A Design for IoT Based Smart Watering System Using LoRa

Khin Than Mya
UCSY, Yangon, Myanmar
khinthanmya@ucsy.edu.mm

Myint Myint Sein
UCSY, Yangon, Myanmar
myint@ucsy.edu.mm

Thi Thi Soe Nyunt
UCSY, Yangon, Myanmar
thithi@ucsy.edu.mm

Udom Lewlompaisarl
NECTEC, Thailand
udom.lewlomphaisarl@nectec.or.th

Yasunori Owada
NICT, Miyagi, Japan
yowada@nict.go.jp

***Abstract*— ASEAN countries are agricultural country and Rice is the main food of the country. The watering of plant is a major factor in agriculture and can impact on the productivity and product yields. In this paper, Design of IoT based Smart Watering System Using Long Range (LoRa) Network is proposed to promote the smart agriculture in the country. The system collects data from paddy field using IoT devices and stored data in cloud server. That will design and monitor the weather stations, sensor nodes, valve-control nodes, and a controller node which is based on the concept of mesh-topological, low-power wireless network platforms.**

Keywords— IOT, Sensors, LoRa, Smart agriculture

I. Introduction

Nowadays, the automatic plant watering system become popular and help people by reducing their times and energies. To reduce the manpower and wastage of water, the IoT based smart watering system is developed for farms.

This paper is a part of the ASEAN IVO project. It is a joint project of NICT(Japan), NECTEC (Thailand) Together with UTB (Brunei) and UCSY (Myanmar), we are working on a project "A mesh-topological, low-power wireless network platform for a smart watering system". This project will be connected by LoRaWAN mesh-topology to send data from farms of Myanmar and Brunei to NECTEC sever in Thailand. This research will greatly contribute to agricultural development in ASEAN countries.

There are some related research of smart watering systems[1-3]. Y. OWADA et.al., [4] presented the architecture and configuration of a mesh topological network. S.N. Ishak et. al., [2] developed the Irrigation system using Raspberry Pi. S. K. Nagothu et. al [3] has been developed a smart watering system using weather and soil sensor. In their system, the data has been collected and send by adopting sensor and weather. The disadvantages of the system have been overcome by need based irrigation system.

II. Process of the System

The proposed system can be used to automatically monitor the temperature, soil moisture and water level. In addition, this system can also be used two sensor nodes equipped with four sensors: water level, soil moisture, pH and underground water, 4 gates created to control the water in the paddy field, two values to control the water in the canal, and two weather stations. The overview of the proposed design of smart watering system is shown in Fig. 1. This system also controlled to measure soil moisture, water level, temperature sensor, and respectively.

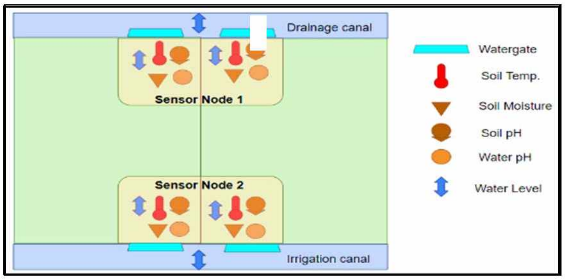

Fig. 1. Overview of smart watering system

III. LoRa/ NerveNet

Low Power Wide Area Network (LPWAN) protocol supports long range, low-cost, deep indoor penetration, energy-efficient, mobile, and secure end-to-end bi-directional communication for Machine to Machine (M2M) and Internet of Things (IoT) applications.[1]

NerveNet provide LoRa Mesh demon and when user configure the LoRa wireless node, user set the parameter onto LoRa Mesh demon. Node & network topology and configuration will be automitaclly done by NerveNet. NerveNet provide the API for application program. When application program receive/send data from/to another node, application program access to database only. NerveNet provide the database on each node with synchronization of data with other nodes. Fig. 2 shows the design of propose system on NerveNet/LoRa.

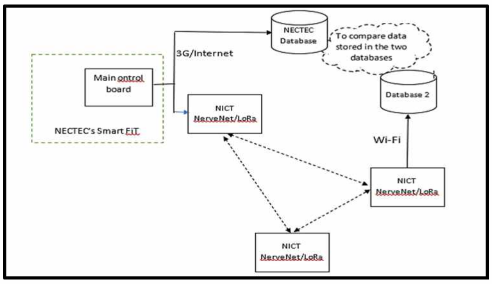

Fig. 2 Design of NerveNet/ LoRa-based system

IV. System Performance

In this system, consists of four main parts, which are weather stations, sensor nodes, irrigation-valve-control nodes, and a controller node. The weather station is used to monitor meteorological data that affect the plant growth. The monitored data include humidity, air temperature, rain precipitation, wind direction and speed, and light intensity. The weather station detects these parameters every 5 minutes.

Sensor nodes are installed and distributed around a farm to detect the soil moisture, as well as the air temperature. The soil

978-1-7281-9802-6/20/$31.00 ©2020 IEEE

moisture data can be used as a factor (i.e., there could be other factors) in making a decision on irrigation-valve controlling. A controller node is a node that makes any decision regarding the watering plan. Also, the controller node serves as a gateway that transmits collected data to a cloud database in NECTEC. Fig. 3 shows the testing for circuit, in which the sensors sense the data from Drainage canal, Irrigation canal, and Weather station and then sends to the controller.

Fig. 3. Testing for circuit design

An irrigation-valve-control node controls irrigation valve according to commands received from the controller node. Each node is powered by a rechargeable 7.2-Amp-Hour lead-based battery connected to a solar panel. The irrigation valve used in this project is called a latching solenoid valve, which changes its operational state by feeding it the energy for a short period of time (e.g., 20-10 millisecond). Using this type of valves, we can implement a system that controls the irrigation valves with low energy, and we can design the irrigation-valve-control node to control at most 4 valves simultaneously.

Fig. 4. Irrigation test for paddy field

In addition, a few sensors, such as a water meter and/or water pressure sensor, can be added to this node to monitor and check the water system. Fig. 4 shows the system implementation and testing field at Khalauktayar village, Yangon Division in Myanmar.

V. Experimental Setup

The data from the sensors at Inlet node, Outlet node and Weather Station will be sent to the NECTEC server using the LoRa technology. Inlet node and outlet nodes can be sensed Drainage canal , Field, Sensor level and Solar power supply using Water level, Soil moister, Soil pH, Soil temperature, Water level, Water pH, and Pressure Sensor. Outlet can also be collected Irrigation canal, Field and Solor power supply. Weather station can be sensed Signal quality of GSM, Barometer, Humidity, Light, Rain, Temperature, Wind direction, Wind speed and Solar power supply. Collected data are sent to the controller, these data will be sent from control to the NECTEC Server (http://agritronics.nstda.or.th). Fig. 5 shows data grapes from Paddy Field in Myanmar to server in NECTEC, Thailand. The data table in the cloud server can be accessed as data sets and analyzed in Fig. 6. Once the data has been processed, the Watergate will be controlled depending on the water requirements.

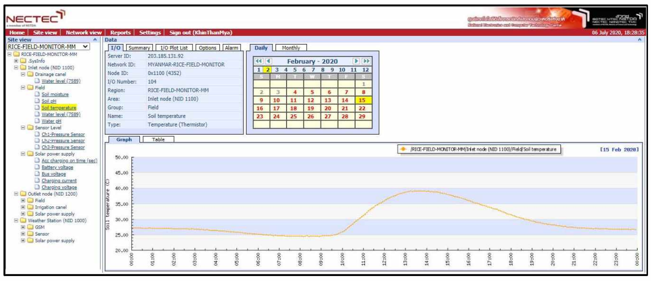

Fig. 5. Data Collected from paddy field to NECTEC server

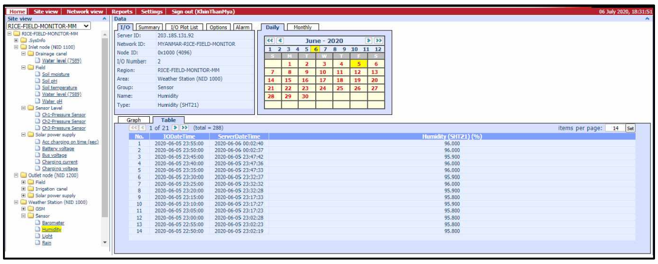

Fig. 6. Data collected from weather station to NECTEC server

VI. Conclusion

A design of the IoT based smart watering system with LoRa/ NerveNet is proposed. It will help to people to prevent the wastage of water, time, cost, and manpower used in farming and increase the efficiency of the irrigation process. A direct social impact of the proposed system is straightforward; this means improving both the quality of agricultural production and quantity. So it can be a solution to the world's food shortage crisis. Furthermore, it has many impacts on various applications that share the same technological infrastructure.

Acknowledgements: This publication is the output of the ASEAN IVO http://www.nict.go.jp/en/asean ivo/ index. html project titled *A Mesh-Topological, Low-Power Wireless Network Platform for a Smart Watering System* and financially supported by NICT (http://www.nict.go.jp/en/ index.html). We thank our project members (NICT-Japan, NECTEC-Thailand, UTB-Brunei, and UTM-Malaysia,) for their supports, co-operation, and collaboration. We wish to thank University of Computer Studies, Yangon, Myanmar for their partial financial support given to this research.

References

[1] http://www.libelium.com/development/waspmote/ documentation/ waspmote-lorawan-networking-guide/

[2] S.N. Ishak et. al., "Smart Home Garden Irrigation System Using Raspberry Pi", 2017 IEEE 13th Malaysia International Conference on Communications (MICC), 28-30 Nov. 2017, The Puteri Pacific, Johor Bahru, Malaysia.

[3] S. K. Nagothu et. al, "Weather based Smart watering system using soil sensor and GSM", World Conference on Futuristic Trends in Research and Innovation for Social Welfare (WCFTR'2016).

[4] Y. OWADA et.al., "An Implementation of Layer 2 Overlay Mesh Network and Edge Computing Platform for IoT", 2019 IEEE 20th International Conference on Mobile Computing and Ubiquitous Network (ICMU), 4 -6 Nov. 2019.

978-1-7281-9802-6/20/$31.00 ©2020 IEEE