Project Title: **Resilient AIoT Green Energy System with Real-time Solution for Effective Aquaculture (REAS-SEA)**

Background:

- Current ***global climate change*** together with a series of upstream dams placed by China on the Mekong River
- Adoption of shrimp farming is a potential and ***natural solution*** for traditional farmers

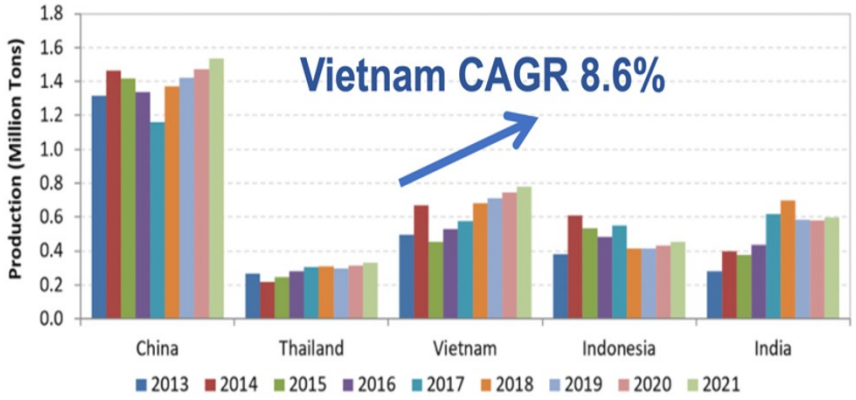


Figure 1: Compounded Annual Growth Rate of aquaculture shrimp farming in Vietnam and other ASEAN countries.

Targets:

- **To support** Southeast Asia and Vietnam's fast growth aquaculture industry with a real-time and holistic control solution
- **To help** farmers optimize their feeding pattern for growth, controlling dissolved oxygen, chemical and antibiotic use, reducing water pollution and mortality rate and feed cost.

Speaker: Vo Nguyen Quoc Bao

Project Title: **Resilient AIoT Green Energy System with Real-time Solution for Effective Aquaculture (REAS-SEA)**

Project Members :

Party	Name	Division
PTIT, Vietnam	***Vo Nguyen Quoc Bao**	**Faculty of Telecommunications**
UTokyo, Japan	*Nguyen Ngoc Mai Khanh	Systems Design Lab (d.lab), Japan
SOITEC, Singapore	*Nguyen Bich Yen	Innovation
NTU, Vietnam	*Tran Thi My Hanh	Department of Research Affairs
	Nguyen Tan Sy	Institute of Aquaculture
	Ngo Van Manh	Institute of Aquaculture
IICT, Laos	Sayfon BOUTCHANTHALATH	Director General, Institute of Information and Communication Technology
	*Padapxay SAYAKHOT	Deputy Director General, Institute of Information and Communication Technology
	Aromhack SAYSANASONGKHAM	Deputy Director, Planning, Cooperation and Finance Division
	Phonexay NAMSAVANH	Technical Officer, Institute of Information and Communication Technology
	Phuangkeo KEOPHENGTHONG	Technical Officer, Institute of Information and Communication Technology
MIC, Vietnam	*Tran Minh Tuan	National Institute of Information and Communication Strategy
MMU, Malaysia	*Foo Yee Loo	Faculty of Engineering
BLU, Vietnam	*Tu Diep Cong Thanh	Bac Lieu University
	Luu Ngo Duc	Faculty of Information Technology
	Duong Viet Hang	Faculty of Education
	Nguyen Minh Tan	Department of Scientific Research Management and International Cooperation
	Nguyen Thi Hong Van	Faculty of Aquaculture
LEO, Japan	*SATOSHI YOSHINO	R&D Division
CADT, Cambodia	*Sopheakmanith Chhoun	Research & Innovation Center
	Chin Vannak	Research & Innovation Center
	Kann Bonpagna	Research & Innovation Center

Project Duration :

- First year: April 1st, 2021 – March 31st, 2021
- Second year: April 1st, 2021 – Mar 31st, 2022

Project Budget: 80,000 USD

Project Activities #1: **Visit LEO Electronics Vietnam**

Time: Apr. 18, 2022
Place: Hai Duong, Vietnam
Members:

- LEO Electronics, Japan
- NhaTrang University, Vietnam
- UTokyo, Japan

Project Activity #2: Visit Chinh-My Shrimp Farm, Khanh-Hoa Province, Vietnam

Time: Apr. 2022
Place: Khanh-Hoa, Vietnam
Members:

- NhaTrang University, Vietnam
- Soitec, Singapore
- LEO Electronics, Japan
- UTokyo, Japan

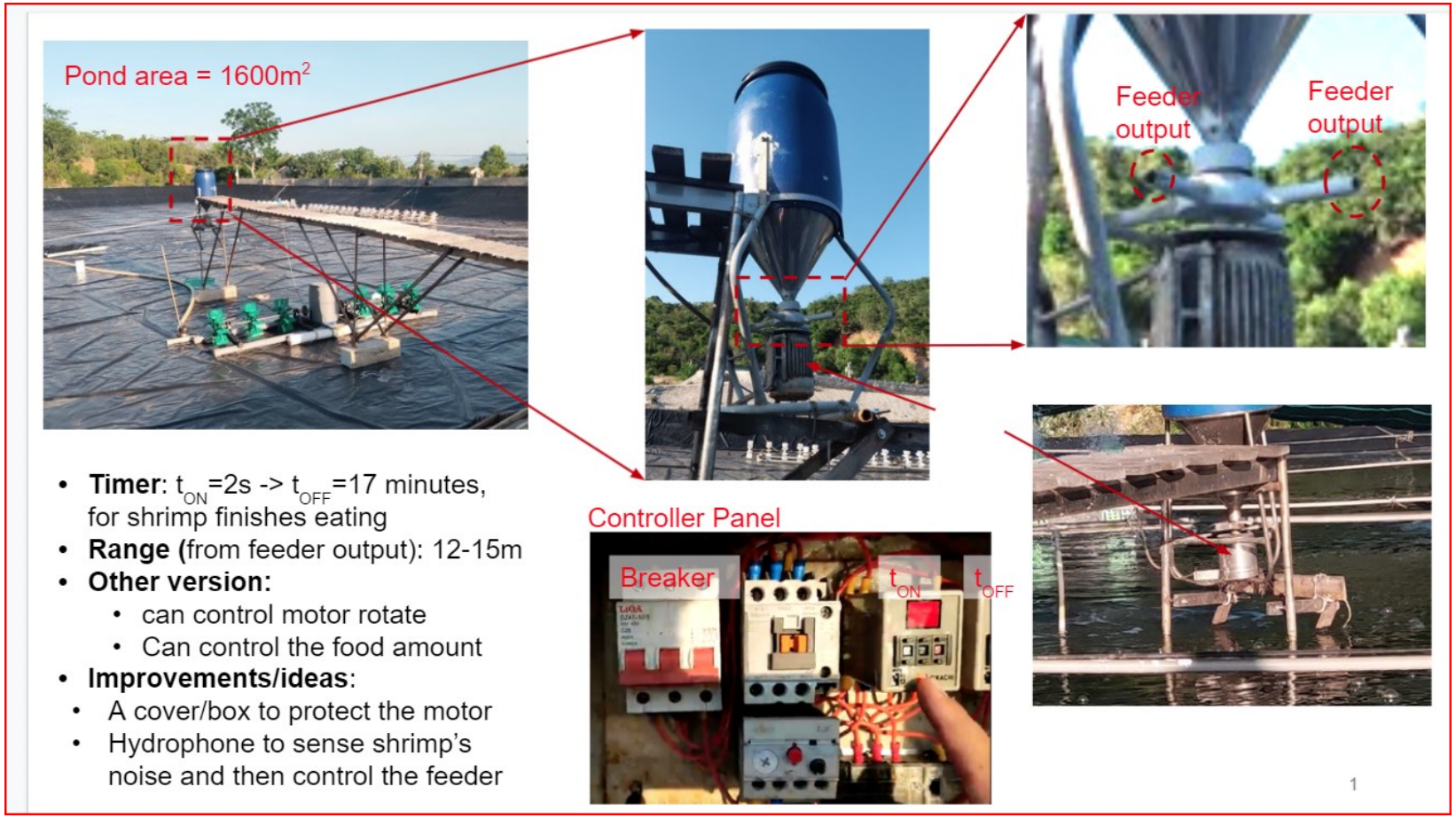






Project result #1: Design and testing shrimp feeder

The conventional Shrimp feeder in Nha-Trang Univ.



- **Timer**: t_{ON}=2s -> t_{OFF}=17 minutes, for shrimp finishes eating
- **Range** (from feeder output): 12-15m
- **Other version:**
  - can control motor rotate
  - Can control the food amount
- **Improvements/ideas**:
  - A cover/box to protect the motor
  - Hydrophone to sense shrimp's noise and then control the feeder

The proposed shrimp feeder: filed test with shrimp foods

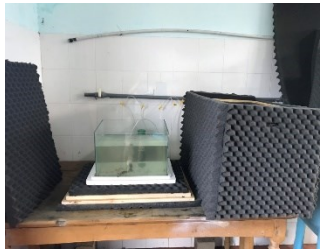
Project result #2: Shrimp sound recording and analyzing

Sound collection and Algorithms

Task #1: Shrimp sound recording

Case #1 (ideal): Soundproof box

Case #2 (practical): Shrimp farm



Measure and Observe

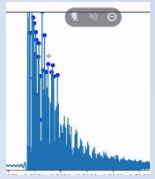
Waterproof camera to obverse shrimp behaviors

Sony: D10 Linear PCM-Recorder D Series

Sony sound amplifier

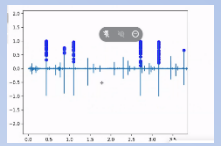
Task #2: Shrimp sound analyzing

Shrimp sounds



Separating shrimp sounds from real farm noise and Interference

Classifying the shrimp sounds to 5 levels



Principal Component Analysis (PCA)

Artificial Intelligence (AI)

PCA is better than AI

Project result #3: System design and testing

The proposed system

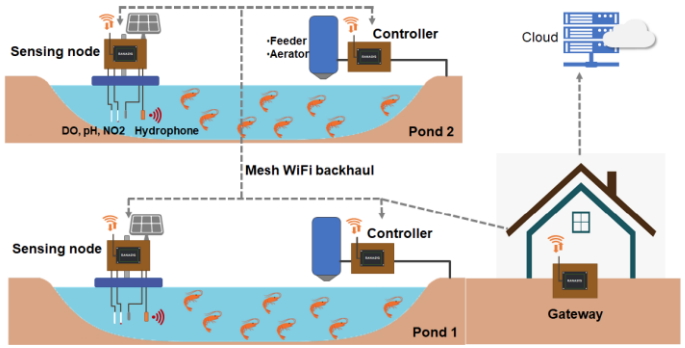
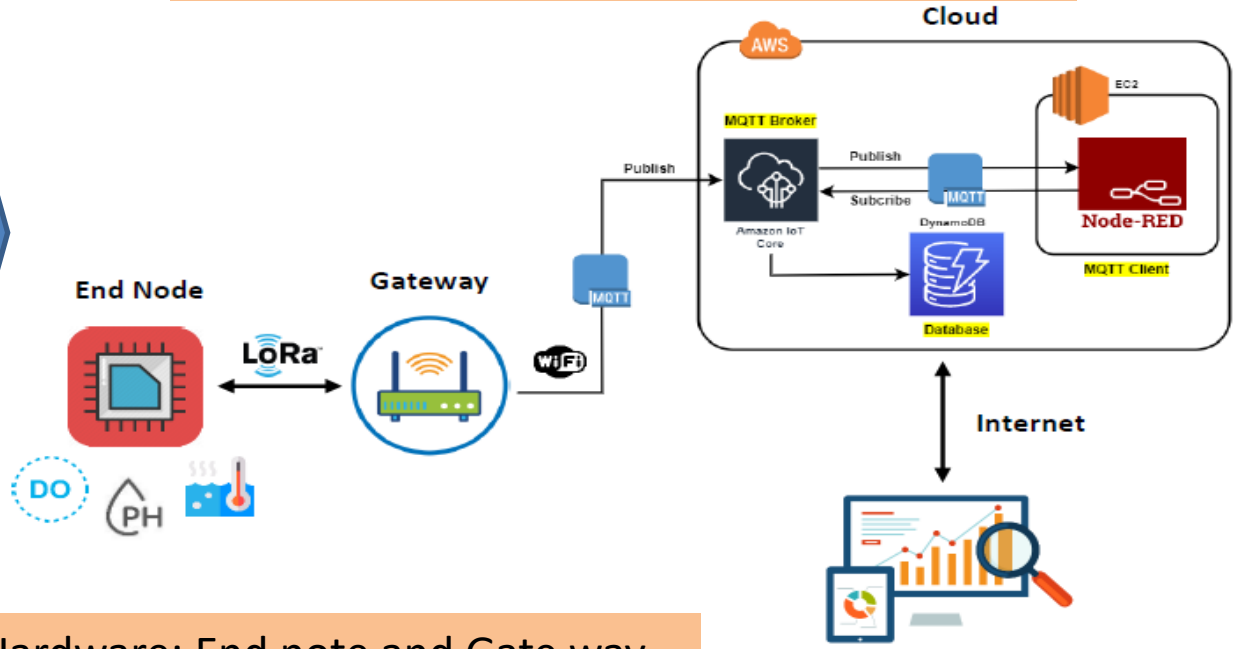
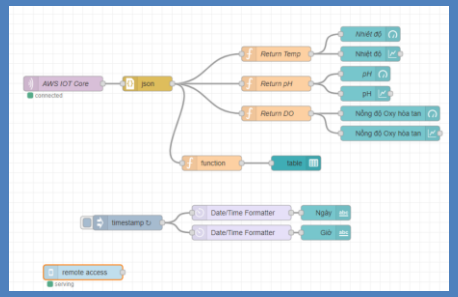


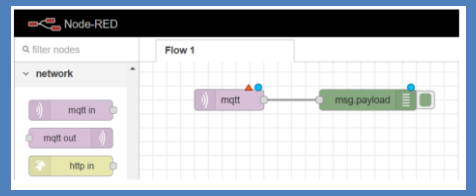
Figure 4: Typical in field deployment for REAS-SEA.

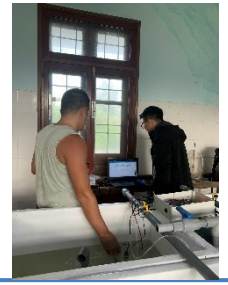
The designed and implemented system

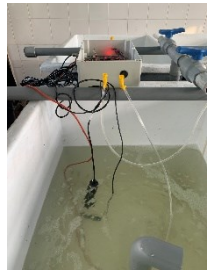


Software: IoT AWS, Node-RED



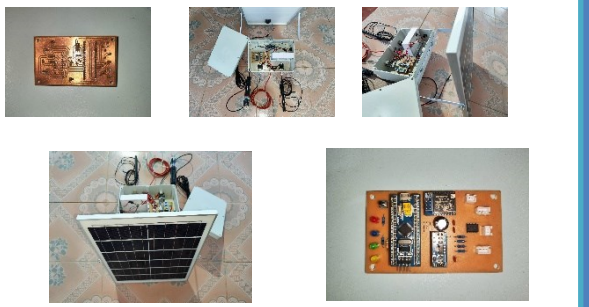






Hardware: End note and Gate way

End node



Gate way

Societal Impact:

- **Provide** early warning to aqua culturists of detrimental changes in critical environmental parameters affecting aquatic animals, mitigating risks

- **Minimize** mortality loss, reducing feed cost, and promoting sustainable and profitable adoption for aquaculture farming for areas along the Mekong river including Lao, Cambodia, and Vietnam including 3M small shrimp farmers

- **Support** the training of students, master's students and farmers
  - students (6 bachelors, 5 engineers) in NTU and 4 bachelors students in PTIT,
  - two master's students and farmers
- **Reduce** environmental contamination by reducing chemical and antibiotics usage in both aquaculture and agricultural farming

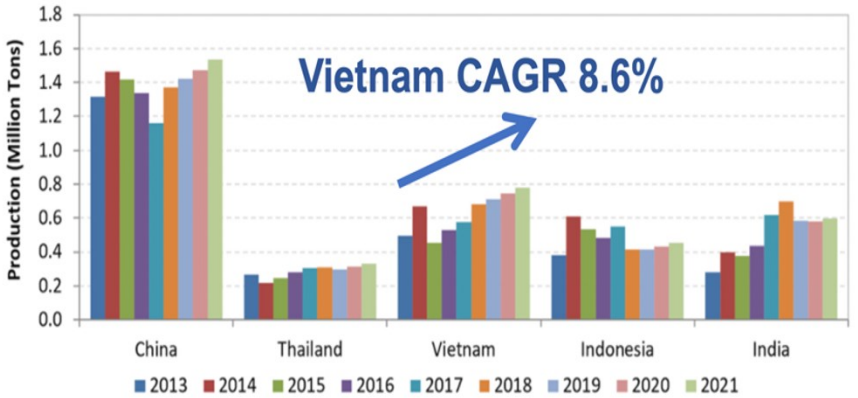


Figure 1: Compounded Annual Growth Rate of aquaculture shrimp farming in Vietnam and other ASEAN countries.

Conclusions:

No.	Main activities	Members	Status/Remarks
1	System and algorithm design	PTIT, Soitec, UTokyo, & NIICS	Done
2	Sensing node design and testing	PTIT & IICT	Done
3	Controllers design and testing	UTokyo & NIPICT	Done
4	Gateway design and testing	UTokyo & IICT	Done
5	Cloud and database	MMU & BLU	Done
6	System fabrication and verification	LEO	In progress
7	Field test	NTU, BLU, NIPICT, & IICT	In progress
8	System optimization	All	In progress

1

Scientific and technological

- A detailed study for the critical parameter sensing and shrimp's eating behaviors.
- An efficient algorithm (based on PCA) to detect shrimp sound from shrimp farms.

2

Application development & experiment

- An efficient algorithm to clarify the shrimp sounds to control the shrimp feeder.
- The practical hardware design and implementation for end-nodes, gateway, cloud and database.
- The practical software design and implementation for the proposed system

Future works:

- **Testing**
  - Sensing node
  - Gateway
  - Cloud and database
- **System fabrication and verification**
- **Field test:**
  - Nha Trang, Khanh Hoa Province, Vietnam
  - Bac Lieu Province, Vietnam
- **System optimization**
- **Publication**