Project Title: **Agricultural IoT based on Edge computing**

Background: ASIAN countries have a large share of agriculture in their economies, so ICT for food is the totally right approach as part of the IVO project's goals. The overall aim of this project is to develop an IoT-based framework with intelligent computing and implementation for an indoor smart farm.

Targets: This project aims to develop an agricultural IoT framework based on edge computing, focusing on addressing existing challenges for agricultural IoT systems from both academic and practical perspectives at the network edge.

1. New intelligent edge computing solutions for data collection and local response control in smart farming.
2. A security framework based on authentication, data preservation, and encryption, suitable for smart IoT applications such as smart farming.
3. An automatic agricultural system for indoor smart farms with the involvement of robot arms and drones.

Speaker: Dr. Hoang Trong Minh

Project Title: **Agricultural IoT based on Edge computing**

Project Members:

PTIT, VIETNAM: Dr. Hoang Trong Minh (project leader),Assoc. Prof. Hoang Dang Hai, Dr. Pham Anh Thu, MSc. Nguyen Thanh Tra.

VNU, VIETNAM: Assoc. Prof. Nguyen Linh Trung, Assoc. Prof. Nguyen Viet Ha, Dr. Dinh Tran Hiep, Dr. Tran Thi Thuy Quynh, Dr. Pham Minh Trien, Dr. Nguyen Le Khanh, Dr. Chu Duc Ha, Msc. Quach Cong Hoang, Dr. Ngo Khac Hoang.

UTM, MALAYSIA: Prof. Norliza Mohd Noor, Dr. Norulhusna Ahmad, Dr. Hazilah Mad Kaidi.

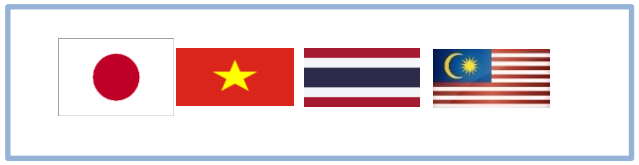
NECTEC, THAILAND: Dr. Chalee Vorakulpipat, Dr. Montida Pattaranantakul, Dr. Soontorn Sirapaisan.

NICT, JAPAN: Dr. Takeshi Takahashi.

Project Duration: 04/2022-03/2025

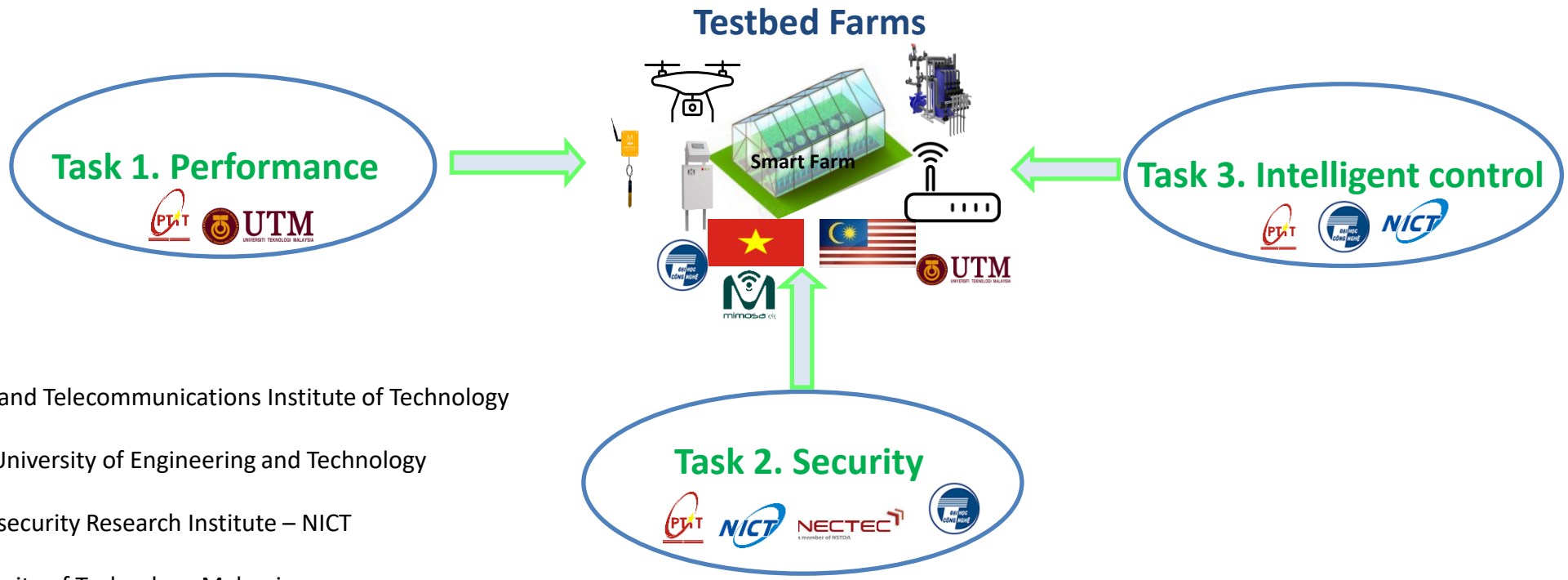
Project Budget: 82.000 USD

Project Activities (Collaboration)



2022-2023 | 20223-2024 | 2024-2025

PJ2-2022 Timeline



- PTIT — Posts and Telecommunications Institute of Technology
- VNU University of Engineering and Technology
- NICT — Cybersecurity Research Institute – NICT
- UTM — University of Technology Malaysia
- NECTEC — National Electronics and Computer Technology Center of Thailand
- MimosaTEK

Project Activities (Task assignment)

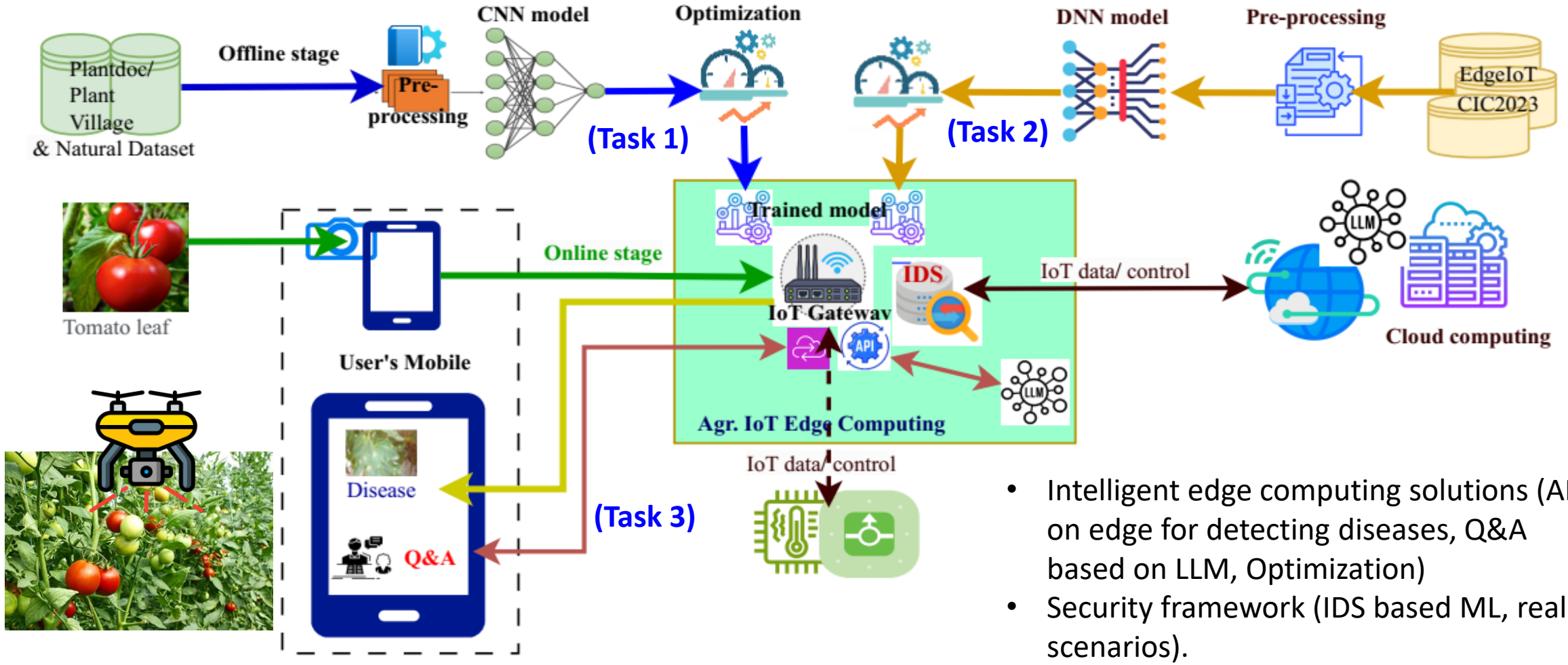
Work package No1		Work package No2		Work package No3	
Design an IoT monitoring system with drones and edge computing capabilities	Develop and optimize edge computing solutions to the system	Design the security framework	Develop the security solutions	Develop the fertilizing and watering systems	Develop the pollinating system and the plant disease predictor.

Work Package	Tasks	Year 1	Year 2	Responsibility				
				PTIT	VNU-UET	UTM	NECTEC	NICT
WP1	Task 1.1	x		②	①			
	Task 1.2		x	①	②	③	③	
WP2	Task 2.1	x		①	②	③	②	②
	Task 2.2		x	①	②	③	②	②
WP3	Task 3.1	x		③	②	①		
	Task 3.2		**x**	**3**	①	②		

① = responsible ② = supportive ③ = exploited

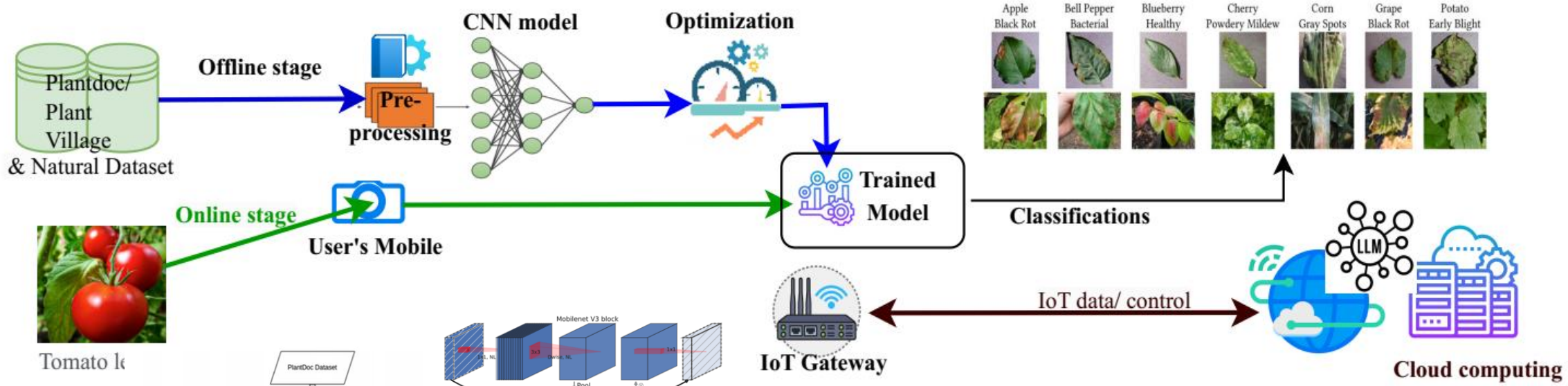
Project Activities (Scientist contributions)

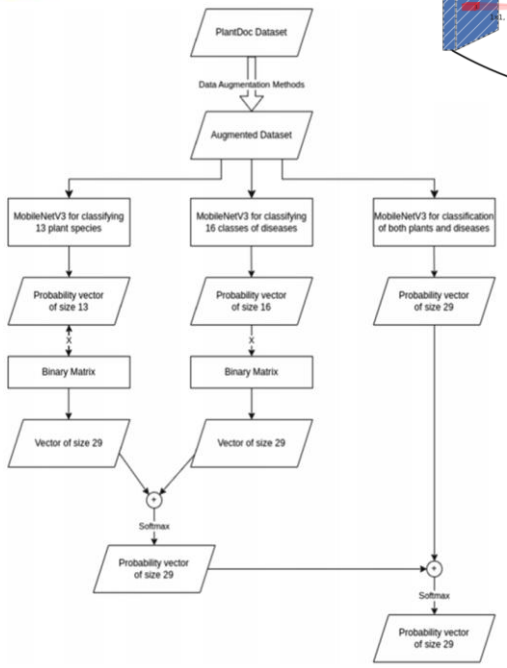
2024-2025



- Intelligent edge computing solutions (AI on edge for detecting diseases, Q&A based on LLM, Optimization)
- Security framework (IDS based ML, real scenarios).

Project Activities (Scientist contributions)





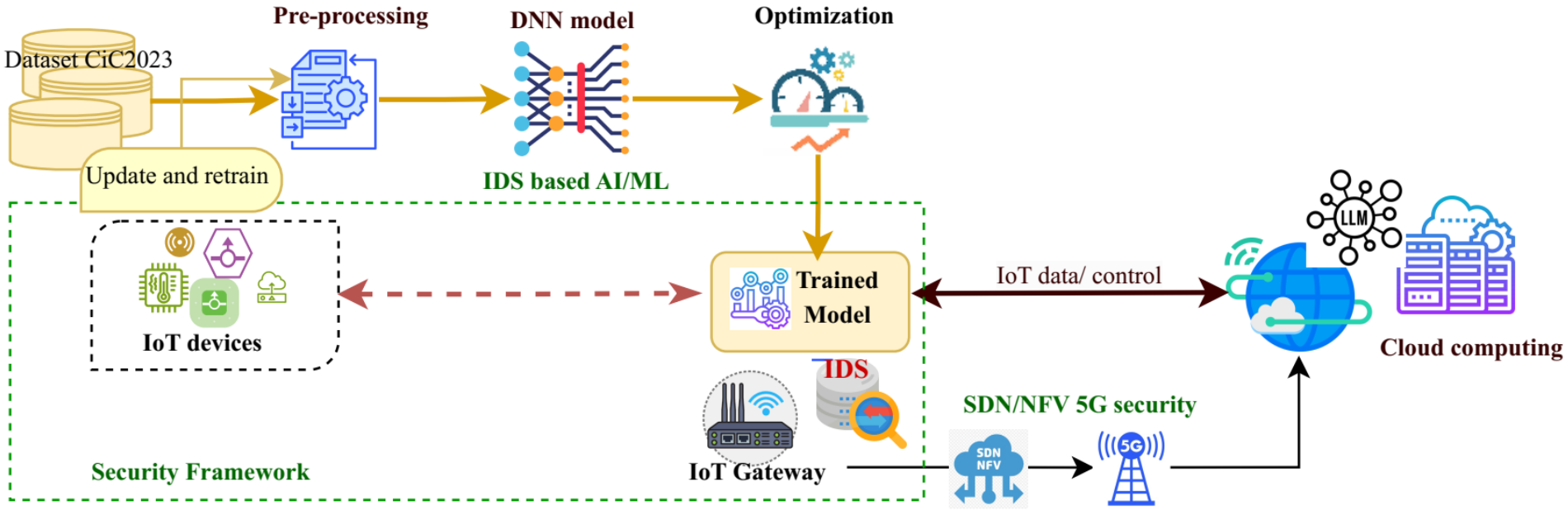
Preprocessing: Augmentation, Balance, Vectorization
ML model: DCNN Model with turning hyperparameters
Optimization: Quantization

Author	Architecture	Color space	Parameters	Accuracy	F1
MobileNet V3 Small	Efficient CNN	RGB	1.5M	99.54%	0.9931
Schuler - Two-Branch	20%L + 80%AB	L–AB	5M	99.48%	0.9923

Model quantization	Precision		Recall	
	Our model	Schuler	Our model	Schuler
full integer 8 bit	0.41	0.78	0.22	0.78
dynamic integer 8 bit	0.68	0.78	0.68	0.78
float point 16 bit	0.70	0.77	0.69	0.77

1. Minh H.T and Anh P.T., "A novel light-weight DCNN model for classifying plant diseases on internet of things edge devices." Mendel. Vol. 28. No. 2. 2022.
2. Anh N.T, Minh H.T and Duc M.T. "An Effective Deep Learning Model for Detecting Plant Diseases Using a Natural Dataset for the Agricultural IoT System." Int. Conf on Intelligence of Things. Cham: Springer Nature Switzerland, 2023.

Project Activities (Scientist contributions)



Security framework for agricultural IoT on Edge computing: IoT devices/networks security; SDN/NFV 5G connected networks; IDS based on AI/MLs.

IDS based on Edge devices: Reduce dataset for retraining, hyperparameters, dimensionality and features.

Edge computing in collaboration: Expert systems/clustering problems

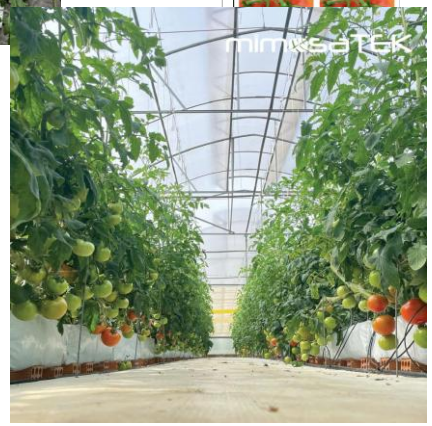
3. Hoang, Trong-Minh, et al. "A Novel DNN-Based IDS System Combined with an LR-GA Method to Detect Attacks." Proceedings of SAI Intelligent Systems Conference. Cham: Springer Nature Switzerland, 2023. SCOPUS Indexed. (Financially supported by NICT)

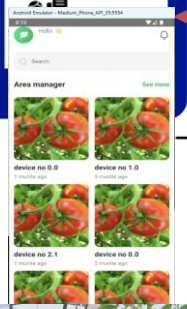
4. Vorakulpipat, Chalee, et al. "Safeguarding Devices and Edge Computing: A Responsive Anti-Scam Approach." 2023 IEEE Intl Conf on DASC/PiCom/CBDCom/CyberSciTech. IEEE, 2023. IE indexed. (Financially supported by NICT)

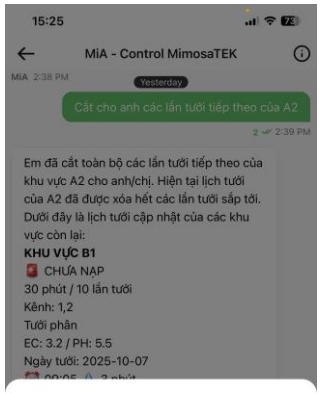
5. Kosuke, Tanizaki; Keisuke, Furumoto; Kohei, Masumi; Trong-Minh, Hoang; Yoshiaki, Shiraishi; Takeshi, Takahashi. “Investigating Agricultural IoT devices and services from cybersecurity perspectives”, ITU Kaleidoscope, 21-23 October 2024, New Delhi, India. IE indexed.

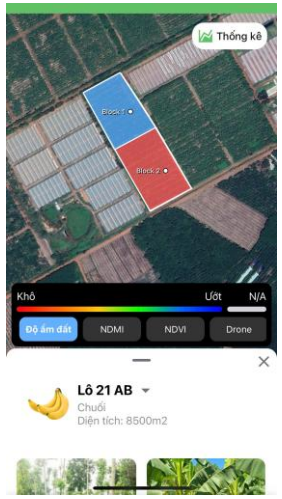
Project Activities (Technological development)

Tomato leaf





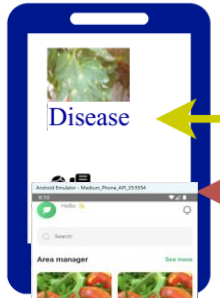


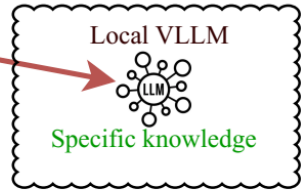


Online stage

IoT data/ control

User's Mobile





IoT data/ control

Workshop in Malaysia

14-17
Jan 2024

Mobile Apps (module)

- Tomato disease detection
- Disease dictionary
- **Voice irrigation software module** (Deployed on Mimosatek's gateway) Aug 2025

R&D results

1. Scientific and technological
   - Figured out the main challenges of the 6 packets of the project's aim.
   - Security issues: IDS-based ML, SDN/NFV security, IoT devices.
   - Disease detection: Image processing, lightweight ML/AI models.
2. Application (or system) development
   - Deployed main components/devices of the greenhouse and the agricultural IoT system
   - Collected real IoT data for caring plants
3. Experiments including field testing

Develop mobile Apps (ML module for disease detection and disease dictionary based on VLLM; Voice irrigation software module (Deployed on Mimosatek's gateway), Aug 2025)

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	A lightweight DNN-based ids for detecting IoT cyberattacks in edge computing	Minh H.T, Anh T.P, Viet V.D, Nhan NV, Hung N.M.	PTIT	Advanced Technologies for Communications (ATC)	20-22 October 2022	Hanoi, Vietnam
1	Agricultural IoT based on Edge computing	Chalee Vorakulpipat, Ekkachan Rattanalerdnusorn, Sasakorn Pichetjamroen	NECTEC	(ICCAIS 2022)	21-24 November 2022	Hanoi, Vietnam
3	A novel DNN-based IDS System Combined with an LR-GA Method to Detect Attacks	Trong-Minh Hoang, Thanh-Tra Nguyen, Hong-Duc Nguyen, Duc-Thuan Luong and Van-Son Nguyen	PTIT	The Intelligent Systems Conference (IntelliSys) 2023	7-8 September 2023	Amsterdam, The Netherlands

Scientific Contribution

Presentations at International Conferences:

No:	Paper title:	Author names	Affiliation	Conference name:	The date of the conference	The venue of the conference
4	Safeguarding Devices and Edge Computing: A Responsive Anti-Scam Approach	Chalee Vorakulpipat, Montida Pattaranantakul, Soontorn Sirapaisan, Soontaree Songserm	NECTEC	CyberSciTech 2023	14-17 November 2023	Abu Dhabi, UAE
5	Investigating Agricultural IoT devices and services from cybersecurity perspectives	Kosuke, Tanizaki; Keisuke, Furumoto; Kohei, Masumi; Trong-Minh, Hoang; Yoshiaki, Shiraishi; Takeshi, Takahashi	NICT-PTIT	TU Kaleidoscope	21-23 October 2024	New Delhi, India
6	Structural Analysis of Asian and African Rice Panicles via Transfer Learning	Cong H.L, Lam T.N, Trung K.P, Le K.N, Tran H.D, Stefan J., Helene A., Pierre D., Nguyen L.T, and Hoang T.M	UET - PTIT	APSIPA ASC	December 3 - 6, 2024	Macau, China

Societal Impact

- The project will contribute to the technical proficiency of research in IoT monitoring for smart agriculture in Vietnam, edge computing in Malaysia and Thailand, and security in Vietnam and Malaysia.
- The collected dataset can be used among our members.
- The disease detection

Conclusion: Current state

1. Scientific and technological
   - Security framework development
2. Application (or system) development
   - Tomato disease detection over Drone image captures
   - Voice-Based Irrigation Control Module Operated by Farmers (local LLM)
3. Experiments including field testing
   - Deploy Apps on the farmer's mobile

Conclusion: Future work

1. Scientific and technological
   - Security framework development
2. Application (or system) development
   - Deploy optimized ML model into the IoT gateway.
3. Experiments, including field testing

   Integrated Apps into the Mimosatek system

Summary of conclusions

1. Finish almost all tasks in the project
2. Transfer the proposed models to the real farms. (01 module in action, 01 module is continued
3. Make strong collaboration (University, Institute, Experimental field, real Farms)