[PROJECT TITLE: An Energy Efficient, Self-Sustainable, and Long Range IoT System for Drought Monitoring and Early Warning]
[OPEN WORKSHOP: Convergence Platform for IoT Based Smart Monitoring Systems]

Report Form

I. Organizer:

Name:	Hoang Van Phuc
Position:	Associate Professor
Institution:	Le Quy Don Technical University, Hanoi, Vietnam

II. Program:

Date: 22-23, December 2021

Venue: Convention Center, No. 236 Hoang Quoc Viet Str., Hanoi, Vietnam.

Program Agenda:

Date	December 22nd, 2021	
Time	**Agenda**	**Speaker**
9:00 AM	Welcoming	Prof. Tran Xuan Nam, LQDTU
9:15 AM	The project achievement and implementation plan: Toward an intelligent IoT platform for drought monitoring systems	Prof. Hoang Van Phuc, LQDTU
10:00 AM	**Tea break**	
10:15 AM	Invited talk 1: Human-Ring-Shaped Wi-Fi Energy Harvester for IoT Devices	Dr. Le Minh Thuy and Mr. Dinh Quang Minh (Hanoi University of Science and Technology, Vietnam)
11:15 AM	On-chip multi-beat sensors for environment monitoring	Dr. Nguyen Van Trung (LQDTU, Vietnam)
12:00 PM	Lunch	
1:30 PM	Deep Learning Based Lightweight Intrusion Detection for IoT systems	Dr. Dao Thi Nga (LQDTU, Vietnam)
2:30 PM	Invited talk 2: Real-Time Field Monitoring Using IoT-Based Sensors and Unmanned Aerial Vehicles	Dr. Pham Minh Trien, VNU, Hanoi
3:30 PM	**Tea break**	
3:45 PM	Hybrid PV and RF EH Power Supply for IoT systems	Prof. Koichiro Ishibashi and Shuntaro Saku (Uni. of Electro-Communications, Tokyo, Japan)

4:45 PM	Novel SOI FET Diode for RF Energy Harvesting with Updated Results	Prof. Jiro Ida (Kanazawa Institute of Technology, Japan)
6:00 PM	**Dinner**	
Date	**December 23rd, 2021**	
Time	**Agenda**	**Speaker**
9:00 AM	Phase Impairment Estimation for mmWave MIMO Systems	Dr. Truong Trung Kien (Fulbright University Vietnam)
9:30 AM	Invited talk 3: Evaluation of Accelerometer Data in Activity Classification for Environment Monitoring	Prof. Tran Duc Tan (Phenikaa University, Vietnam)
10:15 AM	**Tea break**	
10:30 AM	Efficient RF Energy Harvesting for Sustainable IoT Systems	Dr. Luong Duy Manh (LQDTU, Vietnam)
11:00 AM	Short training on deep learning techniques for IoT systems. Training method: Lecture and simulation on MATLAB software.	Trainer: Dr. Doan Van Sang (LQDTU, Vietnam); Trainees: Members of IVO project and officers of NAWAPI
12:00 AM	**Lunch**	
1:30 PM	Defeating Jamming Using Outage Performance Aware Joint Power Allocation and Access Point Placement in Uplink Pairwise NOMA	Dao Van Lan (Madarlanen University, Sweden)
2:30 PM	PUF Design for IoT Device Authentication	Dr. Trinh Quang Kien (LQDTU, Vietnam)
3:30 PM	**Tea break**	
3:45 PM	An IoT Gateway for Smart Environment Monitoring	Dr. Le Thanh Bang (LQDTU, Vietnam)
4:45 PM	Discussion and follow-up plan	Chair: Prof. Hoang Van Phuc, LQDTU
5:00 PM	Closing	Prof. Hoang Van Phuc, LQDTU

III. Participants:

No.	Name	Organization	Itinerary
1	Hoang Van Phuc	LQDTU	21-24, December 2021
2	Tran Xuan Nam	LQDTU	21-24, December 2021
3	Nguyen Van Trung	LQDTU	21-24, December 2021
4	Nguyen Thuy Linh	LQDTU	21-24, December 2021
5	Trinh Quang Kien	LQDTU	21-24, December 2021
6	Luong Duy Manh	LQDTU	21-24, December 2021
7	Le Thanh Bang	LQDTU	21-24, December 2021
8	Dao Thanh Toan	UTC, Hanoi	21-24, December 2021

9	Bui Du Duong	NAWAPI, Hanoi	21-24, December 2021
10	Tran Duc Tan	Phenikaa Uni., Hanoi	21-24, December 2021
11	Tran Duc Nghia	VAST, Hanoi	21-24, December 2021
12	Le Minh Thuy	HUST, Hanoi	21-24, December 2021
13	Nguyen Thu Thuy	NAWAPI, Hanoi	21-24, December 2021
14	Nguyen Viet Ha	NAWAPI, Hanoi	21-24, December 2021
15	Pham Van Phu	NAWAPI, Hanoi	21-24, December 2021
16	Tran Van Thang	NAWAPI, Hanoi	21-24, December 2021
17	Do Van Phuong	NAWAPI, Hanoi	21-24, December 2021
18	Nguyen Thi Hoai	NAWAPI, Hanoi	21-24, December 2021
19	Pham Minh Trien	VNU, Hanoi	21-24, December 2021
20	Tran Xuan Tu	VNU, Hanoi	21-24, December 2021
21	Bui Duy Hieu	VNU, Hanoi	21-24, December 2021
22	Tran Duc Manh	VNU, Hanoi	21-24, December 2021
23	Pham Thi Huyen	UTC, Hanoi	21-24, December 2021
24	Nguyen Huu Thang	VNPT Technology	21-24, December 2021
25	Bui Van Viet	ASIC Technologies	21-24, December 2021
26	Hoang Dinh Dung	ASIC Technologies	21-24, December 2021
27	Dao Thi Nga	LQDTU	21-24, December 2021
28	Doan Van Sang	LQDTU	21-24, December 2021
29	Truong Trung Kien	FUV (Project member)	21-24, December 2021
30	Nguyen Quoc Dinh	LQDTU	21-24, December 2021
31	Nguyen Huu Hung	LQDTU	21-24, December 2021
32	Hoang Minh Thien	LQDTU	21-24, December 2021
33	Pham Cao Dai	LQDTU	21-24, December 2021
34	Luu Van Tuan	LQDTU	21-24, December 2021
35	Nguyen Huu Minh	Telecom. Uni.	21-24, December 2021
36	Ta Van Thanh	Telecom. Uni.	21-24, December 2021
37	Le Duc Hung	HCM Uni. of Science	21-24, December 2021
38	Dinh Quang Minh	HUST, Hanoi	21-24, December 2021
39	Ngo The Anh	UTC, Hanoi	21-24, December 2021
40	Diem Cong Hoang	HUMG, Hanoi	21-24, December 2021
41	Dang Tuan Kiet	VNU, Hanoi	21-24, December 2021
42	Le Quang Huy	VNU, Hanoi	21-24, December 2021
43	Han Trong Thanh	HUST, Hanoi	21-24, December 2021
44	Le Van Hieu	EPU, Hanoi	21-24, December 2021
45	Le Anh Ngoc	EPU, Hanoi	21-24, December 2021
46	Pham Van Hiep	Bac Ha Uni.	21-24, December 2021
47	Le Minh Duong	Bac Ha Uni.	21-24, December 2021
48	Nguyen Khanh Phuong	FPT Software	21-24, December 2021
49	Nguyen Van Nghiep	ETA Vietnam	21-24, December 2021
50	Vu Hoang Gia	LQDTU	21-24, December 2021

51	Duong Quang Manh	LQDTU	21-24, December 2021
52	Le Ha Khanh	LQDTU	21-24, December 2021
53	Do Ngoc Tuan	LQDTU	21-24, December 2021
54	Phan Van Hung	LQDTU	21-24, December 2021
55	Le Phu Cuong	LQDTU	21-24, December 2021
56	Koichiro Ishibashi	UEC (Project member)	Online attendee
57	Jiro Ida	KIT (Project member)	Online attendee
58	Hoang Thi Yen	UEC	Online attendee
59	Dao Van Lan	MU (Project member)	Online attendee
60	Shuntaro Saku	UEC	Online attendee
61	Tran Thai Ha	UEC	Online attendee
62	Tran Tuan Anh	UEC	Online attendee

Total: 55 people (offline) + 7 (online)

IV. Summary of the activities corresponding to the objectives

1. Objective

The main objective of this workshop is to provide a forum for exchange of ideas and latest research results in converging different technologies for Internet of Things (IoT) based smart monitoring systems. The workshop is necessary for this project in gathering leading experts different fields to solve the issues of providing a convergence platform (with advanced wireless communications, data processing, energy efficient sensors, RF energy harvesting and security) for IoT based smart monitoring systems. The workshop aims to provide the overall solutions for IoT based smart monitoring systems in this project. It should be taken place in Hanoi due to several reasons. Firstly, as the capital of Vietnam, Hanoi has leading experts in different fields of IoT systems which are also main topics of our project and famous universities. Secondly, it is convenient to gather leading experts (without budget from IVO project) thank to other events organized in Hanoi this time, such as NICS 2021 and REV-ECIT 2021. Also, some local companies in Hanoi are willing to join the workshop. Moreover, experts from Vietnam National University, Hanoi University of Science and Technology, Phenikaa University will have invited talks in this workshop without budget from the project. The first invited talk presents an efficient energy harvester for IoT devices which can be employed in the drought monitoring in this project. Invited talk 2 provides an systematic perspective for real-time field monitoring applications using IoT-based sensors and unmanned aerial vehicles which will be useful for this project for drought monitoring in the wide regions. Especially, Invited talk 3 delivers a practical guidelines for evaluating the accelerometer data in activity classification for environment monitoring which is useful for this project in developing multi-purpose environment monitoring systems.

2. Activities corresponding to the objectives

a. Review the progress of project:

- Prof. Tran Xuan Nam gives welcome message of the workshop.
- Assoc. Prof. Hoang Van Phuc presents the project achievement and implementation plan toward an intelligent IoT platform for drought monitoring systems.

b. Present, discuss the latest research results in converging different technologies for Internet of Things (IoT) based smart monitoring systems, and conclusions:

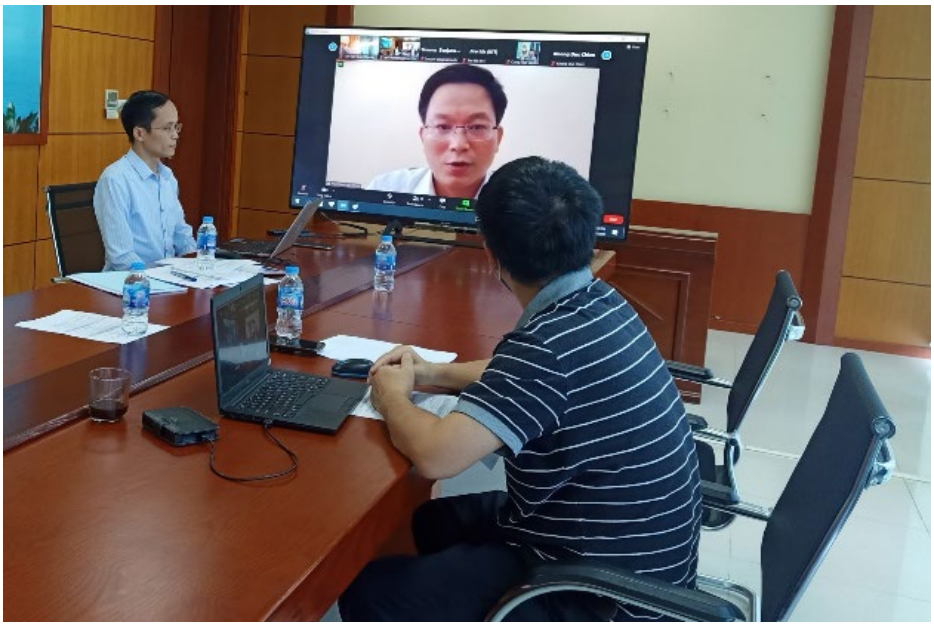
- Dr. Le Minh Thuy and Mr. Dinh Quang Minh from HUST present the invited talk on Human-Ring-Shaped Wi-Fi Energy Harvester for IoT Devices;
- Dr. Nguyen Van Trung (LQDTU) presents about on-chip multi-beat sensors for environment monitoring;
- Dr. Dao Thi Nga (LQDTU) presents about deep learning based lightweight intrusion detection for IoT systems in smart monitoring systems;
- Researchers from VNU, Hanoi present the invited talk on Real-Time Field Monitoring Using IoT-Based Sensors and Unmanned Aerial Vehicles;
- Prof. Koichiro Ishibashi and Shuntaro Saku (Uni. of Electro-Communications, Tokyo, Japan) presents about hybrid PV and RF EH power supply for IoT systems and the possibility of beat sensors with LoRa powered by RF energy harvesting, which followed by the novel SOI FET diode for RF energy harvesting with updated results by Prof. Jiro Ida (Kanazawa Institute of Technology, Japan);
- Dr. Truong Trung Kien (Fulbright University Vietnam) presents about phase impairment estimation for mmWave MIMO systems which is very useful for future IoT applications.
- Prof. Tran Duc Tan (Phenikaa University, Vietnam) an invited talk on evaluation of accelerometer data in activity classification for environment monitoring.
- Next, Dr. Luong Duy Manh (LQDTU, Vietnam) presents the results on efficient RF energy harvesting for sustainable IoT systems.
- Especially, Dr. Doan Van Sang (LQDTU, Vietnam) give a short training cource on deep learning techniques for IoT systems, using interactive lectures and simulation on MATLAB software. Members of IVO project and officers of NAWAPI attend this training course.
- Mr. Dao Van Lan (PhD student of Madarlanen University, Sweden and a member of this project) gives a talk on defeating jamming using outage performance aware joint power allocation and access point placement in uplink pairwise NOMA.
- Dr. Trinh Quang Kien (LQDTU, Vietnam) presents PUF design for IoT device authentication and Dr. Le Thanh Bang (LQDTU, Vietnam) summarizes the results on an IoT gateway for smart environment monitoring.
- Prof. Hoang Van Phuc (LQDTU, Vietnam) chairs the discussions, gives follow-up plan for the project and closing remarks. In conclusion, the project has achieved remarkable results on IoT based drought monitoring and early warning with qualified published papers, scientific exchange activities and a prototype system. For the follow-up plan, the project team will perform the site experiments, propose the application model after the project and make the final report of the project.

3. Detailed changes from the initial proposal:

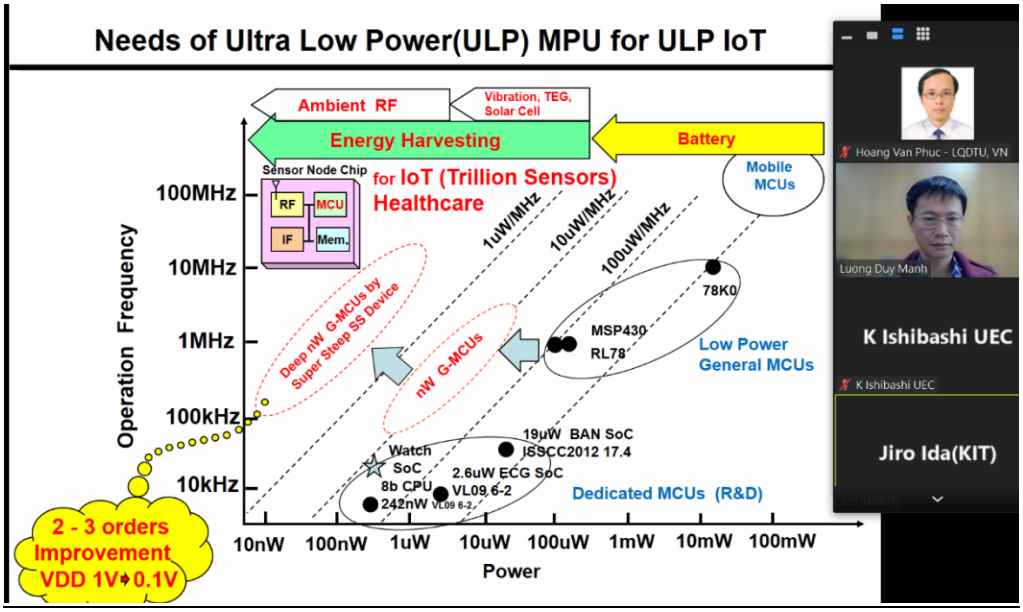
In general, the content of the workshop is unchanged. Due to COVID-19 pandemic, and we used separate rooms for groups of participants for safety.

V. Others

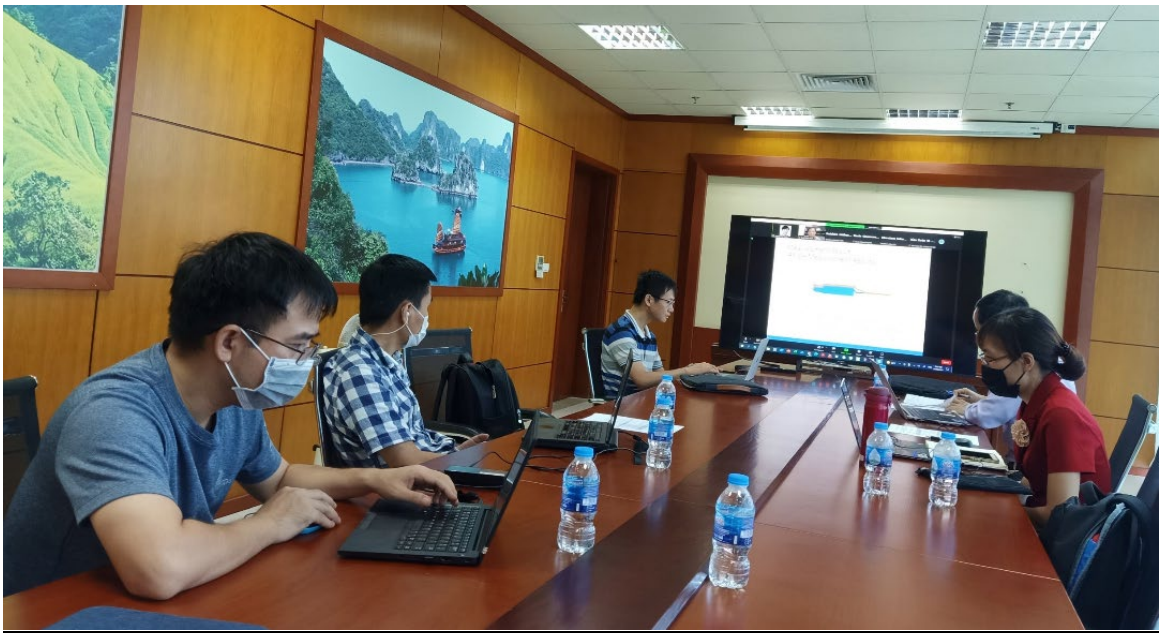
The workshop related pictures as below:



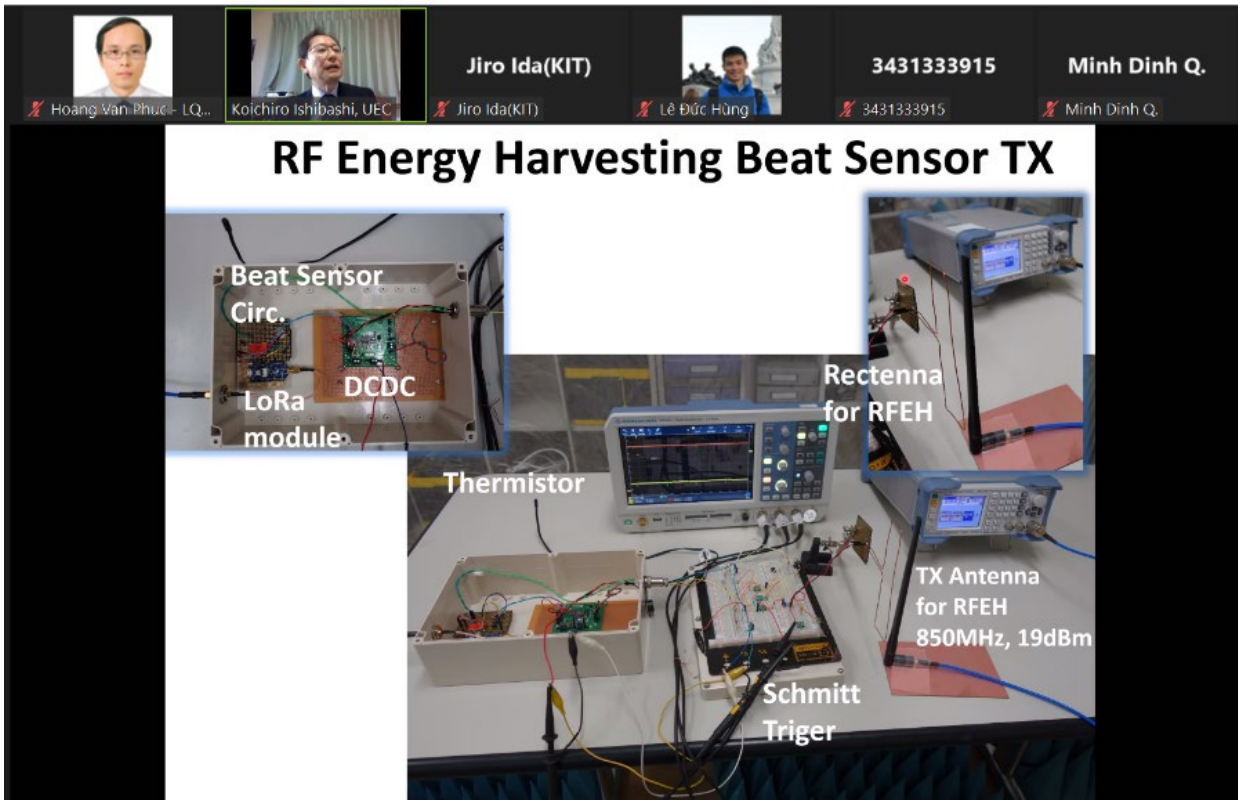
Prof. Tran Xuan Nam gives welcome message of the workshop.



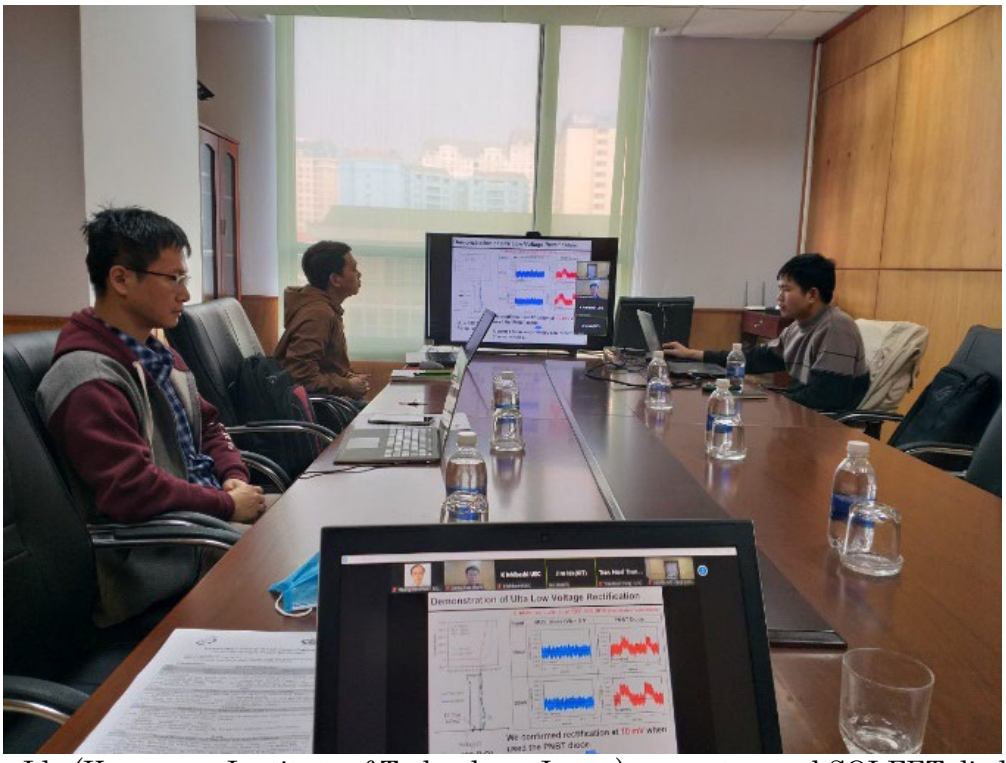
Dr. Le Minh Thuy and Mr. Dinh Quang Minh from HUST present the invited talk on ambient RF energy harvester for self-powered IoT device.



Dr. Nguyen Van Trung (LQDTU) presents the on-chip multi-beat sensors for environment monitoring.



Prof. Koichiro Ishibashi (Uni. of Electro-Communications, Tokyo, Japan) present about hybrid PV and RF EH power supply for IoT systems and the possibility of beat sensors with LoRa powered by RF energy harvesting.



Prof. Jiro Ida (Kanazawa Institute of Technology, Japan) presents novel SOI FET diode for RF energy harvesting with updated results.

Short training on deep learning techniques for IoT systems. Training method: Lecture and simulation on MATLAB software. Trainer: Dr. Doan Van Sang (LQDTU, Vietnam); Trainees: Members of IVO project and officers of NAWAPI.