A Study of Weather Conditions for Developing a Local Weather Forecast Web Application.

Student Name

Mr. Teerawat Saenum

Mr. Kasidach Pratheep Na Thalang

Mr. Natthawat Soontreewong

Teacher Name

Mrs. Patchara Pongmanawut

Miss Apasri Chumchuen

.

Princess Chulabhorn Science High School Trang

Thailand

5th March 2024

Abstract

Currently, Thailand has 1-2 weather stations per province to collect weather data, analyze and forecast daily. However, due to the diverse topography within provinces and the unstable weather, forecasting has become more difficult. Therefore, we would like to study weather conditions, including temperature, humidity, and rainfall, in each district of Trang province. Then we retrieve data from weather station. And processing by LSTM model to forecast weather data to display on web application and LINE Chatbot. Statistical analysis revealed significant differences in temperature and rainfall amounts in each district at a statistically significant level of .05. Thus, we aim to create a web application for reporting specific area weather conditions via a Chatbot with 100% accuracy. Additionally, weather forecasting using an AI-powered web application, utilizing neural networks called Long Short-Term Memory (LSTM), has achieved 85% accuracy. Interested individuals can access this information through the web application or LINE Chatbot, facilitating planning for various activities.

Keywords: Meteorological station, Long Short-Term Memory (LSTM)

Research Question

1. Are the weather conditions different in Mueang Trang district and Yan Ta Khao district of Trang province?

2. Could our web application report weather conditions and forecast the weather in Mueang Trang district and Yan Ta Khao district?

Research Hypothesis

1. The weather condition in Mueang Trang district and Yan Ta Khao district of Trang province are different.

2. Our web application can report weather conditions and forecasts the weather in Mueang Trang district and Yan Ta Khao district.

Introduction

Currently, Thailand provides local weather reports and forecasts for each province, utilizing weather data from weather stations and satellites. However, each province typically has only 1 - 2 weather stations. Trang province, for instance, has only one weather station located in Mueang Trang district. The diverse topography across districts in the province poses a challenge to accurately report weather information; while it may be accurate in Mueang Trang district, it may not be consistent in other districts. Moreover, climate change exacerbates the challenges of weather forecasting. Research from the University of Mumbai highlights the increasing frequency and intensity of heat waves, heavy rain, snowstorms, prolonged droughts, frequent tropical storms, and rising sea levels. These factors contribute to varying weather conditions across

different districts in Trang province. Recognizing these challenges and the resulting inaccuracies in weather reporting and forecasting, researchers aim to install weather stations in each district, such as Yan Ta Khao district, Huai Yot district, and Kantang district. This will enable the analysis of weather differences across the province. To provide accurate and precise weather information to people in each district, a web application for local weather forecasts has been developed. This application covers Mueang Trang district and Yan Ta Khao district, collecting data from weather stations and processing it using the LSTM (Long Short-Term Memory) model. The forecast results are displayed through the web application. Additionally, real-time weather conditions can be viewed via a Line Chatbot, aiding individuals, including farmers, in planning various activities more effectively.

Material

1. Digital thermometer
2. Digital hygrometer
3. Rain Gauge

4. Anemometer
5. Kidbright board
6. Google Colab

Method

1. Study sites

This research was conducted to survey the weather conditions at two study sites: Yan Ta Khao district, Trang province, located at coordinates latitude 7.40371°N, longitude 99.64787°E, and the weather station at Princess Chulabhorn Science High School, Mueang Trang district, Trang province, located at coordinates latitude 7.51226°N, longitude 99.62070°E.
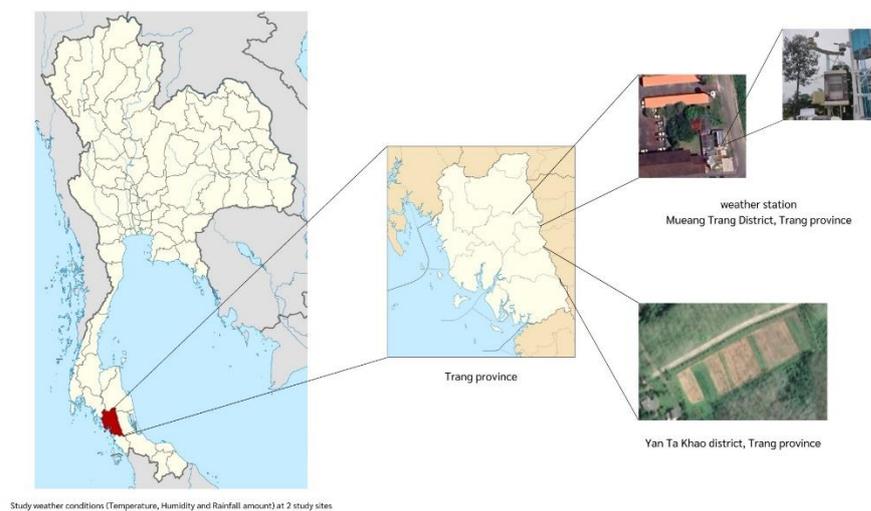

Figure 1 Study sites

2. Data Collection

Collect weather condition data including temperature, humidity, and rainfall at 2 study points using GLOBE method during May - October 2023 as follows.

2.1 Measuring air temperature using a digital thermometer by requiring the thermometer to read the temperature every noon.

2.2 Measuring relative humidity in the air using a digital hygrometer.

2.3 Measuring the rainfall amount using a rain gauge to collect rainfall data once a day (every 24 hours) at noon (Solar noon).

2.4 Send data to GLOBE Data Entry.

3. Creating a web application for local weather forecasts.

3.1 Steps for training the LSTM model for weather forecasting

3.1.1 Data preparation

to make a model understand input data and arrange data to 20 previous hour weather data and 1 hour future data then separate data 80% for training data and 20% for testing

3.1.2 Modify a lstm model by add input layer, hidden layer and output layer of neural network model

3.1.3 Evaluate model

1. Check a loss graph to prove that model didn't overfitted

2. Check mean square error of model

3.2 Creating web application using JavaScript CSS and HTML and use Vercel for hosting the web application

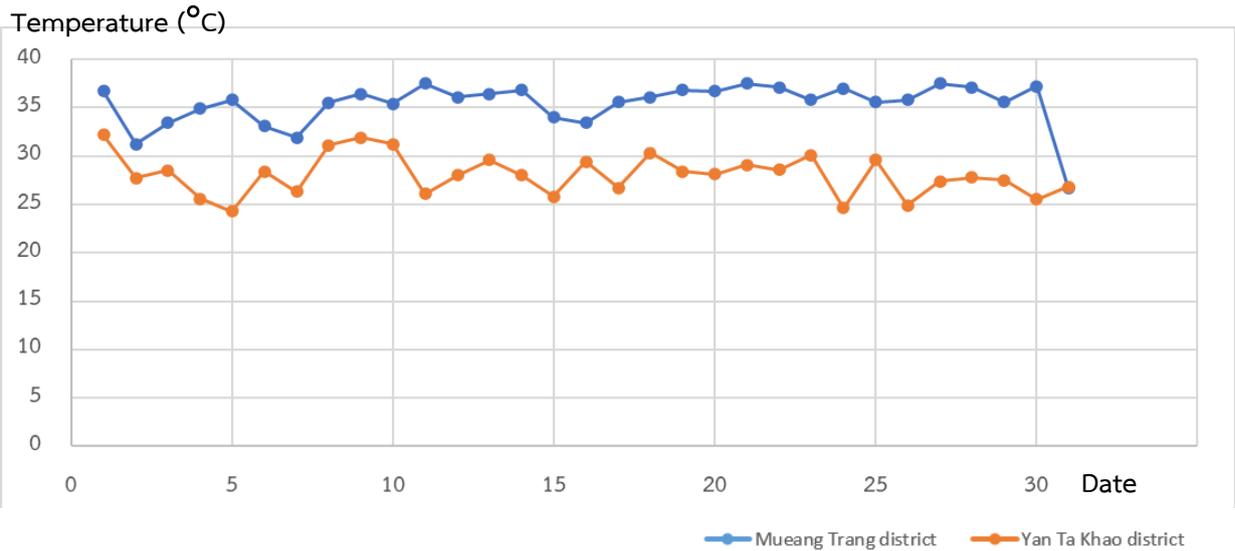3.3 Creating Line Chatbot using Python.

4. Data Analysis

4.1 Use t-ststistic to analyze the differences in weather conditions between Mueang Trang district and Yan Ta Khao district at the significance level of .05 using Microsoft Excel.

4.2 Using Root mean squared error in Google Colab

Results

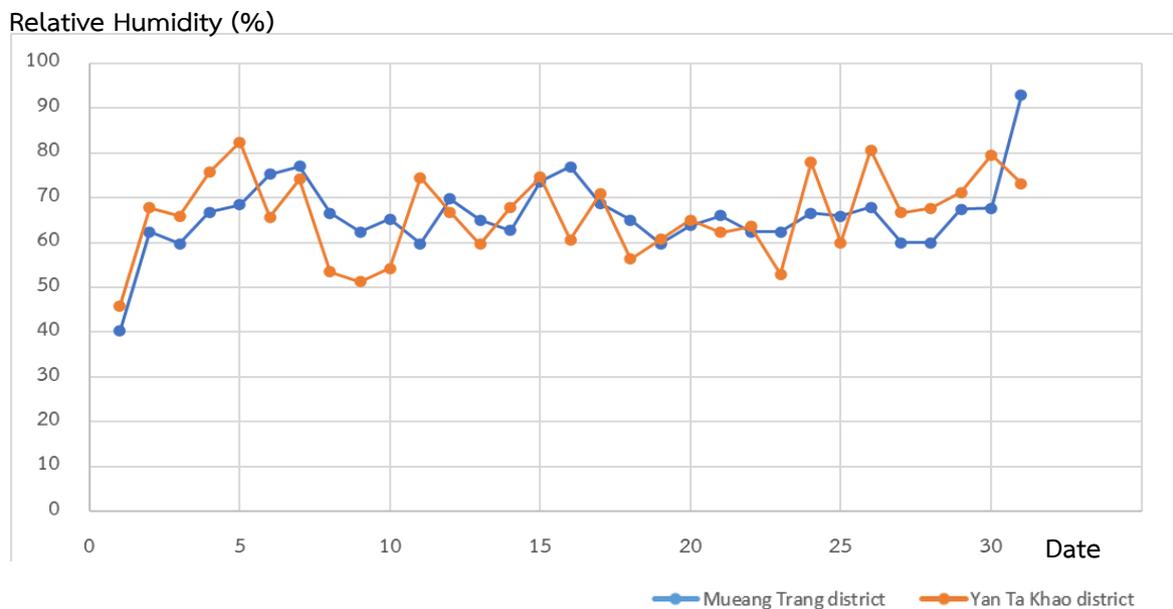**1. Results of the Study on Weather Conditions in Mueang Trang district and Yan Ta Khao district, Trang province.**

1.1 Average temperature of Mueang Trang district and Yan Ta Khao district, Trang province, in October 2023, as shown in Graph 1.

Temperature (^{o}C)

Graph 1 Shows the relationship between the average temperature of Mueang District. and
        Yan Ta Khao District

        The average temperatures of Muang and Yan Ta Khao districts, Trang province, in October 2023, as
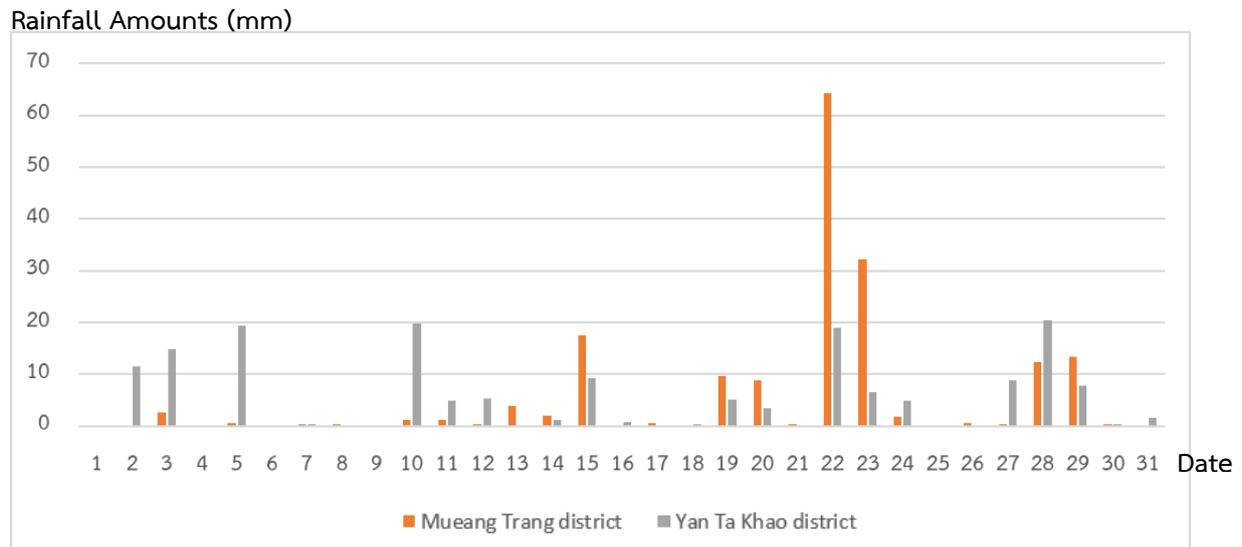shown in Graph 1, were found to have statistically significant differences at the .05 level.

        1.2 Relative humidity of Mueang Trang district and Yan Ta Khao district, Trang Province, in
October 2023, is shown in Graph 2.

Relative Humidity (%)

Graph 2 Shows the relationship between the relative humidity of Mueang District. and
        Yan Ta Khao District

        The relative humidity of Muang Trang and Yan Ta Khao districts, Trang province, in October 2023,
as shown in Graph 2, were found not to differ significantly at the .05 level.

1.3 Rainfall in Mueang Trang district and Yan Ta Khao district, Trang Province, in October 2023, is shown in Graph 3.

Rainfall Amounts (mm)

Graph 3 Shows the relationship between the rainfall amounts (mm) of Mueang District. and
Yan Ta Khao District

The rainfall amounts of Mueang Trang and Yan Ta Khao districts, Trang province, in October 2023, as shown in Graph 3, were found to have statistically significant differences at the .05 level.

From the study of weather data in Mueang Trang and Yan Ta Khao districts, it was found that temperature and rainfall significantly differ at the .05 level due to the topographical differences between the two districts. Therefore, we developed a weather data reporting and forecasting application based on these findings

2. Creating a web application for local weather forecasts.

2.1 From the evaluation of the LSTM model, the model has a Mean Square Error of 2.830, indicating that the model predicts rainfall amounts with errors. However, upon observing the graph, it can be inferred that predictions regarding the occurrence of rain are accurate.
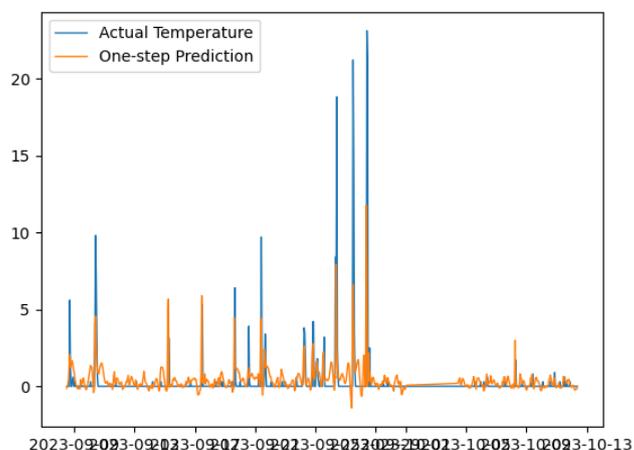

Figure 2 The model has a Mean Square Error

2.2 Results of the study on putting data into a Line Chatbot to report weather condition.
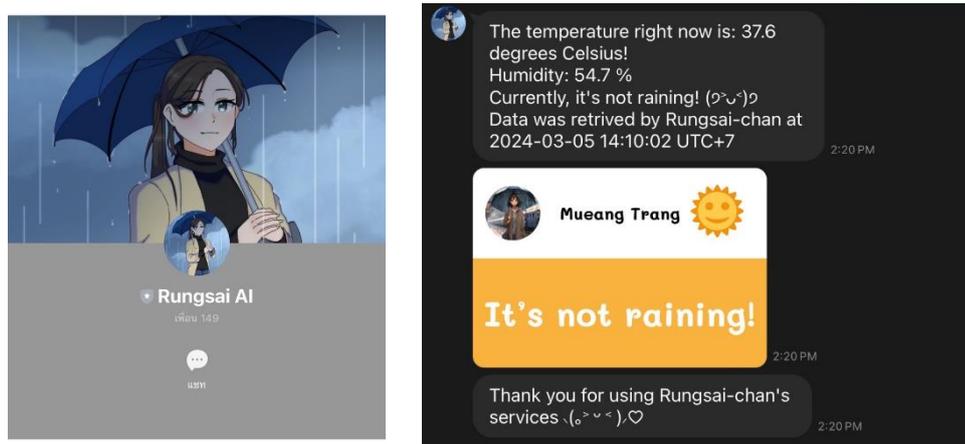

Figure 3 – 4 Weather condition report via Line Chatbot

From the study. The weather condition reported by the Chatbot is 100% accurate.

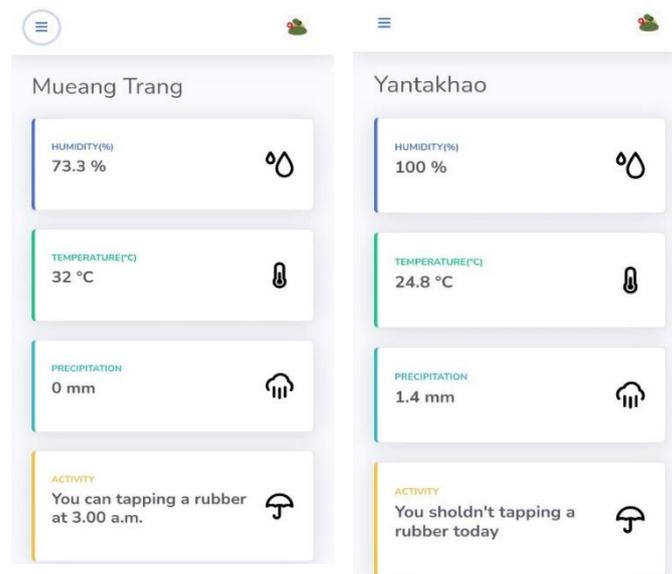2.3 Results of a study of weather forecasts from a created web application.

Figure 5 – 6 Weather forecast report via web application

From the results of the study, it was found that weather forecast report via created web application has an accuracy of 85%.

Conclusion

The study of weather conditions, including temperature, relative humidity, and rainfall amounts, in Mueang Trang and Yan Ta Khao districts of Trang province revealed that the temperature and the amount of rainfall during October 2023 are statistically significantly different at the .05 level, but the relative humidity of the air in both districts is not different. Therefore, we propose to create a web application to

report weather conditions using a chatbot and to forecast weather in specific areas. This aims to increase the accuracy of weather information, allowing people in the district to receive more accurate forecasts. The study found that the chatbot was able to report weather information with 100% accuracy, while web applications built to forecast weather conditions were 85% accurate. From the results of the study, it was concluded that weather condition reports and forecasts from web applications for specific areas can be utilized and are beneficial to the people in those districts who wish to obtain weather information and plan their activities.
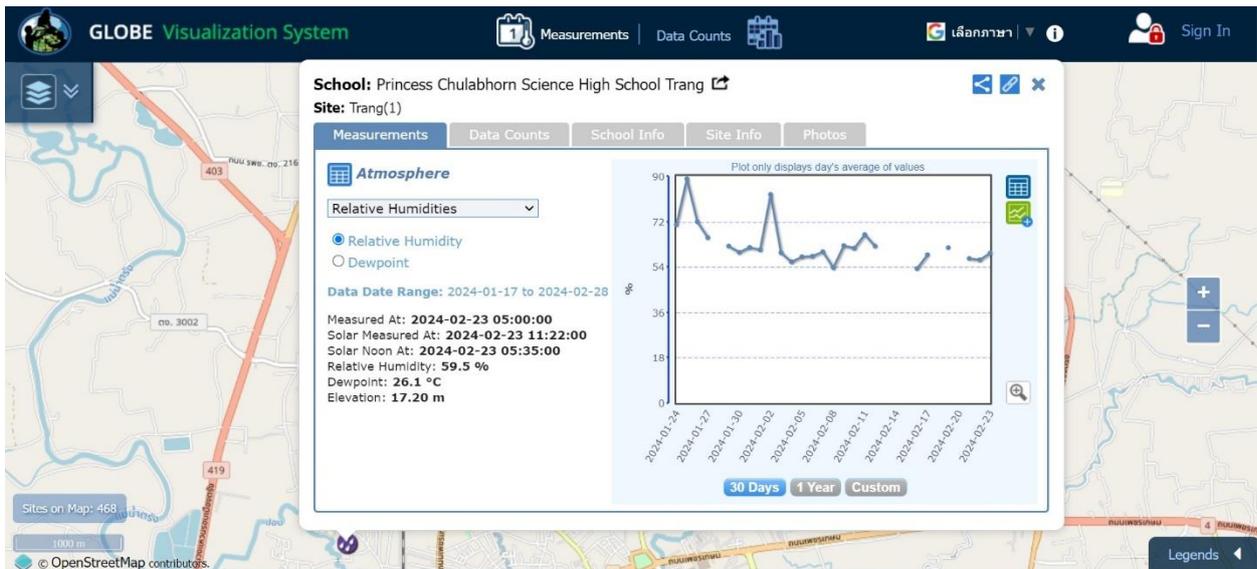
Discussion

From studying weather condition data in Mueang Trang district and Yan Ta Khao district, both are different because topography of Yan Ta Khao district is next to the sea and has mountains. For Mueang Trang district, the topography is mostly plain Therefore, if we install a weather station in each district in Trang province. Collected data and analyzed so that we can get more accurate weather information for specific areas which will be beneficial to the people in that district.

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Weather condition data in GLOBE Data Entry

Optional Badge

I make an impact

Our research focuses on reporting local weather condition and forecasts. This initiative aims to provide residents in the district with weather condition details, including temperature, relative humidity, rainfall amounts, and weather forecasts for the following day. Such information aids farmers and community members in planning their activities, such as rubber tapping, fishing and other activities.

I am data scientist

In this research, we collect daily weather data from weather stations in Mueang Trang District and Yan Ta Khao District. Then analyze the gathered data and develop an LSTM model to report weather information and forecasts for the next hour to achieving precise predictions necessitates a substantial amount of data.

I am collaborator

Throughout this research, all team members are actively involved in collecting weather data and are assigned specific duties in various sections. These duties encompass weather data analysis, creation of weather report and forecast models, and development of a web application. Additionally, we have collaborated with officials from the Meteorological Department of Trang Province to verify weather information in Mueang Trang District. Moreover, we have engaged with the Yan Ta Khao district community to test the usability of the web application we developed.