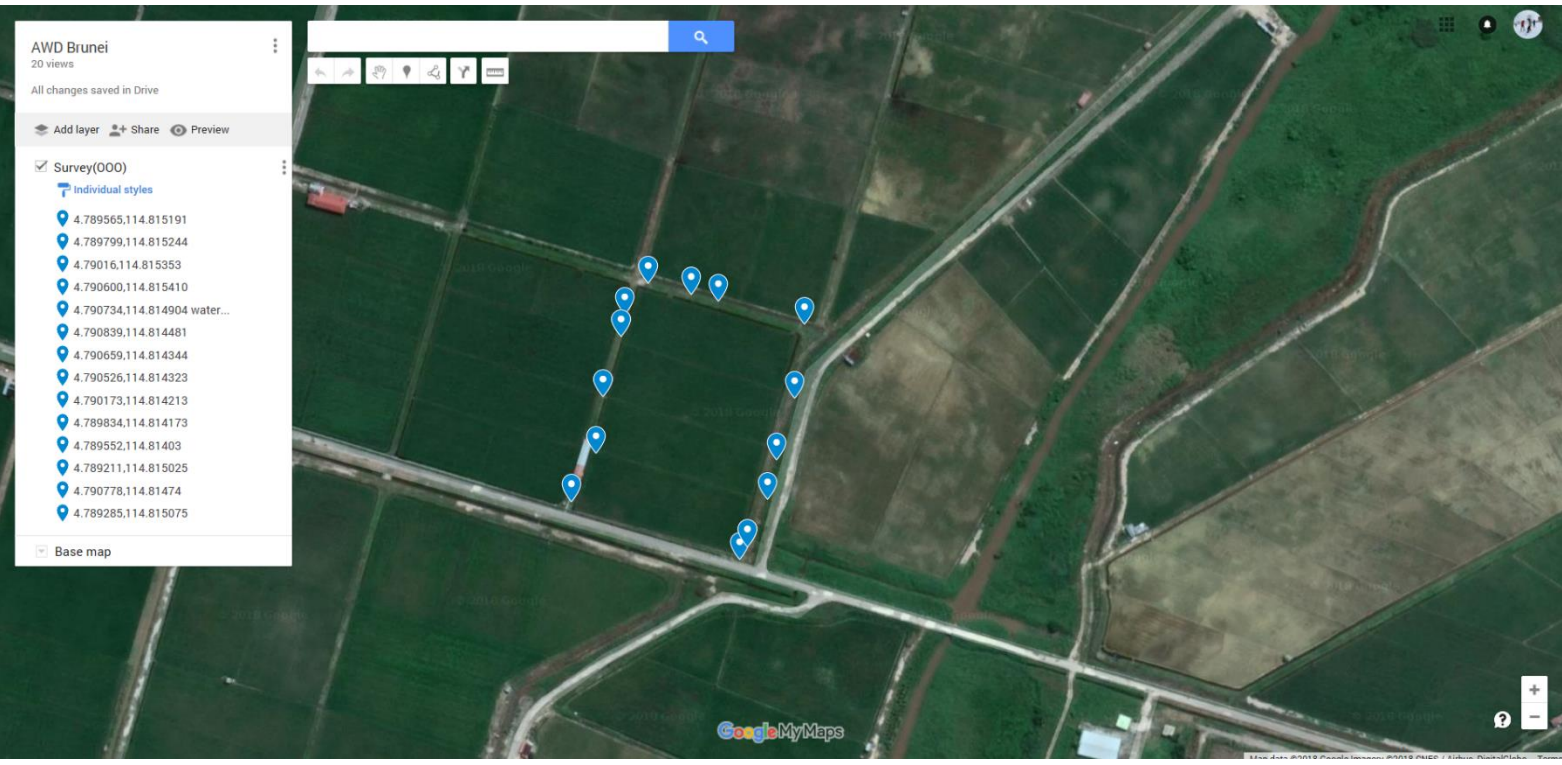
Visiting Brunei's site

Year	Activity	Month											
		01	02	03	04	05	06	07	08	09	10	11	12
2018	NECTEC provides account to access NECTEC database.							Yellow					
	NECTEC installs pressure sensors.								Yellow				
	NECTEC-NICT technical meeting									Yellow			
	Each party collects information/requirements.							Yellow	Yellow	Yellow			
	We will submit purchase form to NICT. (End of Sep.)									Red			
	NICT internal process (after receiving the form).										Yellow	Yellow	
	UTM analyses data for the IVO Forum 2018 (ONLY).							Green	Green	Green	Green	Green	
	IVO Forum 2018 (27-28 Nov.)											Red	
	CIIS 2018 (Thanika/Seksun will attend the conference.)											Yellow	
	Special group meeting in Taiwan.												Blue
NECTEC implements/assembles HW boards.												Yellow	
2019	Meeting #2 in Brunei (hosted by UTB)		Blue										
	NECTEC installs the system at the Brunei site.		Yellow										
	Testing/Evaluation/Data collection and analysis		Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
	Meeting #3 in Myanmar (hosted by UCSY)							Blue					
2020	Meeting #4 in Malaysia (hosted by UTM)		Blue										
	Final meeting in Thailand (hosted by NECTEC)							Blue					

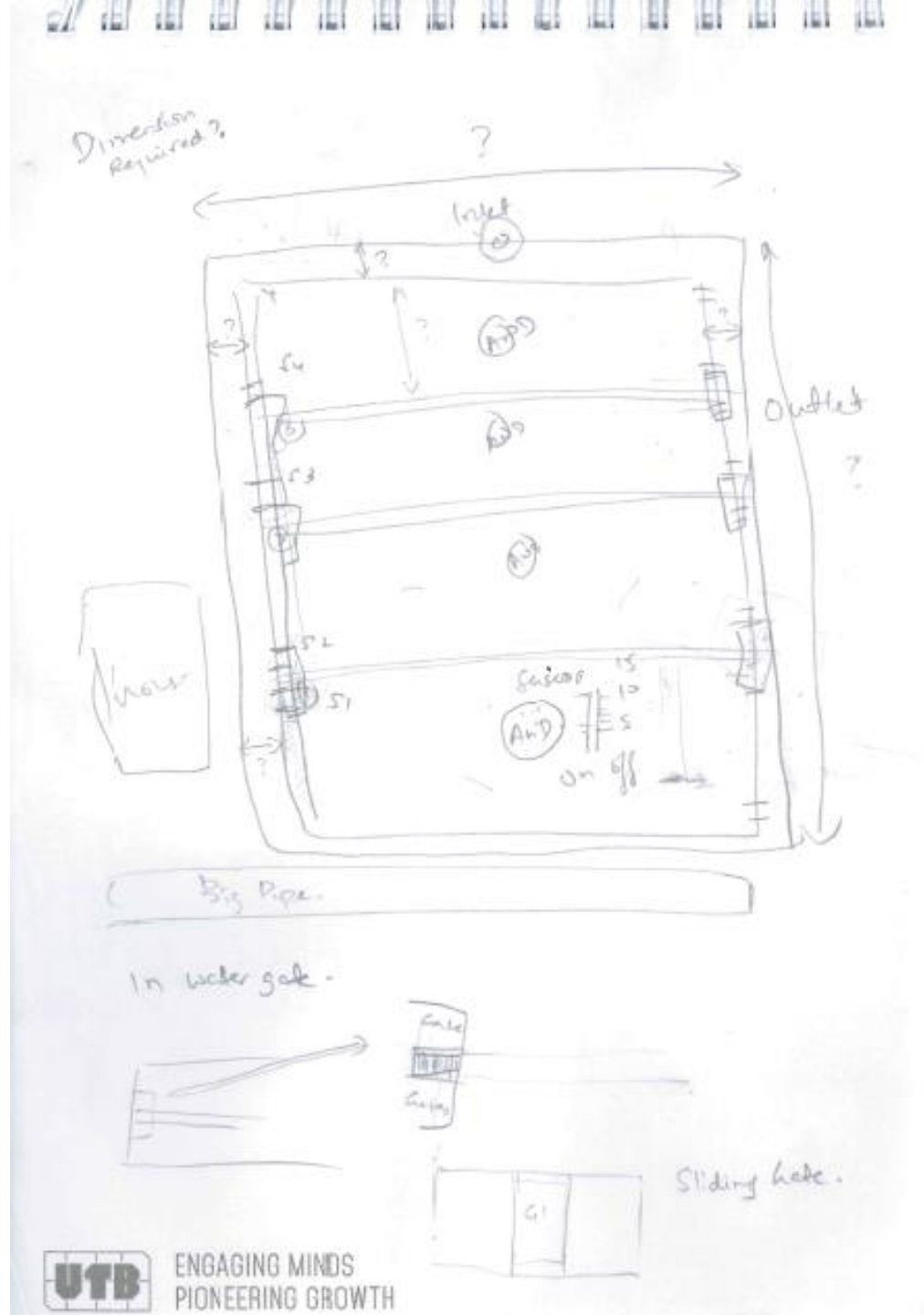
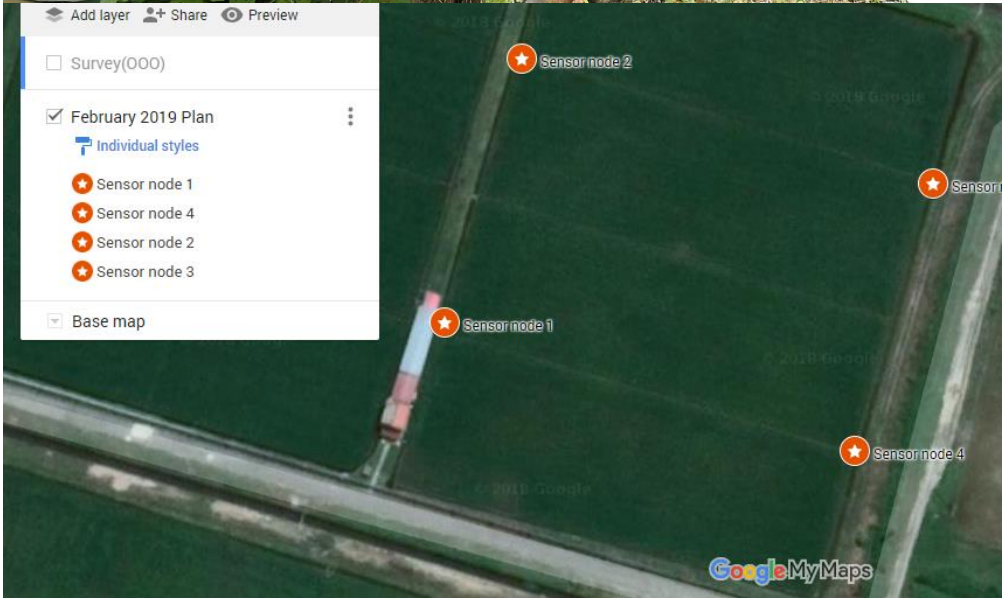
Visiting Brunei's site



Visiting Brunei's site



Visiting Brunei's site



Budget

- 3-year financial support: 116,000 USD.
 - 36,000 USD (2018)
 - 40,000 USD (2019)
 - 40,000 USD (2020)

- 2018
 - Kick-off meeting 12,576.25 USD
 - Brunei trip (NOV 18) 421 USD (47,500 JPY)

Thank you!