ASEAN IVO

ICT Virtual Organization of ASEAN institutes and NICT

NAPC: Networked ASEAN Peat Swamp Forest Communities

ASEAN IVO Project Review and Progress Report

National Institute of Information and Communications Technology

UPM UNIVERSITI PUTRA MALAYSIA

MIMOS BERHAD

Prof. Ir. Dr. Aduwati Sali (UPM)

ASEAN IVO Project Review 2021

Project Overview

- Project Title:
  - NAPC: Networked ASEAN Peat Swamp Forest Communities
- Project Fund:
  - ICT Virtual Organization of ASEAN Institutes and NICT (ASEAN IVO)
- Project Members:
  - Wireless and Photonic Network Research Centre (WiPNET), UPM Malaysia
  - Institute of Tropical Forestry and Forest Products (INTROP), UPM Malaysia
  - MIMOS Berhad, Malaysia
  - School of Computing and Informatics, Universiti Teknologi Brunei (UTB), Brunei
  - Faculty of Forestry, Bogor Agricultural University, Indonesia
  - NICT Asia Center, Chulalongkorn University, Thailand
  - Badan Pengkajian dan Penerapan Teknologi (BPPT), Indonesia
- Project Duration: July 2018 – June 2021 (3 years)
- Project Amount: USD76,000

What's the Story?

1

Transboundary haze - How can we improve and complement the existing peatland management?

2

How can we promote cost-effective IoT system?

3

How can we ensure the peatland forest is covered?

4

What are we going to do with the peatland data?

Peatland in ASEAN – before NAPC

Red skies in Jambi caused by haze filtering out sunlight

ASEAN+

Monday, 23 Sep 2019

9:29 AM MYT

JAMBI: The skies turned red here on Sunday (Sept 22) due to the haze, caused by widespread forest fires, that has risen to the upper levels of the atmosphere, reports *Sinar Harian*.

The Malay daily reported that Indonesia National Board for Disaster Management information chief Agus Wibowo Soet had explained that the phenomenon, which was also known as "Rayleigh Scattering", was caused by the movement of haze away from hotspots.

Indonesian astronomer Marufin Sudibyo also explained that the skies did not turn red because of a sudden increase in temperatures.

"Rayleigh Scattering happens when sunlight is dispersed by smoke, dust or airborne particles that filter shorter wavelengths and release longer wavelengths that are in the orange or red spectrum, making the area appear to be dim and red," he said.

Marufin also told Sinar Harian that in the Jambi situation, the density of the micro- and nano-particles in the air was large enough to make it much more dense than the normal atmosphere.

However, he stressed that the phenomenon did not have any adverse effects on human vision.

Haze: Still no respite for Malaysians

NATION

Monday, 23 Sep 2019

PETALING JAYA: There is no respite for Malaysians from the haze, as many areas are recording polluted air levels or are at the brink of breaching the "unhealthy" mark.

This is despite forecast that the haze may lift soon.

The geographical scope of the haze has widened, with more parts of the country experiencing polluted air.

As of 5pm yesterday, the number of areas with high API readings across the country rose to 45.

This was a stark contrast to only 18 areas which were classified as having unhealthy or very unhealthy API levels at 5pm on Saturday.

Very unhealthy air quality levels were recorded at Johan Setia in Klang (208) at 5pm yesterday, while Sri Aman peaked at 205.

NEWS NATIONAL

To blunt impact of forest fires, Brunei to introduce new law to tackle open burning

Incidents of open burning recorded daily in past year

Wardi Wasil

© AUGUST 5, 2019

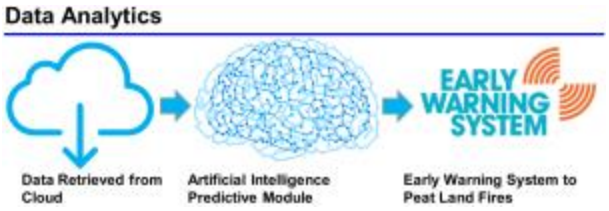
Firefighters extinguish fire on peat land forest in Central Kalimantan during Indonesia's worst bout of haze in 2015. The fires were lit by companies clearing vast tracts of land for plantations. Photo: Romeo Gacad/AFP

SHARE TWEET SUBMIT

BANDAR SERI BEGAWAN – Brunei is set to introduce a law that will tackle "rampant" open burning in an effort to mitigate bush and forest fires.

NAPC Project Overview

- Deploy **IoT-based solution for peat swamp forest monitoring** with the communities
- **Technological innovation**: to deploy, analyse and disseminate information using an IoT-based peat swamp forest monitoring system
- **Social innovation**: to conduct social programs for peat swamp forest communities such as educational and entrepreneurship events related to the peat swamp forest



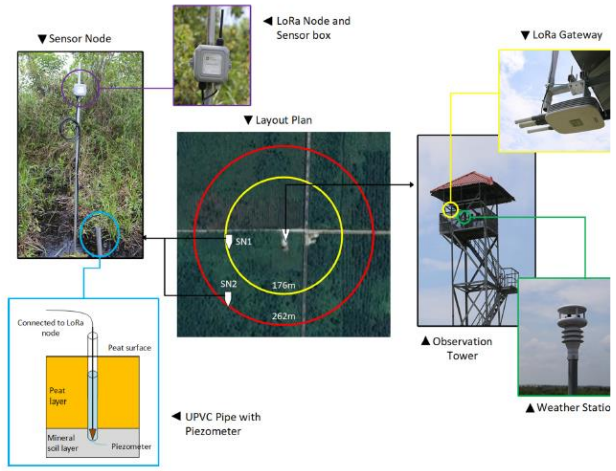
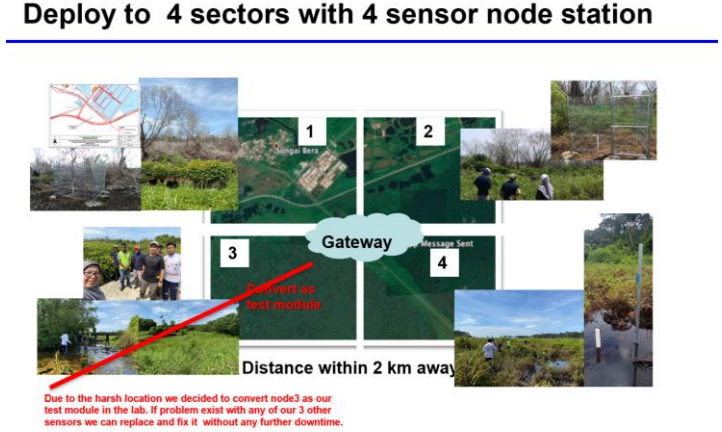
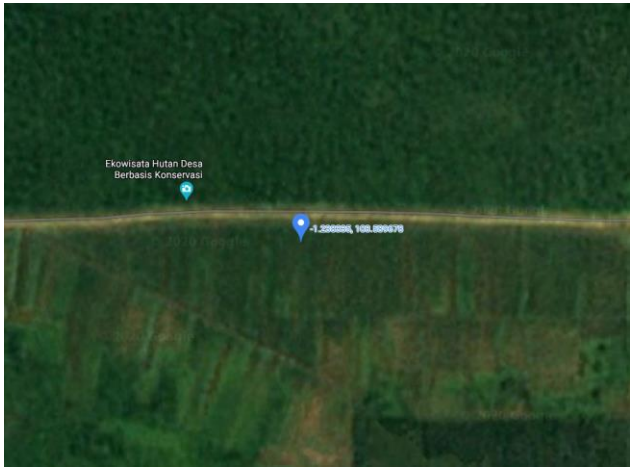


Fig. 1. Overall layout plan of the deployed IoT system, with each component hig

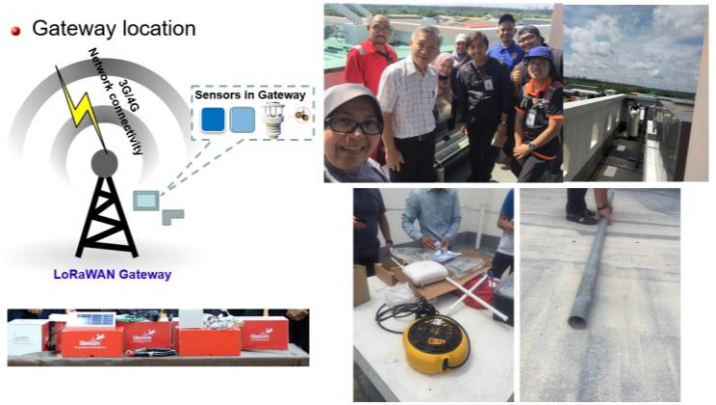


Jambi Indonesia



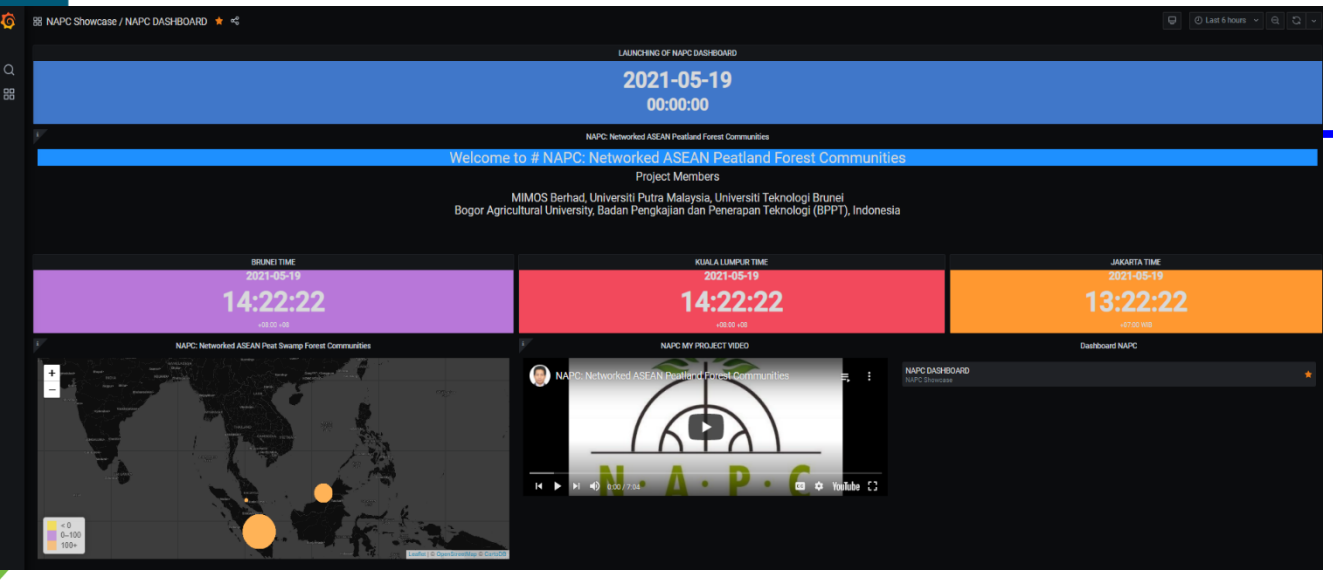
RMFR Malaysia

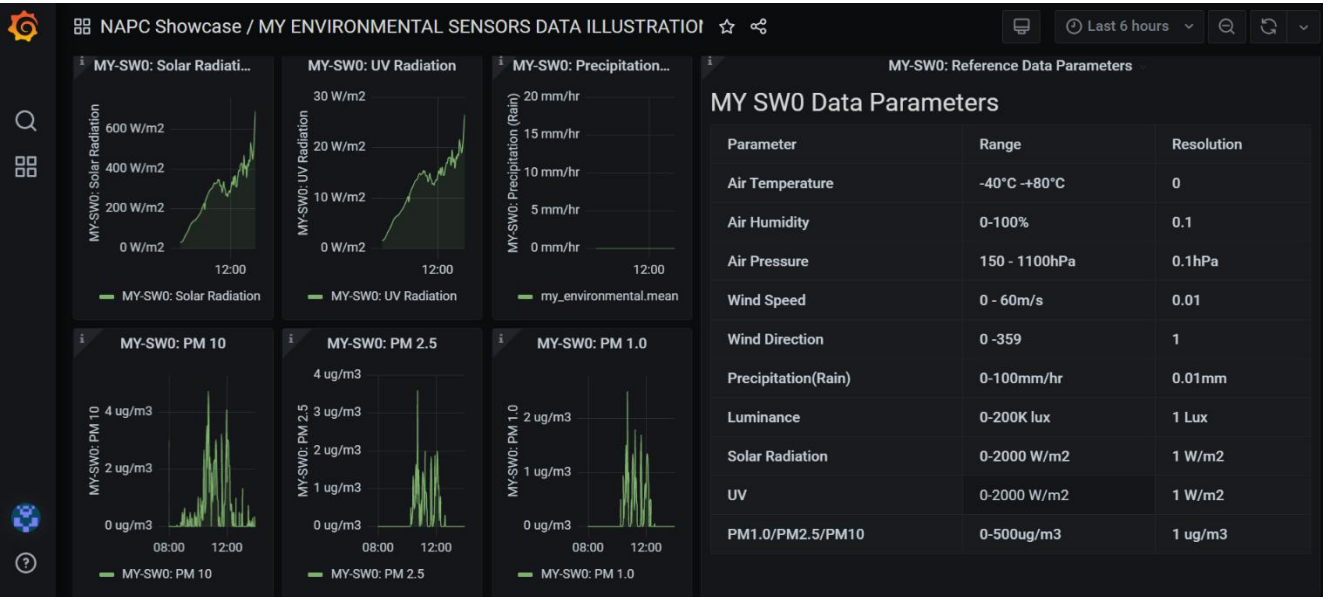
Badas Brunei

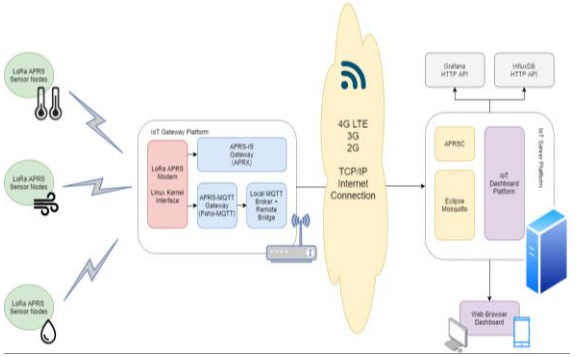


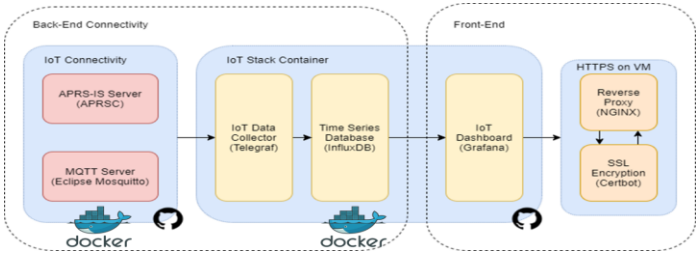
Project Activity
IoT System Deployment

Project Activity
NAPC Dashboard









Project Activity
NAPC Workshops

1

Indonesia
19 – 20 Jan 2021

2

Brunei
4 March 2021

3

Malaysia
23 – 25 March 2021

R&D Results
LoRA Optimisation for Peatland Monitoring

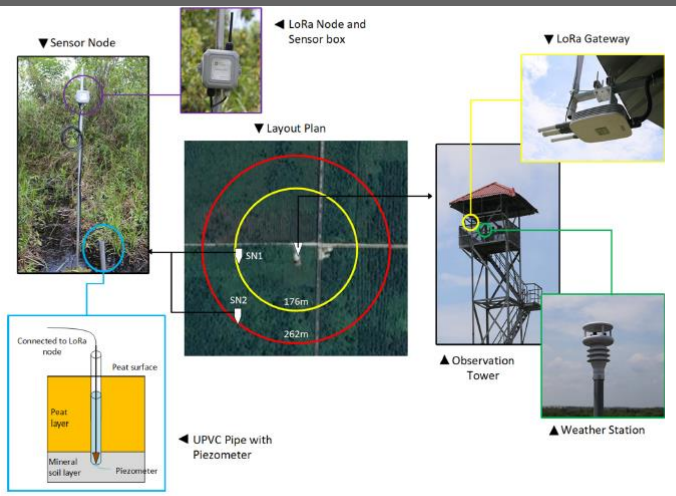
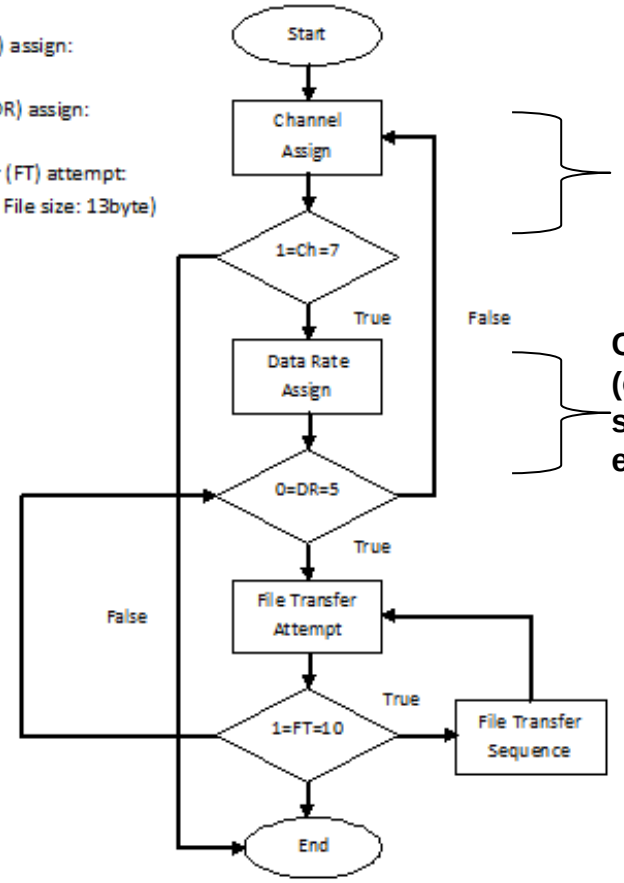


Fig. 1. Overall layout plan of the deployed IoT system, with each component highlig

*Remarks

1. Channel (Ch) assign: Ch1 – Ch7
2. Data Rate (DR) assign: DR0 – DR5
3. File Transfer (FT) attempt: FT1 – FT10 (File size: 13byte)



Configure LoRa channel (meet MCMC transmission guideline)

Configure LoRa Data Rate (optimize transmission success rate in various environment)

Configure Data Transfer (Strategize and optimize transmission efficiency)

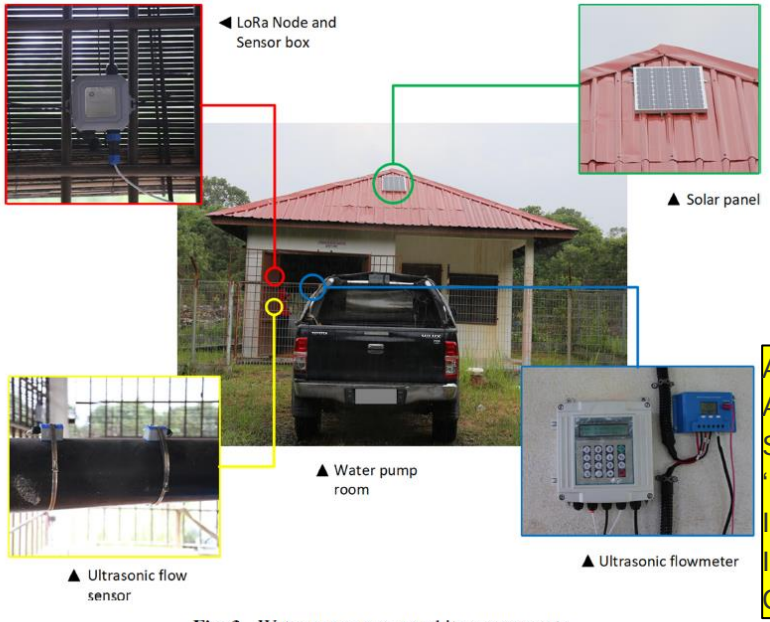


Fig. 3. Water pump room and its components.

Aduwati Sali, Azizi Mohd Ali, Borhanuddin Mohd Ali, Sharifah Mumtazah Syed Ahmad Abdul Rahman, Jiun Terng Liew, Nur Luqman Saleh, Ahmad Ainuddin Nuruddin, Sheriza Mohd Razali, Ibtisam G. Nsaif, Nordin Ramli, Hafizal Mohamad, Naomi Terada, 'Peatlands Monitoring in Malaysia with IoT Systems: Preliminary Experimental Results'. In: Suhaili W.S.H., Siau N.Z., Omar S., Phon-Amuaisuk S. (eds) Computational Intelligence in Information Systems. CIIS 2021. Advances in Intelligent Systems and Computing, vol 1321. Springer, Cham. https://doi.org/10.1007/978-3-030-68133-3_23

R&D Results
Machine Learning (ML) in Peatland Management

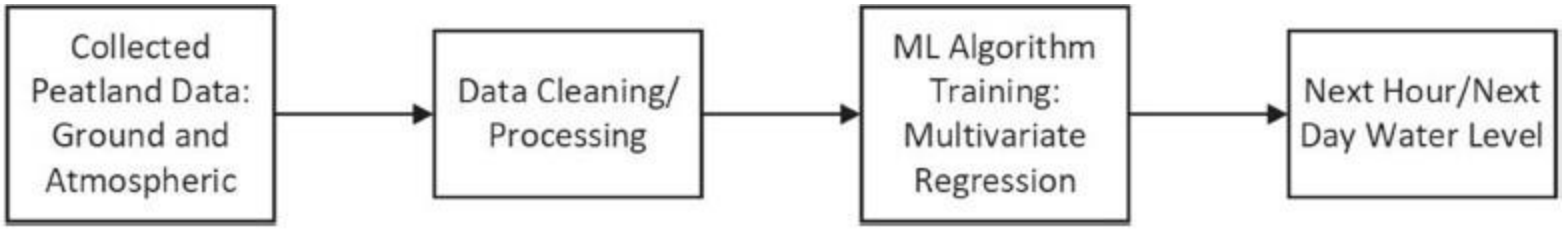


Fig. 4. Complete procedure of ML in proposed peatland management.

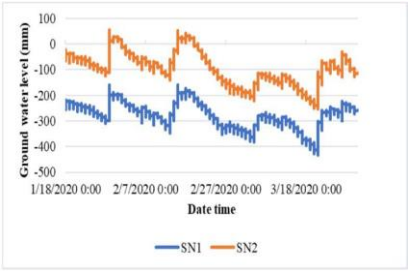


Fig. 5. GWL recorded by ground sensor nodes.

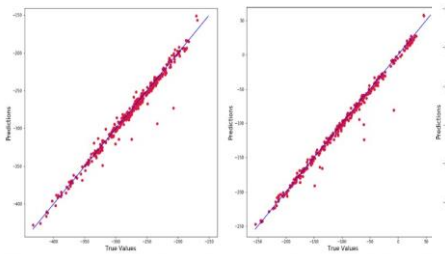


Fig. 6. Performance of ML model in predicting next hour GWL, left for SN1, right for SN2

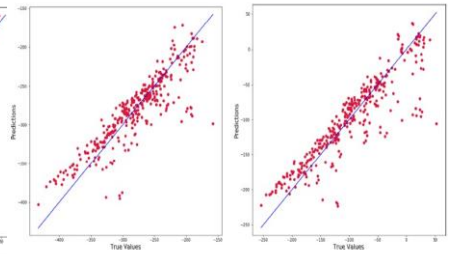
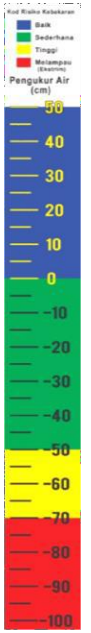


Fig. 7. Performance of ML model in predicting next day GWL, left for SN1, right for SN2.

Table 1. Fire risk codes from GEC.

Water table depth range (mm)	Colour code	Fire risk
500 to 0	Blue	Low
−500 to 0	Green	Medium
−500 to −700	Yellow	High
−700 to −1000	Red	Extreme



Jiun Terng Liew, Aduwati Sali, Nor Kamariah Noordin, Borhanuddin Mohd. Ali, Fazirulhisyam Hashim, et al.. Sustainable Peatland Management with IoT and Data Analytics. *22nd IFIP WG 5.5 Working Conference on VIRTUAL ENTERPRISES, PRO-VE 2021*, Nov 2021, Saint-Etienne, France. 10p. ⟨emse-03346490⟩

Ground Water Level (GWL) RMSE (next hour): 7.4407

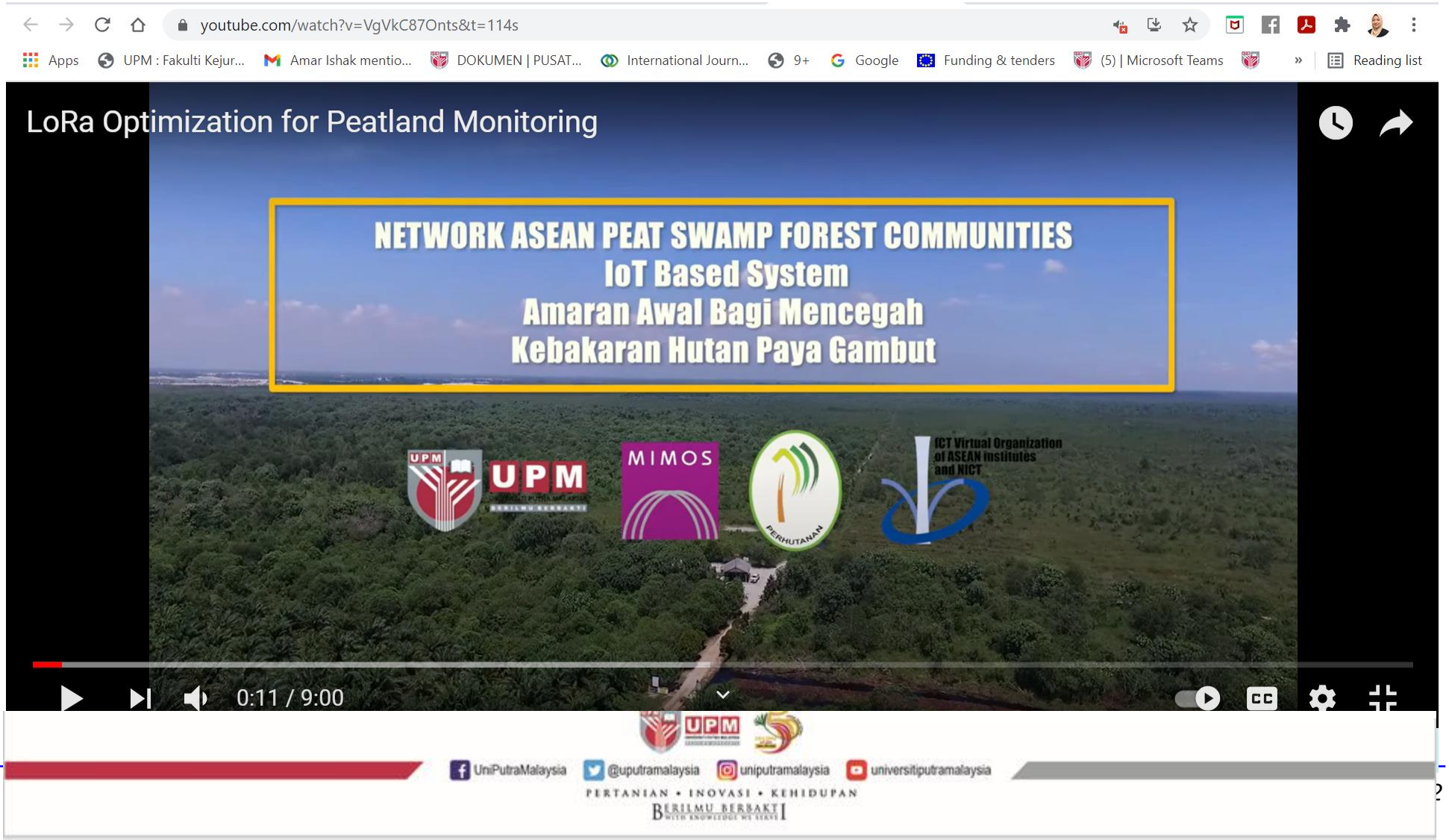
Ground Water Level (GWL) RMSE (next day – 24-hour): 27.4672

Scientific Contribution

- Publications:
  - Aduwati Sali, Azizi Mohd Ali, Borhanuddin Mohd Ali, Sharifah Mumtazah Syed Ahmad Abdul Rahman, Jiun Terng Liew, Nur Luqman Saleh, Ahmad Ainuddin Nuruddin, Sheriza Mohd Razali, Nordin Ramli, Hafizal Mohamad, Naomi Terada, 'Radio Frequency LoRa Measurement Campaign at Different Land Use Area in Peat Swamp Forest of Peninsular Malaysia', IEEE Access, Nov 2021
  - Aduwati Sali, Azizi Mohd Ali, Borhanuddin Mohd Ali, Sharifah Mumtazah Syed Ahmad Abdul Rahman, Jiun Terng Liew, Nur Luqman Saleh, Ahmad Ainuddin Nuruddin, Sheriza Mohd Razali, Nordin Ramli, Hafizal Mohamad, Naomi Terada, 'Neural Network for Peatland Ground Water Level (GWL) Prediction in IoT System, IEEE Access, Nov 2021
  - Aduwati Sali, Azizi Mohd Ali, Borhanuddin Mohd Ali, Sharifah Mumtazah Syed Ahmad Abdul Rahman, Jiun Terng Liew, Nur Luqman Saleh, Ahmad Ainuddin Nuruddin, Sheriza Mohd Razali, Ibtisam G. Nsaif, Nordin Ramli, Hafizal Mohamad, Naomi Terada, 'Peatlands Monitoring in Malaysia with IoT Systems: Preliminary Experimental Results'. In: Suhaili W.S.H., Siau N.Z., Omar S., Phon-Amuaisuk S. (eds) Computational Intelligence in Information Systems. CIIS 2021. Advances in Intelligent Systems and Computing, vol 1321. Springer, Cham. https://doi.org/10.1007/978-3-030-68133-3_23
  - Jiun Terng Liew, Aduwati Sali, Nor Kamariah Noordin, Borhanuddin Mohd. Ali, Fazirulhisyam Hashim, et al.. Sustainable Peatland Management with IoT and Data Analytics. 22nd IFIP WG 5.5 Working Conference on VIRTUAL ENTERPRISES, PRO-VE 2021, Nov 2021, Saint-Etienne, France. 10p. ⟨emse-03346490⟩
- Intellectual Property:
  - Copyright, LoRa Optimisation for Peatland Monitoring
  - Copyright, IoT-based Peatland Monitoring with Data Analytics

Promotional Video

https://www.youtube.com/watch?v=VgVkC87Onts&t=114s



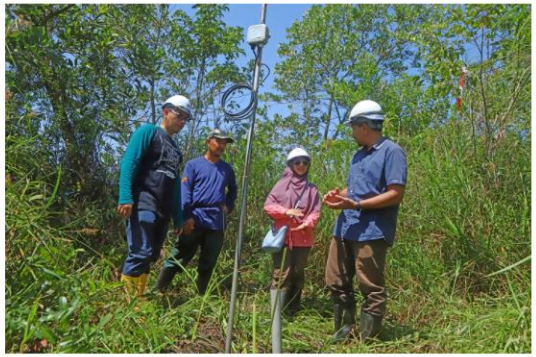
Awards and Recognitions

Project Promotion and Media Coverage

UPM, Mimos partner to develop IoT-based early warning system to curb peat fires

By Digital News Asia August 18, 2020

- During impending heatwave, peat forests are susceptible to fire
- New IoT system uses sensors to make monitoring of peat conditions easier



Well, it seems that on top of a global pandemic, Malaysians will now have to hunker down for a period of heat and dryness. The Malaysian Meteorological Department had recently predicted that the country will experience a dry spell caused by the Southwest Monsoon season, which is expected to continue until mid-September.

Rencana

Media Permata

FINALIS BRUNEI KONGSI PENYELIDIKAN CEGAH KEBAKARAN TANAH GAMBUT

Borneo Bulletin THURSDAY, MAY 21, 2020 13

Lifestyle

Kumail Nanjiani is finding his way through 'The Weirds' Page 16

File photo of peatland in Kalimantan

Fighting peat fires with technology

An interview with Assistant Professor at the Universiti Teknologi Brunei Dr Wida Susanty binti Haji Suhaili, who recently became the national finalist for Brunei in the 2020 ASEAN-US Science Prize for Women.

Continue to Page 14

14 | Lifestyle THURSDAY, MAY 21, 2020 Borneo Bulletin

Fighting peat fires with technology

Sensor cegah kebakaran tanah gambut

Oleh INTAN SHAMIA CHE OMAR

KEBAKARAN tanah gambut amat mudah berlaku ketika musim kemarau sehingga sukar dikawal. Hanya dengan sepintung rokok yang dibuang di dalam kawasan berkenaan boleh menyebabkan kebakaran yang sukar dikawal.

Projek IoT ini membantu kerajaan untuk memberi amaran kepada kejadian jerebu yang akhirnya akan mengakibatkan kesihatan serta kesejahteraan masyarakat.

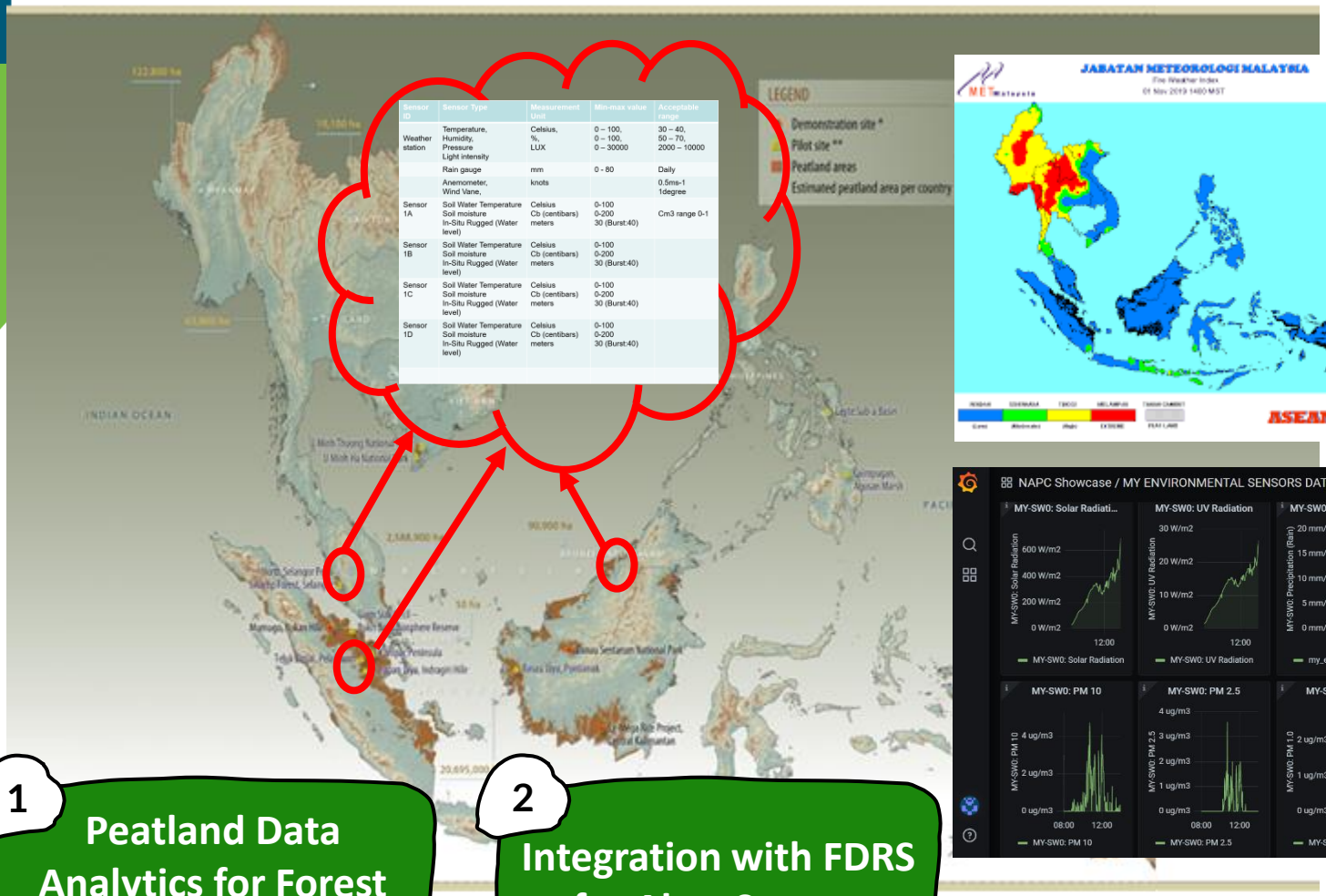
Pelbagai usaha telah dilaksanakan oleh pihak berkuasa untuk mengatasi permasalahan berkenaan seperti penanaman semula pokok serta penamatan secara berkala bagi mencegah sebarang elemen yang boleh membawa kepada kebakaran hutan.

Memandangkan lagi kaedah tersebut, Universiti Putra Malaysia (UPM) menghasilkan inovasi terkini bagi mengesan kebakaran tanah gambut dan suhu tanah paya gambut.

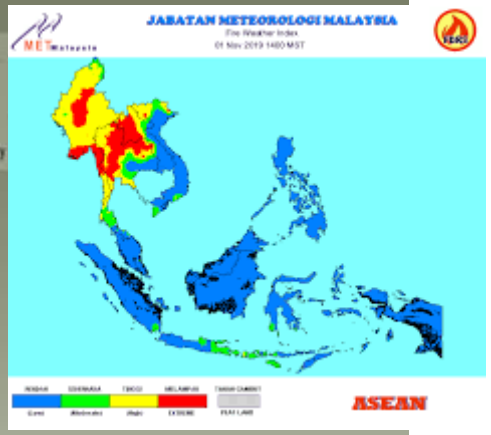
Kumpul data tiga negara

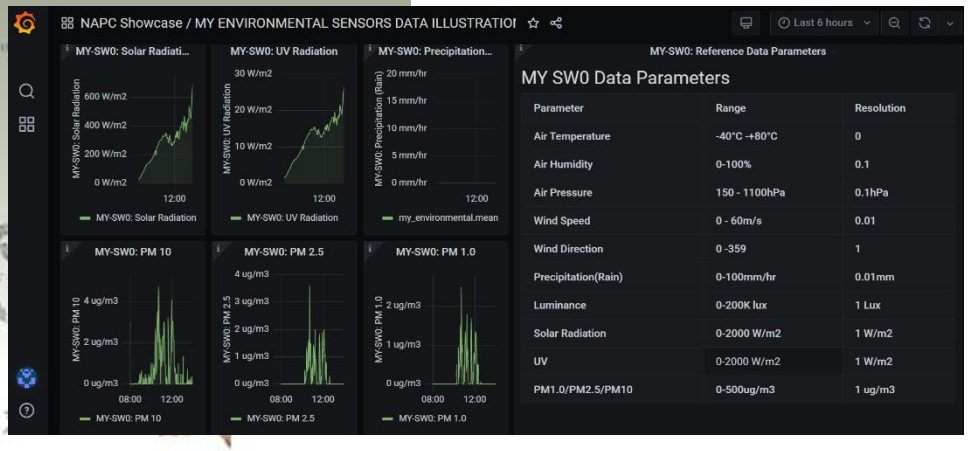
IoT atasi kebakaran tanah gambut

Future Work



Sensor ID	Sensor Type	Measurement Unit	Min-max value	Acceptable range
Weather station	Temperature, Humidity, Pressure Light intensity	Celsius, %, LUX	0 – 100, 0 – 100, 0 – 30000	30 – 40, 50 – 70, 2000 – 10000
	Rain gauge	mm	0 - 80	Daily
	Anemometer, Wind Vane,	knots		0.5ms-1 1degree
Sensor 1A	Soil Water Temperature Soil moisture In-Situ Rugged (Water level)	Celsius Cb (centibars) meters	0-100 0-200 30 (Burst:40)	Cm3 range 0-1
Sensor 1B	Soil Water Temperature Soil moisture In-Situ Rugged (Water level)	Celsius Cb (centibars) meters	0-100 0-200 30 (Burst:40)	
Sensor 1C	Soil Water Temperature Soil moisture In-Situ Rugged (Water level)	Celsius Cb (centibars) meters	0-100 0-200 30 (Burst:40)	
Sensor 1D	Soil Water Temperature Soil moisture In-Situ Rugged (Water level)	Celsius Cb (centibars) meters	0-100 0-200 30 (Burst:40)	





Parameter	Range	Resolution
Air Temperature	-40°C ~+80°C	0
Air Humidity	0-100%	0.1
Air Pressure	150 - 1100hPa	0.1hPa
Wind Speed	0 - 60m/s	0.01
Wind Direction	0 -359	1
Precipitation(Rain)	0-100mm/hr	0.01mm
Luminance	0-200K lux	1 Lux
Solar Radiation	0-2000 W/m2	1 W/m2
UV	0-2000 W/m2	1 W/m2
PM1.0/PM2.5/PM10	0-500ug/m3	1 ug/m3

1. **Peatland Data Analytics for Forest Fire Estimation**
2. **Integration with FDRS for Alert System**

National Institute of Information and Communications Technology

Thank you!

Prof. Ir. Dr. Aduwati Sali
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Faculty of Engineering, UPM.

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