Platform of Lorawan Transceiver module

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Abstract - This research article presents the design and development of a location system using a low-power wireless data network (LoRaWAN). The device is designed for tracking locations and reporting the status of specific areas. The core principle of the system is that the central processing unit collects data from various sensors, including satellite location sensors, temperature sensors, and relative humidity sensors. This data is then transmitted via LoRaWAN technology to a server, where it is processed and displayed on a map, accessible through a web server. The system provides the geographical location, specifying latitude and longitude, and displays real-time temperature and relative humidity of the nodes.

Keywords - LoRawan network system, GPS, Sensor, positioning system, wireless low power data communication network

I. Introduction

Thailand relies heavily on imported IT equipment, primarily from countries such as China, the United States, and Europe. These manufacturers design IoT devices to be compatible with their own platforms, which have servers located abroad and use English as the default language. Recently, Thailand has begun developing its own platforms and IT systems, operating at frequencies between 920–925 MHz, as licensed by the NBTC. The primary applications in Thailand involve smart farms, smart factories, and military uses, such as providing location coordinates via network systems.

LoRaWAN is a system created to support the M2M and IoT markets. It enables the prototypeeof low-power data connections for long-distance communications using radio wave designed to support very low signal levels. The system ensures the transmission of low-power signal over long distance.

Based on this principle, we aim to address the challenge by creating a domestic platform and server system in Thailand that supports almost all industrial sectors. The system will be commercially viable and will support operations on both Windows and Raspberry Pi server systems. It must be capable of transmitting data and being utilized in both commercial and military applications.

From the above principles and rationale, Jang proposes to develop a signal transceiver platform using LoRa devices to explore ways to develop IoT devices that can be locally implemented using cellular networks to transmit data to a display system via GPS [1], [2], and temperature sensors through short messages.

In this paper, we also take the concept of the above research and develop our own platform of Lorawan Transceiver module with Thai language on our own premise Server.

II. Long-range wireless low-power data communication network (Lorawan)

Long-distance communication technology, or LoRa, is an abbreviation for Long-Range, developed by the Semtech company. LoRa technology is permitted for use in Thailand in the 923 MHz ISM band [3]. It operates with bandwidths (BW) [4] of 125, 250, or 500 kHz, depending on the frequency bands allowed in each country. LoRa technology operates on the LoRaWAN Stack protocol, as depicted in Fig. 1, which is regulated by the LoRa Alliance [5].

The working principle involves a tracking device that transmits data to a destination through a gateway. Generally, the communication range is at least 10 kilometers. The gateway acts as an intermediary, forwarding client information to the server via a TCP/IP network through either a LAN system or a mobile network.

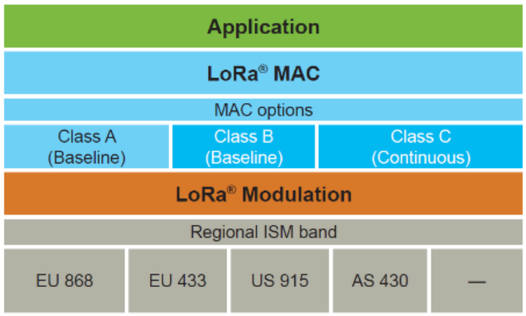

Fig.1 Protocol LoRaWAN Stack

LoRa is an emerging technology that plays a key role in today's smart IoT architecture. A chirp spread spectrum modulation technique is used in LoRa [6], though it remains susceptible to interference and noise. Therefore, LoRa technology is of particular interest in areas where it is being studied, developed, or applied.

III.SYSTEM DESIGN

A. Working Principles of Nodes

The transmitter will send the first set of data as blank data to test the signal [7]. After that, it will receive the values of the GPS sensor and the temperature sensor after the Arduino has received the values of both sensors. Will send data through the Lora Chip, but in the case that neither sensor can receive the data, the code will loop in waiting for the value. each sensor so that data can be sent further, as depicted in Fig. 2.

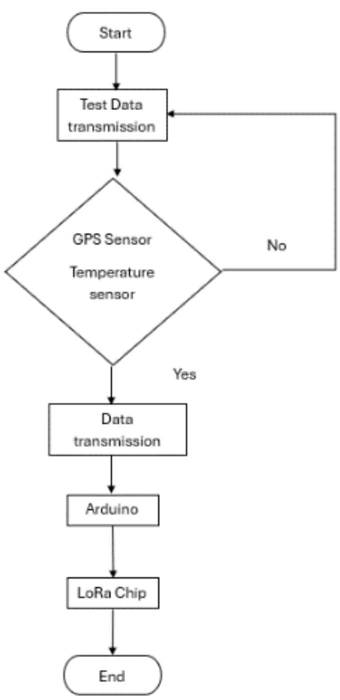

Fig. 2 Diagram Design of System Structure

B. Working Principles of Gateway

The receiver will receive the signal through the LoRa chip on the Raspberry Pi to import data into the ChirpStack program. After receiving the value, it will decode. To forward the received data via MQTT to Node-red after receiving the data. The data will be separated. to import data into SQL Server, as depicted in Fig. 3.

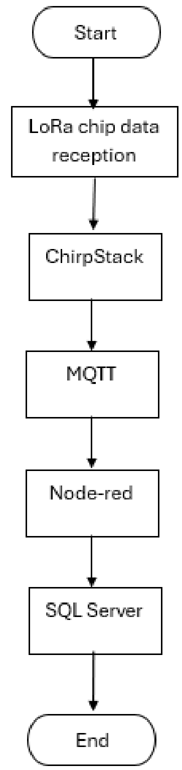

Fig. 3 Diagram Design of System Gataway LoraWAN

C. Chirpstack working principle

the data is received from the transmitter through the RFM95W chip and check whether the transmitter has been activated or not after detecting that it has been activated. Filter the data that the transmitter sends data after. The filter is finished. Data will be displayed through the Device Data page and exported via MQTT, as depicted in Fig. 4.

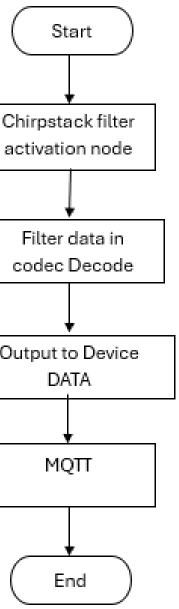

Fig. 4 Diagram Design of Chirpstack

D. Node-red working principle

The Chirpstack values are received through MQTT to enter Node-Red. After converting the entered values, it will convert Node-Red's JSON to filter the data that will be imported into SQL Server by filtering the required data. After that, SQL will be written to be imported into the SQL Server, as depicted in Fig. 5 and Fig. 6.

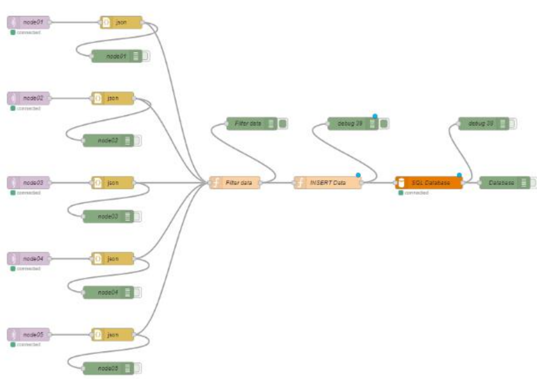

Fig. 5 Diagram of Node-RED

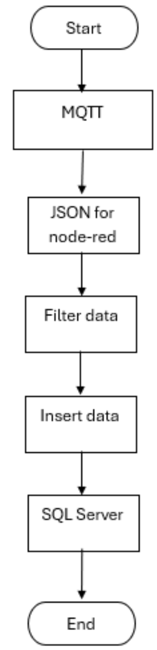

Fig. 6 Diagram Design of Node-RED receive

E. Working Principles of Dashboards

The dashboard will work through Node-RED system. Node-red will retrieve data from SQL Server. After that, Node-red will send the data to the dashboard that was programmed. as depicted in Fig. 7 and Fig. 8.

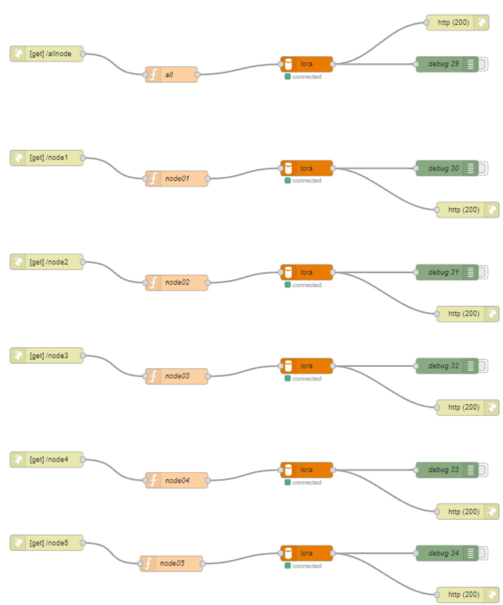

Fig. 7 Diagram of Node-RED Dashboard

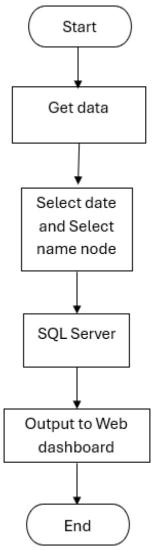

Fig. 8 Diagram Design of Node-RED Dashboard

IV. SYSTEM IMPLEMENTATION

The design of position reports equipment with temperature through the LoRaWAN platform. It combines a Raspberry Pi with a GPS sensor and a temperature sensor to transmit data to a receiver station in the 923 MHz frequency band. This study aims to explore the feasibility of being able to report location and display data through the Dashboard website.

A. Transmission LoraWAN Prototype

The principle of the prototype is that a neo-6M GPS sensor module and receive GPS signals and a DHT22 that receives temperature values. It then sends location and temperature coordinates to the Arduino Uno 3 board. Next, the Arduino converts the data to the RFM95W chip and sends the data to the gateway, which receives the data, as depicted in Fig. 9.

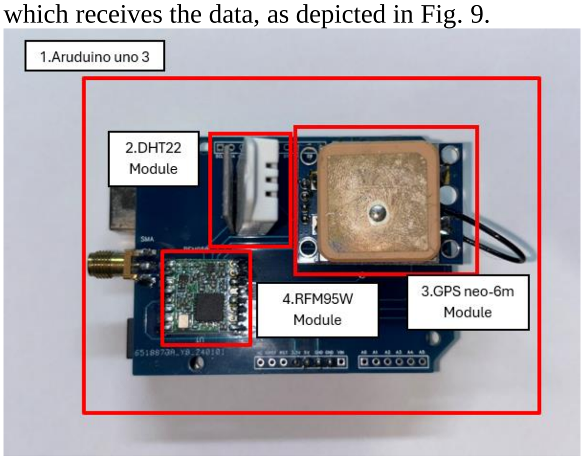

Fig. 9 Transmission LoraWAN Prototype

B. LoRaWAN Gataway Prototype

After receiving data through the RFM95W chipset and entering it through the Raspberry Pi into Chirpstack of the Raspberry Pi itself, the data will be sent to Chirpstack of the Windows server. It will be converted after received from the Transmission LoraWAN prototype and forward it through MQTT to be entered. There is also Node-Red, which is used to estimate results and extract data to be sent to the data storage database, as depicted in Fig. 10.

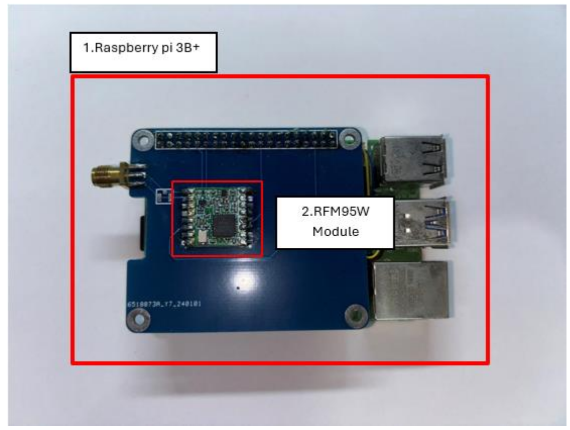

Fig. 10 LoRaWAN Gataway Prototype

V. EXPERIMENTAL RESULTS

As part of the experiment, detection and notification, thetest was performed via LoRAWAN to test the system's connectivity performance. In the display of the Transmission LoraWAN Prototype, the test results are:

A.Chirpstack received data

The gateway will forward the received data to the network server and application server, respectively. through the mobile phone network system. The application server can display details of information received from the device, as depicted in Fig. 11 and Fig. 12 .

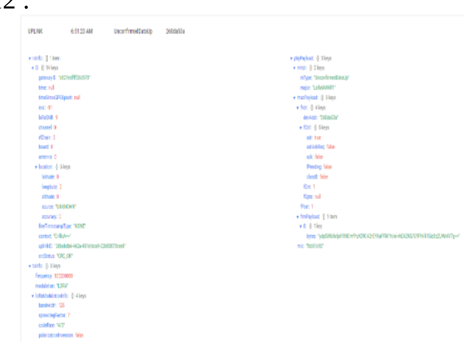

Fig. 11 Details within the data frame displayed on ChirpStack Application Server system.

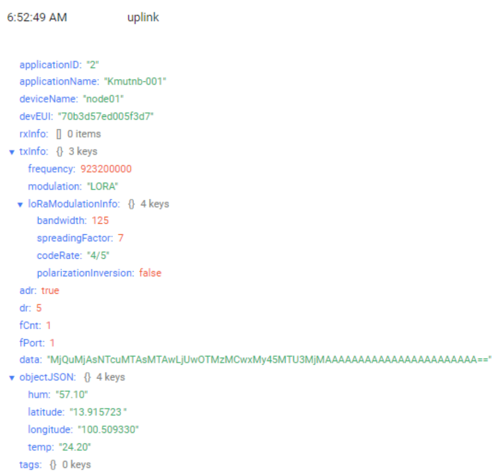

Fig. 12 Details within the data frame displayed on ChirpStack Application Server Filter data

B. Web dashboard

The data is displayed on the web dashboard. 1. Name of the device 2. Show the location of the device. 3. Show temperature values. Relative humidity can be displayed on the Web Dashboard, as depicted in Fig. 13.

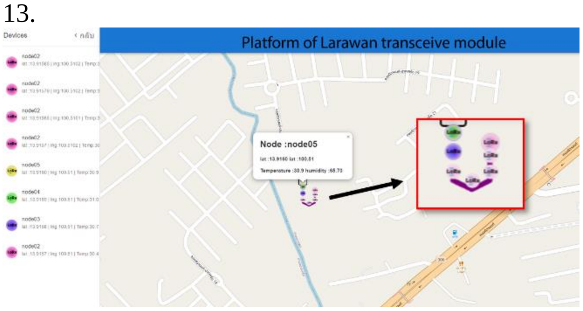

Fig. 13 Dashboard on web site

VI.CONCLUSION

This paper presents the design and development of a LoRaWAN transceiver module platform for transferring GPS location, temperature, and humidity data using LoRaWAN technology. The LoRaWAN modules can be used for any IoT devices. With this platform, we demonstrate the successful transmission of data with a historical log file. This confirms the platform's capability to replace any cloud server platform provided by manufacturers, eliminating concerns about service termination from other country manufacturers.

Acknowledgement

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