[PROJECT TITLE: An Energy Efficient, Self-Sustainable, and Long Range IoT System for Drought Monitoring and Early Warning]
[Traveling to Field Test Sites]
Report Form

I. Proposer:

Name:	Hoang Van Phuc
Position:	Member/Project secretary
Institution:	Le Quy Don Technical University

II. Objective:

In this field travel trip, we aim to investigate the conditions of Red delta river basin region and perform experiments with the monitoring stations for the developed drought monitoring and early warning system. The experiment place of this field travel trip is the Red delta river basin region in Phu Tho province in the north of Vietnam (with the distance from Hanoi is around 120km) where the hazard of drought is very serious. The experiments in this field travel trip provides the results of LoRa coverage, RF EH module efficiency and data of sensor modules for the final report of this project. Especially, with this trip, we will discuss with local officers about the deployment plan of the developed drought monitoring and early warning system when the project is completed.

III. Schedule:

Date	Location	Work	Person in charge
1st day	Hanoi - Phu Tho province	Travel from Hanoi to field site; Discussion with local officers about drought in Red delta river basin region	All
2nd day	Phu Tho province	Investigate field test region	Nguyen Van Trung
3rd day & 4th day	Phu Tho province	Test the LoRa coverage	Hoang Van Phuc, Nguyen Van Trung
5th day	Phu Tho province	Test the RF EH module	Hoang Van Phuc
6th day	Phu Tho province	Test the sensor modules	All
7th day	Phu Tho province - Hanoi	Discussion with local officers about deployment when the project is completed; Travel from field site to Hanoi	All

IV. Participants:

No.	Name	Organization	Itinerary
1	Hoang Van Phuc	LQDTU	February 21-27, 2022
2	Nguyen Van Trung	LQDTU	February 21-27, 2022

V. Summary of the activities corresponding to the objectives

In this field travel trip, we performed different experiments using the rental water monitoring station at the field site (including the station space, meeting room, electricity, basic sensors, etc. available in the station). The experiments of testing the RF EH module and the sensor modules need to be performed continuously (daytime and nighttime). Based on this investigation, we have estimated the number of LoRa nodes and monitoring stations required for the prototype system in this river basin region.

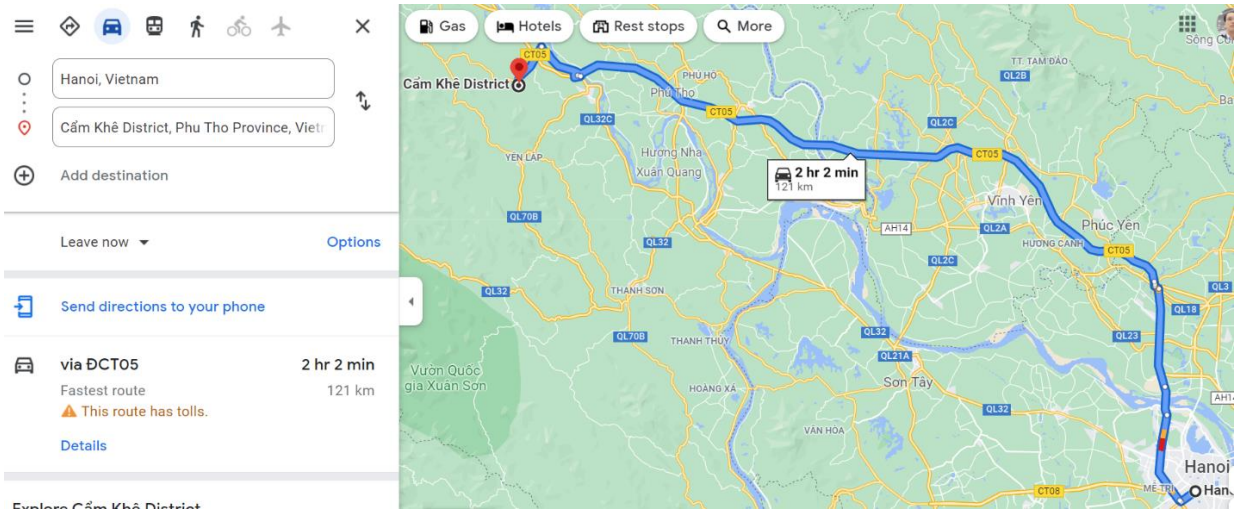

Figure 1. The way from Hanoi to the experimental site.

From that data collected by the IoT sensors, the IoT gateway and sever help to provide the general conditions of drought in the river basin region, as shown in Figure 2.

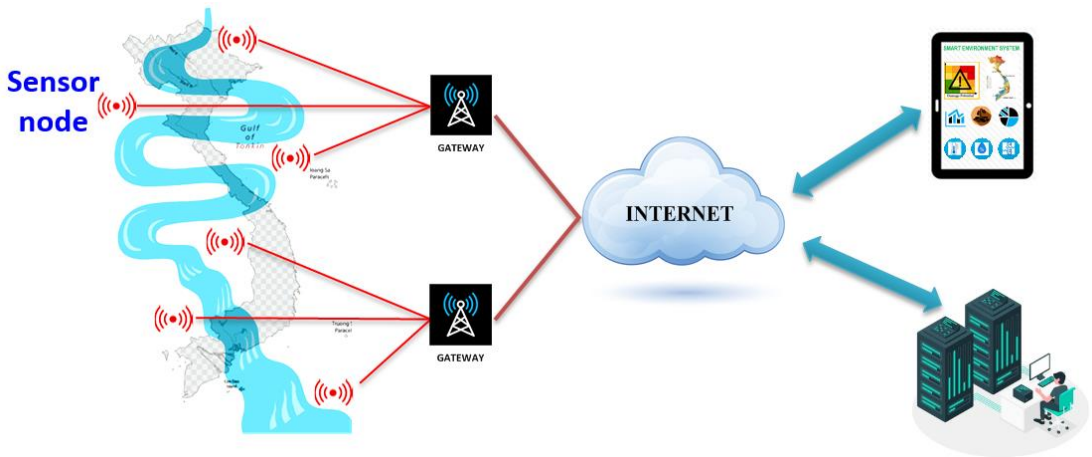

Figure 2. System structure for site experiments.

Especially , we tested the coverage and maximum communication distance of LoRa nodes. It shows that we can achieve the maximum distance of 2500m without special power amplifiers.

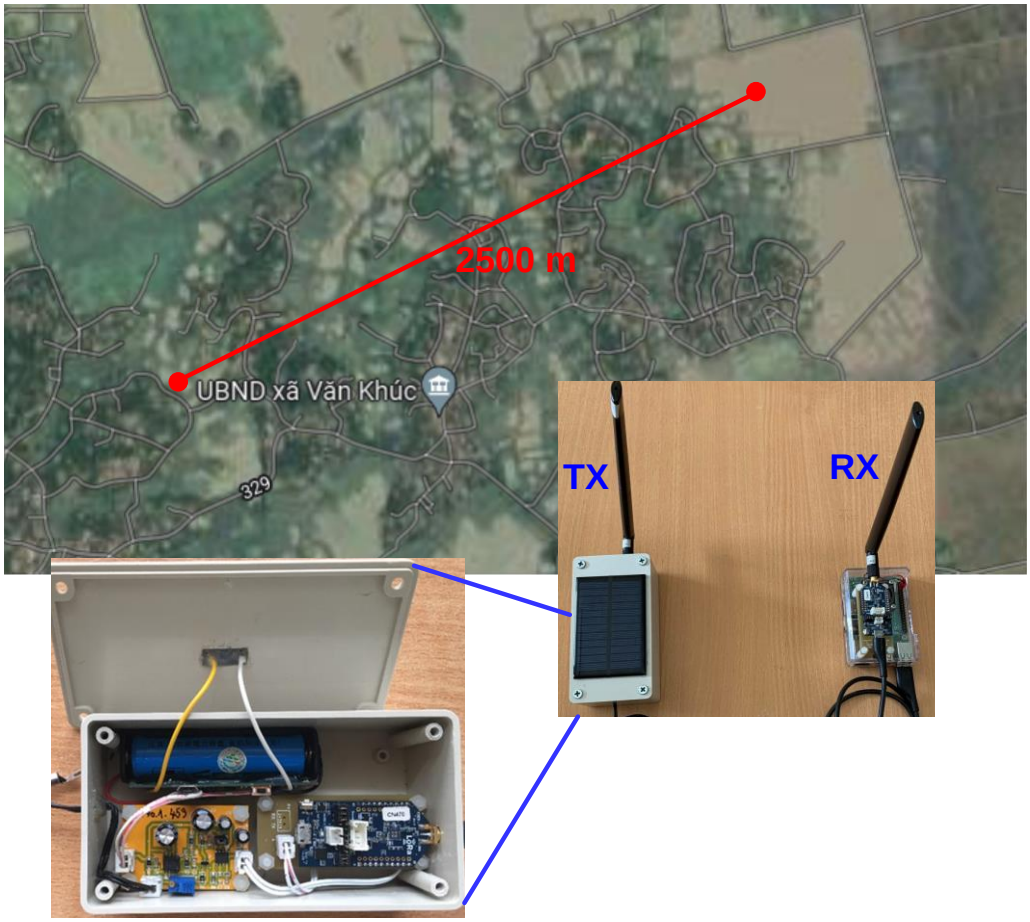

Figure 3. Testing the maximum communication distance of LoRa nodes.

For RF EH testing, we have performed experiments in the field site to estimate the output DC voltage generated from the RF signal. With the operating frequency at GSM-900, GSM-1800 and 2.45 GHz, we obtained the measured DC output level of 643mV which can provide supply voltage for various IoT devices, as shown in Figure 4.

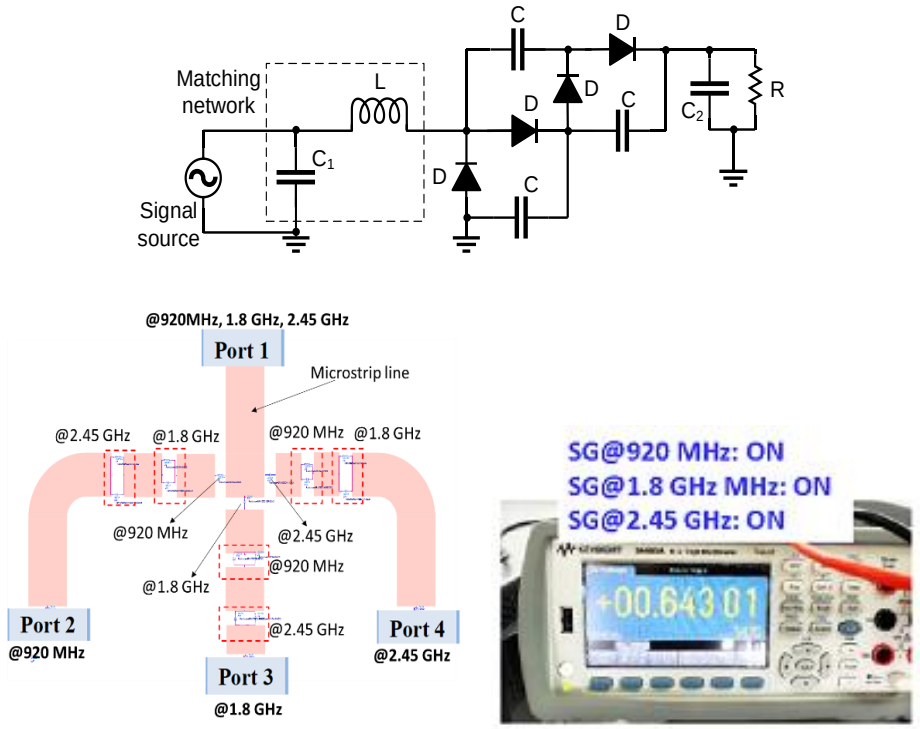

Figure 4. RF EH module testing.

For testing the sensor modules, we set up the experiments on the river basin with the new designed Beat temperature sensors, as shown in Figure 5. The LoRa board works at 433 MHz, the spectrum spreading factor values of SF = 7, 12, and the bandwidth of 500 KHz for testing the sensor module. The real system experiments have shown that the maximum communication distance of 1700m can be achieved. Moreover, the energy consumption to transmit one ID is only 0.05462 Ws (54.62 mWs). On the other hand, the energy consumption without ID transmitting is 0.00315 Ws (3.15 mWs).

During the discussions with local officers, we expect that after the project finish, the developed IoT system will be transferred for using in this water monitoring station. The research team from LQDTU will build the completed IoT system based on the outcome of this project and send to local officers for installing in the water monitoring station. The IoT sensor data from the water monitoring station will be sent to sever at LQDTU so that the situation of drought hazard at the river basin area can be monitored and predicted.

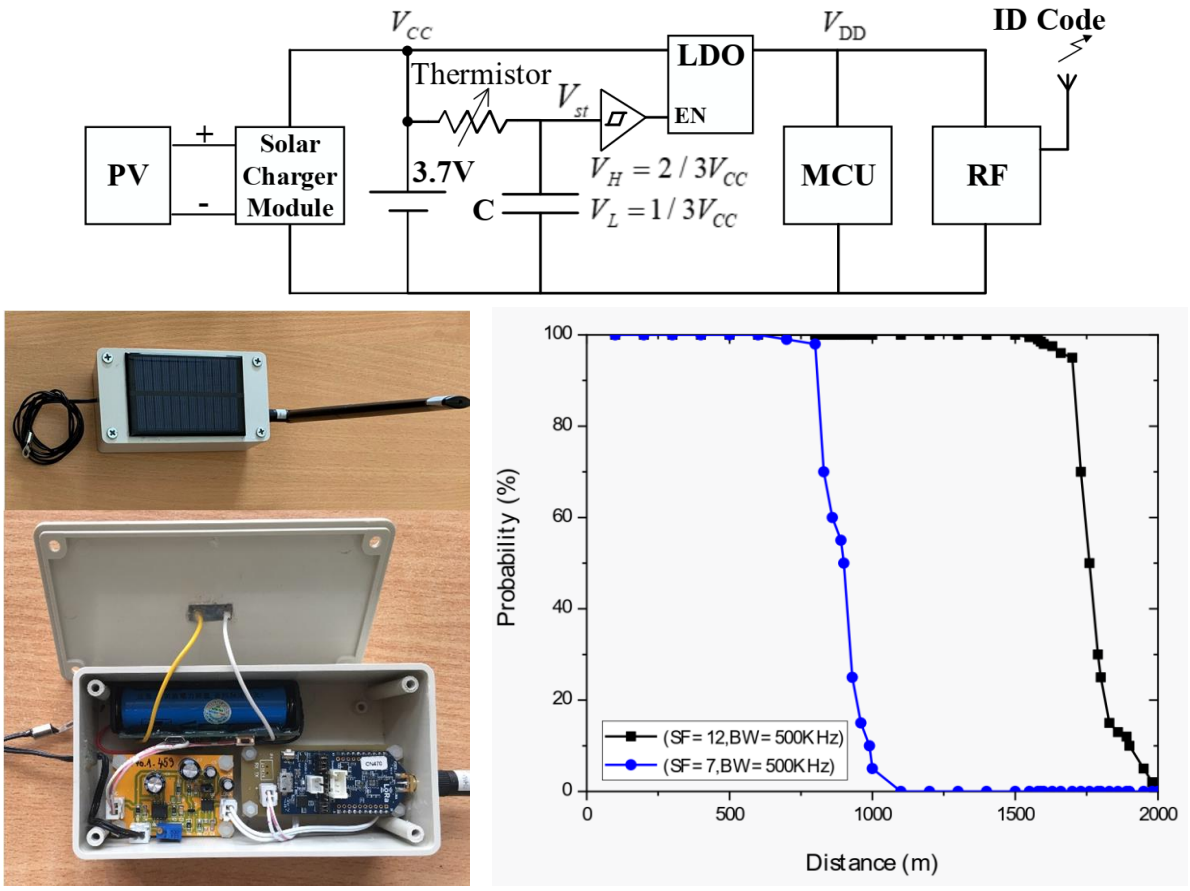

Figure 5. Testing the sensor modules.

VI. Others

Some other pictures as follows.

(a)

(b)

Figure 6. Red river basin in Cam Khe Van Khuc village, Cam Khe district, Phu Tho province