Visual IoT Network for Environment Protection and Disaster Prevention

Background :

One of the leading causes of air pollution problems (e.g., PM2.5) is a forest fire. It is found that about 92% of burned area in Chiang Mai are in the conservation forest and national park. Furthermore, with the problem of high steep mountainous terrain in conservation and national parks and insufficient patrol staff, it is very difficult to do the effective monitoring and firefighting task with a quick response. Using Visual IoT in the forest fire monitoring system will increase the ability to accurately assess and provide information about the situation of the scene quickly. In this project, Visual IoT will be used in conjunction with other sensors such as satellite image in order to assess the situation of forest fire.

Targets:

- System of visual IoT cameras with transmission modules
- Algorithms for forest fire detection
- Data visualization

Speaker:

Dr. Kanokvate Tungpimolrat (Project Leader)
National Electronics and Computer Technology Center, Thailand

Visual IoT Network for Environment Protection and Disaster Prevention

Project Members :

National Institute of Information and Communications Technology (NICT)
Mapua University
University of Computer Studies, Yangon (UCSY)
National University of Laos (NUOL)
National Electronics and Computer Technology Center (NECTEC)
Sirindhorn International Institute of Technology (SIIT)
King Mongkut's Institute of Technology Ladkrabang (KMITL)

Project Duration : June 2022 – May 2024 (2 years)

Project Budget: 40,000 USD/year

Project Activities

2022 (Nov) - **2023** (Nov)

- Training at NICT (19-21 Dec 2022)
- Field experiment in Chiang Mai, Thailand (1-2 Jan 2023)
- Field experiment in Chiang Mai, Thailand (6-16 Jun 2023)
- Field survey in Naypidaw, Myanmar (17-18 Aug 2023)
- Workshop/Training in Yangon, Myanmar (21-24 Aug 2023)
- Workshop/Training in Vientiane, Lao PDR (4-8 Sep 2023)

Activities in Chiang Mai (Thailand)

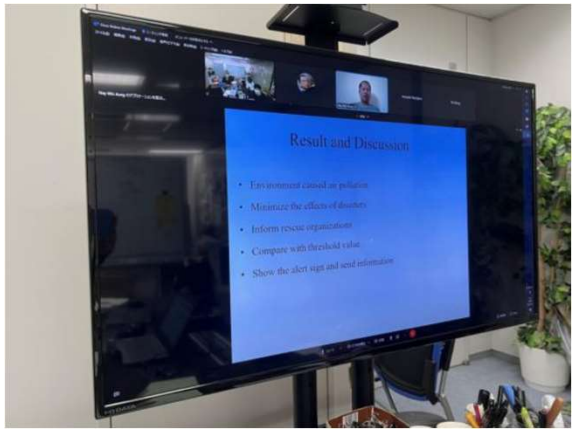
Activities in Yangon (Myanmar)

Activities in Vientiane (Lao PDR)

Project Activities – 1. Training at NICT (19 – 21 December 2022)

Viaul IoT system installed at NICT

1. To update the progress and review current activities
2. Visual IoT workshop - To learn from NICT about the Visual IoT system for applications in each country.
3. To discuss on the design of the tailor-made Visual IoT systems to be applied to all systems.
4. To discuss on the action plan and budget plan for future activities in each country.



Visual IoT workshop at Dr. Murata Lab (NICT)

2. Field experiment for smoke/fire detection dataset development in Chiang Mai (1 – 2 Jan 2023)

The procedural activities are summarized as follows.

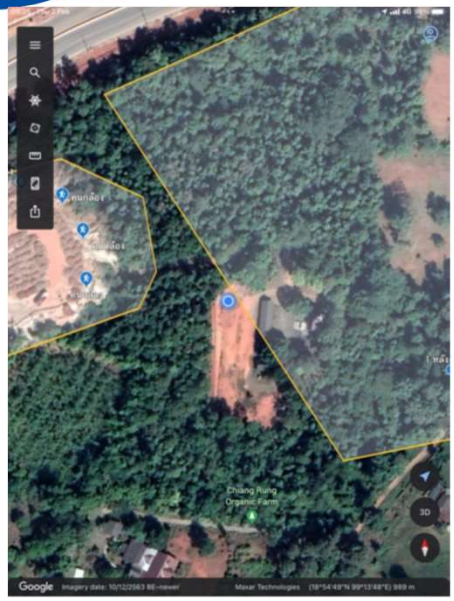
- Local government officers responsible for setting fire were ready at a planned and designated position (fire spot)
- They made smoke for half an hour for one fire spot.
- Four cameramen, including one at the top of tower, were ready to take photos (snapshot and video) from before the appearance of smoke until it died out.
- Once the fire was set, the camerapersons took photos from different viewpoints simultaneously.
- Then, the local government staff moved to the following designated spot and repeated the procedure.

Meeting with local government officer

Local government staffs

Fire / smoke setting and extinguishment

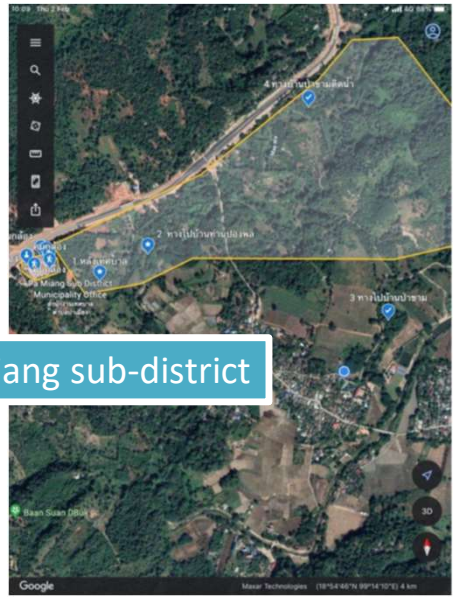
2. Field experiment for smoke/fire detection dataset development in Chiang Mai (1 – 2 Jan 2023)



Area #1 (18º54'49'' N 99º13'48'' E)

Area #2(18º54'38'' N 99º13'55'' E)

4 areas in Pa Miang sub-district



Area #3(18º54'46'' N 99º14'10'' E)

Area #4(18º54'06'' N 99º13'38'' E)

This field experiment aims to develop an image-based dataset for the training, validation and testing of forest smoke/fire detection models in Chiang Mai, Thailand. The activity is crucial to this project's objective since the model's performance depends upon the quality and quantity of the dataset.

During our experiment at Pa Miang, we got an instant order from the Chiang Mai government office to temporarily terminate and postpone the experiment. Because the Chiang Mai government office just launched a no-burn policy. And the subdistrict office got such a message after a few hours that the experiment started. -- the experiment at the other 4 locations in other sub-districts could not be continued --

3. Field experiment for smoke/fire detection dataset development in Chiang Mai (6 – 16 Jun 2023)

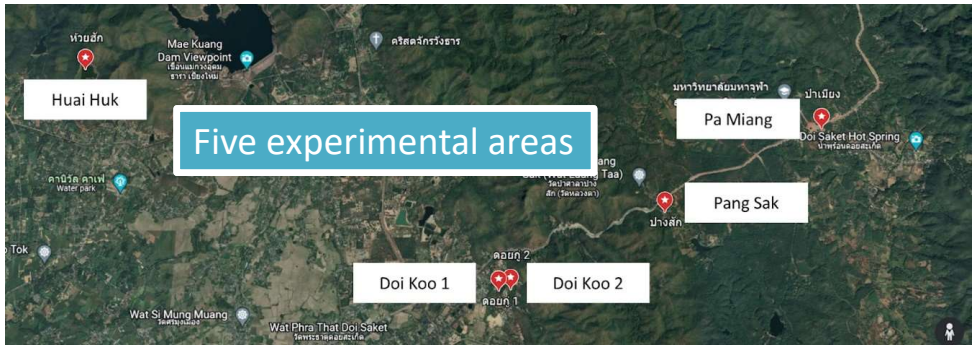
After no-burn policy period, the 2nd field experiment for developing an image-based dataset have been conducted in all 3 targeted sub-districts.

The dataset is open for project member to access.

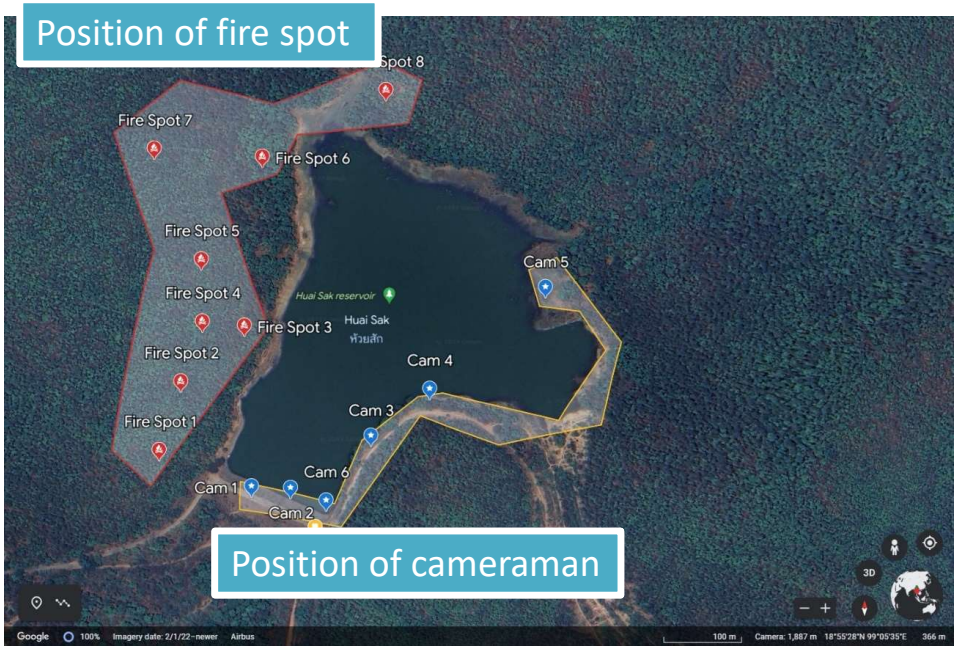
Area	Location	Total number of fire spots	#Photos taken
1. Huai Huk	lat 18.9245582, long 99.094015	8	4,355
2. Pa Maing	lat 18.9145094, long 99.2284893	7	3,977
3. Doi Koo 1	lat 18.8854613, long 99.1708773	5	2,580
4. Doi Koo 2	lat 18.885279, long 99.1706582	4	1,887
5. Pang Sak	lat 18.9026969, long 99.203065	5	1,843
Total number of photos taken in this field experriment			14,642

Five experimental areas, as planned, include

- Huai Huk (lat 18.9245582, long 99.094015),
- Pang Sak (lat 18.9026969, long 99.203065),
- Doi Koo 1 (lat 18.8854613, long 99.1708773),
- Doi Koo 2 (lat 18.885279, long 99.1706582), and
- Pa Miang (lat 18.9145094, long 99.2284893),



3. Field experiment for smoke/fire detection dataset development in Chiang Mai (6 – 16 Jun 2023)



Experiment site at Hua Huk (Nong Yang sub-district)

3. Field experiment for smoke/fire detection dataset development in Chiang Mai (6 – 16 Jun 2023)

Hua Huk area

Pa Miang area

Example of images in the dataset

Doi Koo #1 area

Pang Sak area

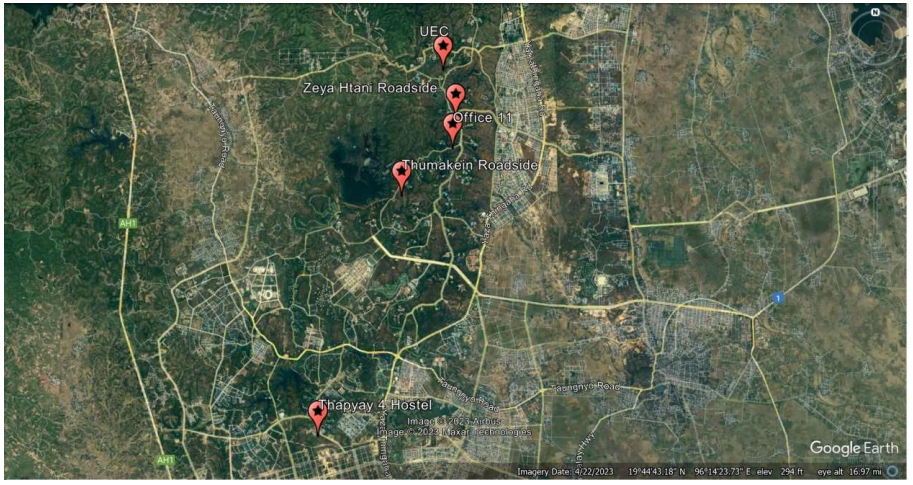
Field survey – 17-18 Aug 2023

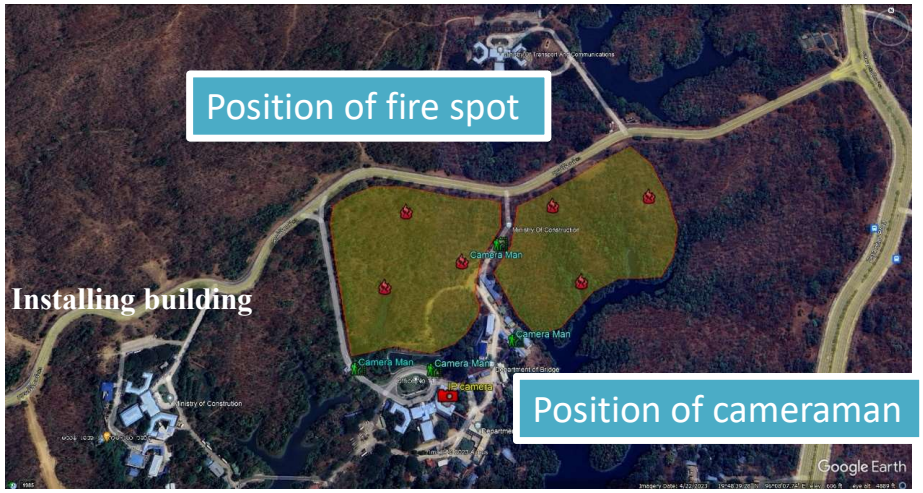
Five Experimental Areas

- Zeya Htani Roadside (lat 19.8215805, long 96.1347508)
- UEC (lat 19.8370015,long 96.1305619)
- Office 11 (lat 19.8122702, long 96.1337410)
- Thapyay 4 Hostel (lat 19.7231362, long 96.0896800)
- Thukamein Roadside (lat 19.7973553, long 96.1167706)

Date : 10/2/2023, Time :09:50 am

Recent forest fire in Napidaw (NPT), Myanmar





5. Workshop/Training in Yangon, Myanmar (21-24 Aug 2023)

1. To update and review current activities in Thailand and Myanmar
2. To organize a hand on workshop/ training on accessing to the server of datasets taken from the sites in Chaingmai and tools as well as methodology for machine learning development to the participants in Myanmar including researchers in UCSY and local partners.
3. To discuss to the local partners in Naypidaw as shown about the targeted areas and exact locations of Visual IoT system installation. Furthermore, to do the detailed survey of environment in surrounding area including the existing tower or building to install the Visual IoT system and quality of the 4G LTE signal in the areas. *- We change to visit UCSY, since the travelling time from Yangon to Naypidaw takes about 6 hours during current situation in Myanmar.*

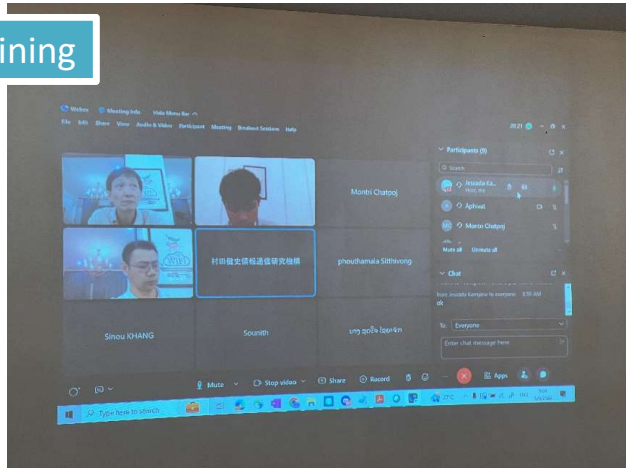
Workshop/ Training

Visiting to UCSY

6. Workshop/Training in Vientiane, Lao PDR (4-8 Sep 2023)

1. To update and review current activities in Thailand and Lao PDR
2. To organize a hand on workshop/ training on accessing to the server of datasets taken from the sites in Chaingmai and tools as well as methodology for machine learning development to the participants in Lao PDR including researchers in NUOL and local partners.
3. To discuss to the local partners in Sangthong district about the targeted areas and exact locations of Visual IoT system installation. Furthermore, to do the detailed survey of environment in surrounding area including the existing tower or building to install the Visual IoT system and quality of the 4G LTE signal in the areas. *- It was raining, so we could not climb up to the targeted location on the hill for detailed survey.*

Workshop/ Training



Visiting to Sangthong district

Presentations at International Conferences:

- Conference paper: “Forest Fire Detection and Warning System for Disaster Prevention”, 20th International Conference for Computer Applications(ICCA) (https://www.ucsy.edu.mm/ICCAConference23.do, Feb 27-28, 2023 in Yangon, Myanmar (presented by UCSY team)
- Conference paer: “Vision System for Recognition of Water Level, Rain Water, and Flood Detection”, 2023 IEEE 14th Control & System Graduate Research Colloquium (ICSGRC 2023) (https://ieeemy.org/section/events/2023-14th-ieee-control-system-graduate-research-colloquium-icsgrc-2023/), Aug 5, 2023 in Shah Alam, Malaysia (presented by Mapua team)
- Conference paper: “FireSpot: A Database for Smoke Detection in Early-stage Wildfires”, The 18th International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP 2023) (https://isai-nlp-aiot2023.aiat.or.th/), November 27-29, 2023, in Bangkok, Thailand (presented by NECTEC team)

Societal Impact

- A direct social impact of this project has two folds. The first one is a practical surveillant system for environment protection and disaster prevention in wide area utilized by local government agencies in order to minimize the damage that may occur both to health and property. For the second fold, the visual IoT system could be applied in other domains, such as smart mobility, smart agriculture, and smart tourism.

Vientiane (Lao PDR)

Naypidaw (Myanmar)

Chiang Mai (Thailand)

Conclusion

Activities that have been done so far in 2023 are summarized as follows.

- **Workshop/Training Meetings**: 3 workshops, 3 sites
  - Japan, Myanmar, Lao PDR
- **Field experiments:** 2 field experiments, 5 areas in 3 sub-districts
  - Chiang Mai (Thailand) – Nong Yang, Pa Miang and Choeng Doi sub-district
- **Field survey:** 1 field survey, 1 area
  - Naypidaw (Myanmar)

Plan

	2023		2024					
	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Field experiment in Myanmar								
Field experiment in Lao PDR								
Equipment purchasing								
Equipment installation								
Machine learning development								
Data visualization design & implementation								
Data collecting and system verification								
Technical papers preparation & submission								
Final report								