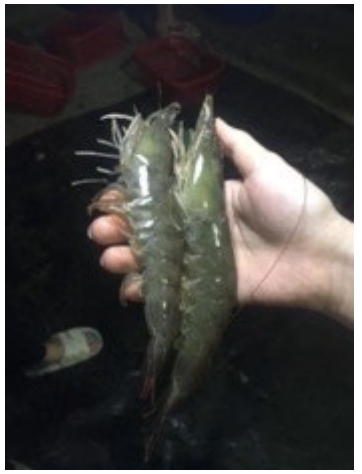
Project Title:**Resilient AIoT Green Energy System with Real-time Solution for Effective Aquaculture (REAS-SEA)**

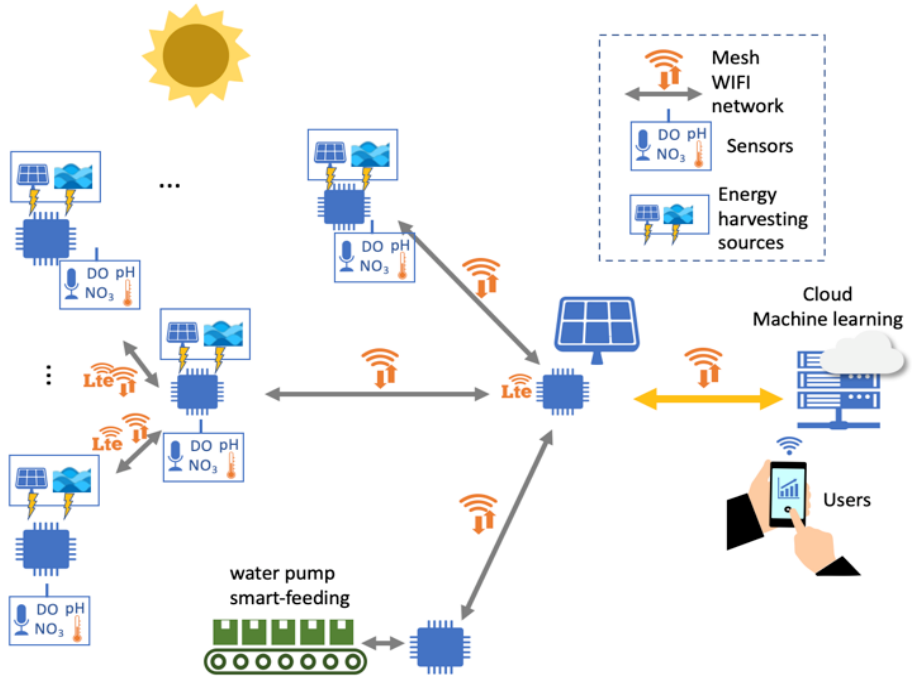


Background :

- 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

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:

Tran Thi My Hanh, Nha Trang University, Vietnam

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	*Luu Ngo Duc	Faculty of Information Technology
	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, 2022
- Second year: April 1st, 2022 – Mar 31st, 2023
- Third year: April 1st, 2023 – Mar 31st, 2024

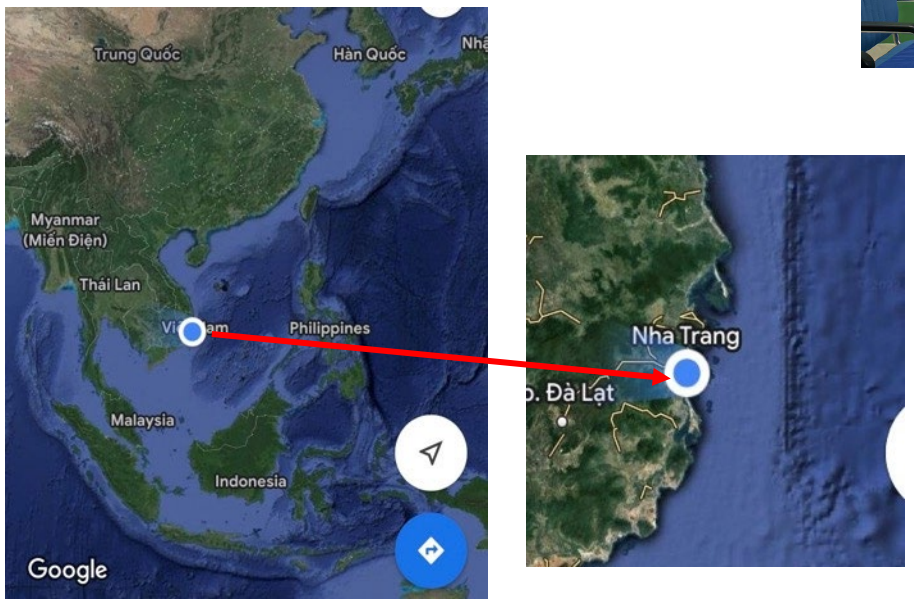
Project Budget:

80,000 USD

Project Activities: Face to face meeting at Nha Trang University, Vietnam

Time: September 14, 15. 2023
Place: Nha Trang University, Khanh Hoa Province, Vietnam
Members:

- NTU, Vietnam
- Soitec-Singapore
- IICT, Laos
- CADT, Cambodia
- UTokyo, Japan (online)
- MMU, Malaysia (online)



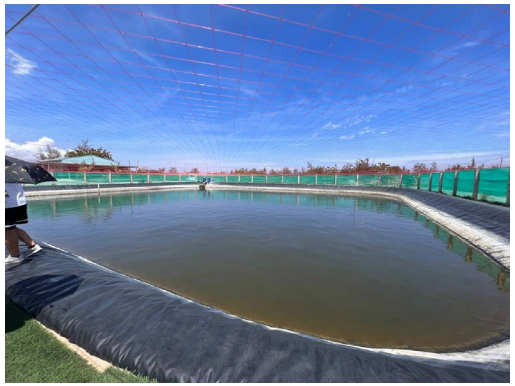
Project Activities: NTU Aquaculture lab, NhaTrang Univ., Vietnam

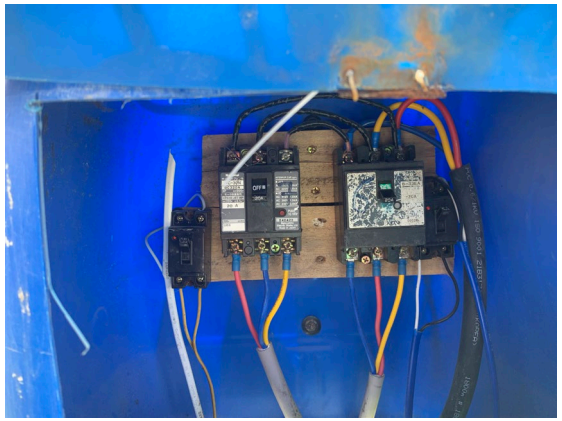
Time: Sept. 15 2023
Place: Cam Ranh, Vietnam
Members:

- NTU, Vietnam
- Soitec-Singapore
- IICT, Laos
- CADT, Cambodia

Time: Sept. 15 2023
Place: Ninh Thuan Province, Vietnam

- Members: NTU, Vietnam
- Soitec-Singapore
- IICT, Laos
- CADT, Cambodia





Project Activities: **Indoor and outdoor experiment**

Content 1: Experiment indoor

1.1. Recording sound of shrimp at different nutritional status (hungry state, average eating state, satiation stage) in anechoic chamber and normal tanks (8m)

1.2. Measure environmental parameters (pH; DO, temperature; Total Ammonia) use automatic sensor.

Content 2: Experiment outdoor (Field trip)

2.1 Shrimp sound Recording in pond.

2.2 Test environment parameters in shrimp pond (pH; temperature; DO; TAN) by automatic sensor.

2.3 Trail feeder machine.

2.4 Use underwater Camera to check shrimp feeding.

Result : Measure environment parameters in tanks

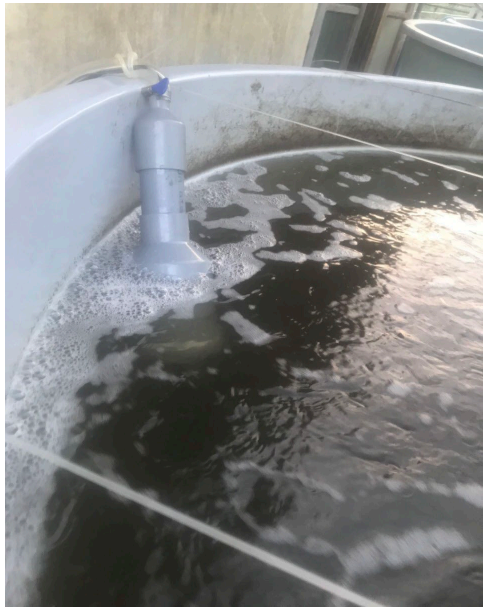
Second step:

Time: Apr to June -2023

- **Total tanks**: 03 tanks

Volume 8 m^3/tank.

- **Density**: 200 con/m^2
- **Time for trail**: 30 - 60 days.
- **Environment parameters :** DO; pH; ORP
- **Measure Device:** ASIA



Result : Environment outdoor

Measure Device:

ASIA IVO.

Environment parameters:

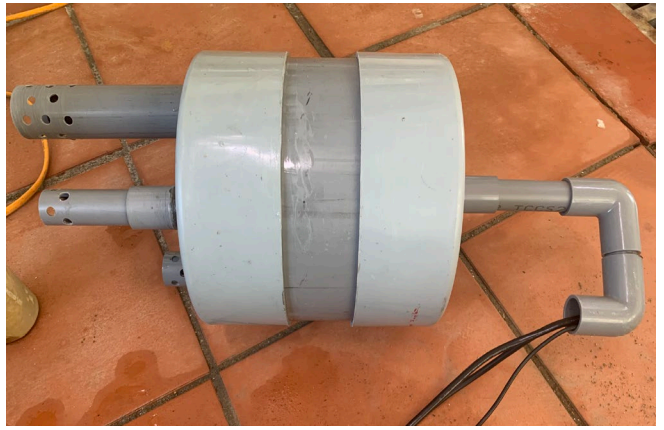
DO; pH; temperature; ORP

Pond Systerm:

2 ponds; Size 200m/pond.

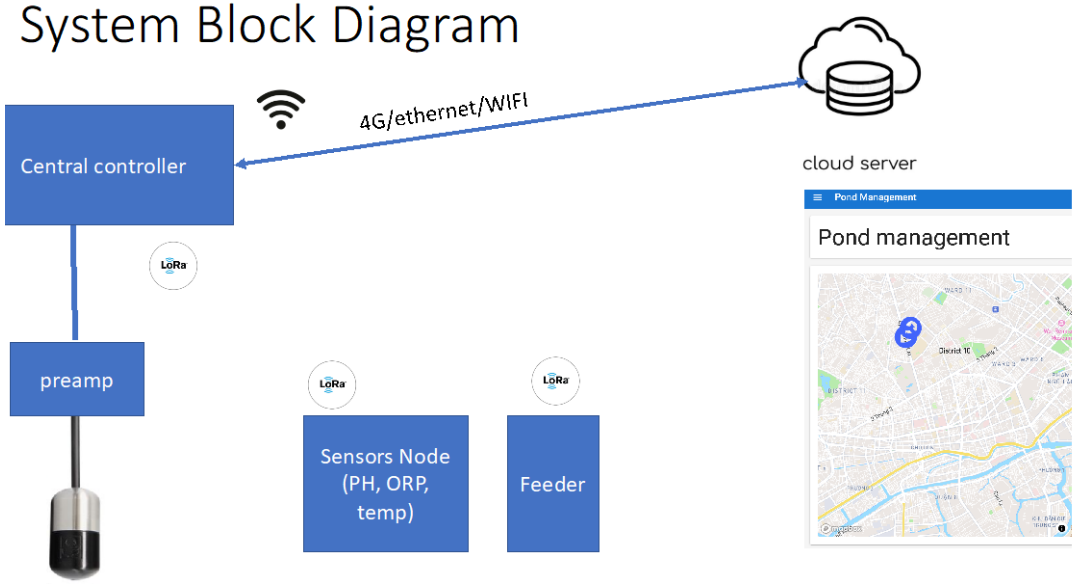
Time:

From June to Oct – 2023.

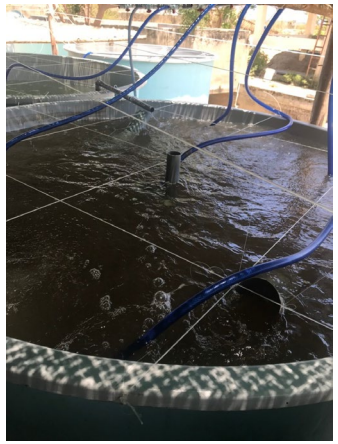


R&D results: Shrimp Pond Data Acquisition System

System Block Diagram



Phase 1: 4/2023



- Focus on indoor monitoring
- Monitored PH, ORP and temperature

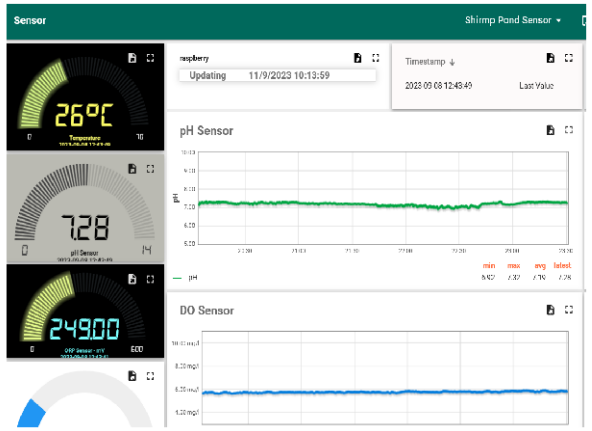
- Connection is unstable after 1 week → change the communication module
- PH, ORP and temperature value was stable in door

Phase 2: 7/2023

- Outdoor Monitoring
- Monitored PH, DO and temperature
- Record shrimp sound in door

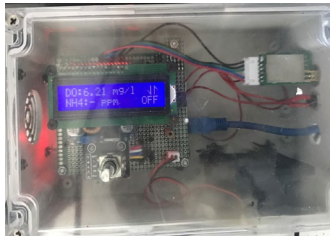
R&D results: Shrimp Pond Data Acquisition System

Outdoor Water Quality Monitoring System

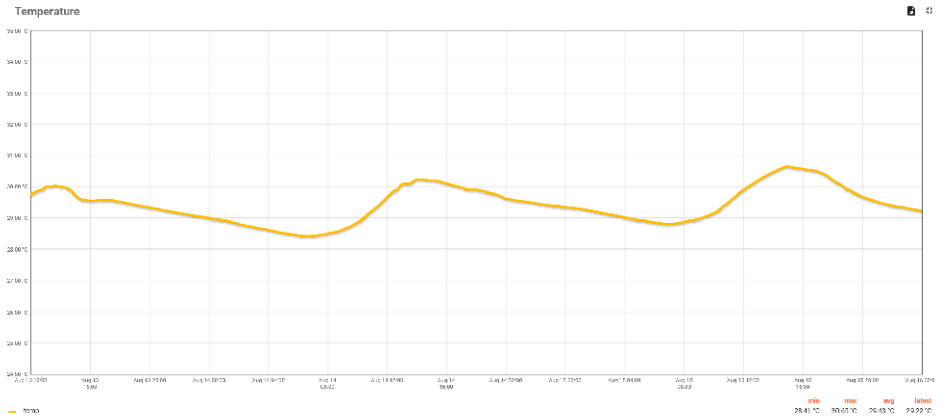


Sensors and measurement node

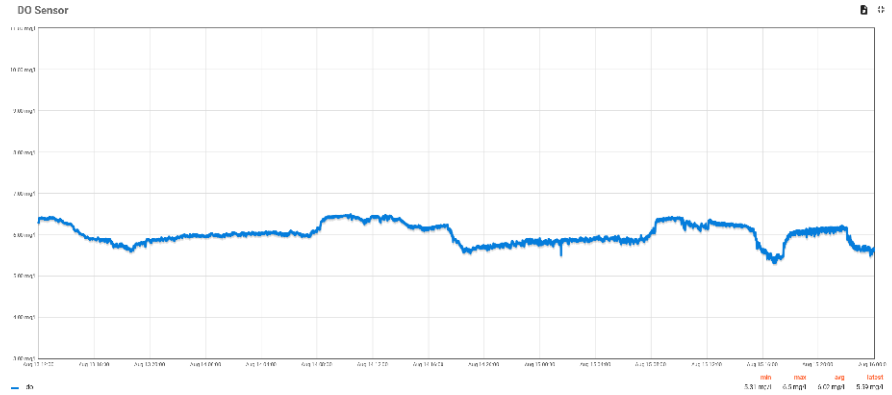
DO	RK500-04
PH	HAOSHI H-101
Temp	PT100



Water temperature chart



DO chart



Shrimp eating sound recording

- Utilize a hydrophone to record under water sound
- Design a preamp device to amplify the hydrophone output
- Use smartphone to record the sound
- Upload result to cloud storage for later analyzing

Request for sound processing

At least **1000** files:

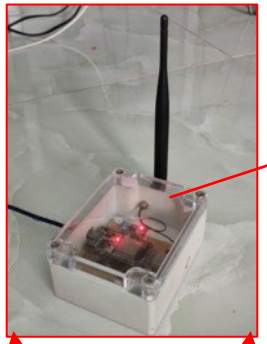
1. **Indoor shrimp only** with **cleaner** quality
2. Specific recordings of **natural shrimp behavior** vs **eating**
3. Recordings of varying **amount** of shrimp.
4. Different **time domain** of eating period
5. **10+** files of **outdoor noises**: **single** and **mixed**

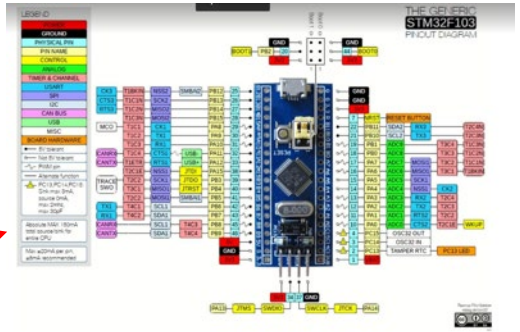
Getty Images/iStockphoto

R&D results: Sensing Node Design and Implementation

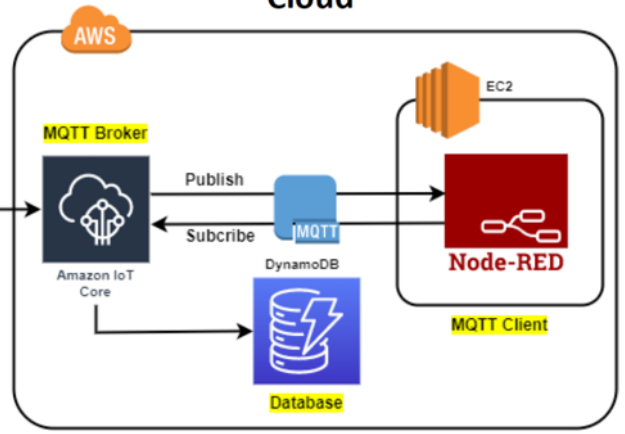
Sensing End Node with Solar

Gateway





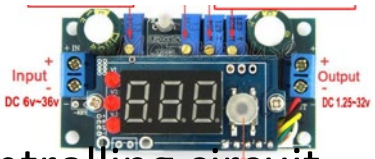
Cloud



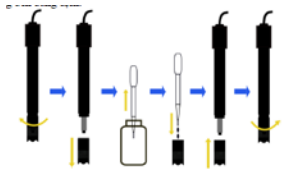
Node-RED

real-time sensing

End Node



Controlling circuit

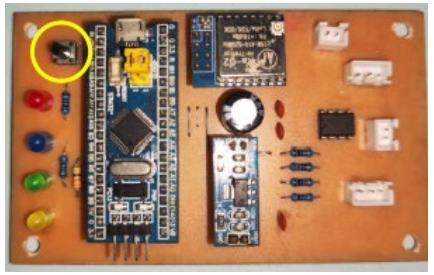


LoRa

Gateway

MQTT

WiFi



Internet

PC/Laptop/Smartphone/Table

Scientific Contribution:

Presentations at International Conferences:

No:	Paper title:	Author names	Affiliation	Conference name:	The date of the conference	The venue of the conference
1	Application of sensing and electronic systems for automatic management of environmental factors and diseases in intensive shrimp farming	Nguyen Tan Sy[1], Nguyen Ngoc Mai Khanh[2], Nguyen Thi Bich Yen[3], Nguyen Dinh Huy[1], Bui Quoc Bao[4], Hoang Nguyen[5], Nguyen Thi Kim Cuc[1], Tran Thi My Hanh[1].	[1]Nha Trang University, Vietnam [2]The University of Tokyo, Japan [3]Soitec, France [4]Ho Chi Minh City University of Technology, Vietnam [5]MnM System Designs LLC, United States	Aquaculture Vietnam 2023	11-13/10/2023	Ho chi Minh city, Vietnam
2	Application of sensing and electronic systems for automatic management of environmental factors and diseases in intensive shrimp farming	Nguyen Tan Sy[1], Nguyen Ngoc Mai Khanh[2], Nguyen Thi Bich Yen[3], Nguyen Dinh Huy[1], Bui Quoc Bao[4], Hoang Nguyen[5], Nguyen Thi Kim Cuc[1], Tran Thi My Hanh[1].	[1]Nha Trang University, Vietnam [2]The University of Tokyo, Japan [3]Soitec, France [4]Ho Chi Minh City University of Technology, Vietnam [5]MnM System Designs LLC, United States	Current status and solutions for sustainable development of Ca Mau shrimp industry	12/2023	Ca Mau Province, Vietnam

Societal Impact:

- **Provide** early warning to aquaculturists 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 five bachelors, two master's students and farmers
- **Reduce** environmental contamination by reducing chemical and antibiotics usage in both aquaculture and agricultural farming
- **Help** students have a good opportunity to have access to new technology, and enhance their practical ability as well as creativity in the process of conducting experiments to apply this technology in shrimp farming.





Conclusion:

1. **Scientific and technological**

- A detailed study for the critical parameter sensing and shrimp's eating behaviors.
- Hardware designs for anechoic chamber and sensing/communication node
- Research collaboration: online and onsite meetings

2. **Application development & experiment**

- Experiment for shrimp sound recording:
  - Design anechoic chamber with hydrophone
  - Experiments: indoor and outdoor
  - Data analysis
- Field test for Feeder
- Sensing node:
  - Design sensing hardware
  - Field test at shrimp pond

Future works:

- **Field Test for**
  - Sensing node
  - Shrimp sound detection and algorithm
  - Cloud and database
  - At NTU and BLU, Vietnam
- **System optimization**
- **Data analysis**
- **Conference paper and final report**