Development of real-time Smart Weather Station and Web Processing Service for Monitoring and Evaluation of field Environmental Data Based on IoT and FOSS4G

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ABSTRACT

Real-time environments monitoring such as temperature and humidity has become a crucial thing especially in the era of climate change that results in global warming. The problem of global warming has resulted in a number of illnesses, including illnesses such as heat stoke which, if we have a robust climate observation system. This will allow us to protect and be harmless from these hazards.

The aim of this study is to develop the low cost weather station to monitor specific environmental elements. A number of Inter of Things (IoT) technologies have been used to form the proposed system. Wireless Sensor Network (WSN) and Ethernet are the main technologies that are utilized with the propose station. The design of the weather station consists of three parts: Hardware using arduino, wemos-d1, software using arduino IDE, QGIS and Web application. Web application has designed using FOSS4G such as JavaScript, PostgreSQL/PostGIS, Geoserver, Openlayers, AJAX, PHP, HTML, CSS. The automate measuring process of the data from weather station has implemented using ZOO WPS. This web app has been shared on the public server to be accessed and monitoring the Heat Stress Index (HIS) in real-times.

keywords *Web :GIS, Internet of Things, Web Processing Service, Wireless Sensor Network*

1. INTRODUCTION

The accurate assessment of the quality of temperature can support the effective decision making on the effects from the surrounding environment in which continues to change its conditions. Therefore, the assessment process to verify the temperature conditions is aimed to be activated in order to notify human or other living things who will be affected (Zeqiang *et al.,* 2016). In order to support decision making in a real-time situation, the current sensor system technology has been applied and more accepted because of its ability to collect data. The monitoring data such as temperature, humidity etc. can be automatically collected through a programming language and sends data to the database. It has been further

integrated with sensor system technology and Geographic Information System (GIS) using Free and Open Source Software for Geospatial (FOSS4G) which is free of charge. The integration aimed to develop the process spatial analysis so the environmental data analysis will be more effective.

The analysis of weather applies GIS, web processing service(WPS), and spatial interpolation. This technique can present the data in a graphical and spatial format and the result of the analysis through internet system which can access the real-time data. The data have been managed by various kinds of sensor system integrating together through a web interface which can verify monitor the information received at all times from the records of the sensor system called Sensor Observation Service (SOS) (Devaraju *et al.*, 2015). The researcher has investigated the data management of a sensor system in istSOS Project, the project offering the measured data from the sensor system through a website accredited from Sensor Web Enablement (SWE). Each set of the sensor can send data across each other via ad-hoc format Wireless Sensor Network (WSN) (Vaibhavraj *et al.*, 2015). The data will be later sent to be collected in the database through the internet network and then presented through a web interface.

2. CONCEPTUAL FRAMEWORK AND METHODOLOGY

The conceptual framework by applying Internet of Things technology which is accessible through internet network from the sensor system to verify and analyze those factors that result in the weather in the study area. The data processing that accesses the spatial analysis from a web interface to warning the data can analyze the data that users can check the results of the weather. (Choosumrong *et al.*,2016).

The workflow of the sensor system that consists of the weather measuring sensor consists of air temperature, relative humidity, and light intensity measurements. The sensor receives the commands from the written instruction integrated with Arduino wemos D1 Wi-Fi board controller which transfers the data through Wi-Fi Internet.

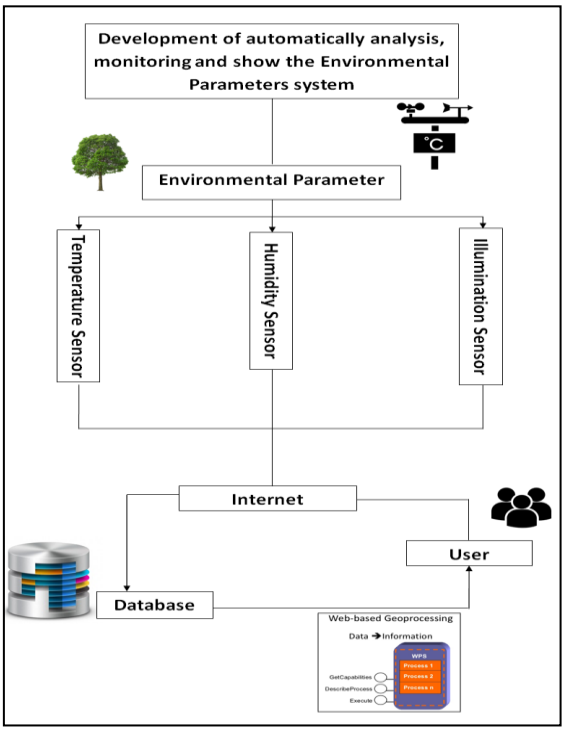

Figure. 1. Conceptual Framework

3. THE DEVELIPMENT OF DATA PRESENTATION RECEIVED FROM SENSOR MONITORING STATIONS ON A WEBPAGE

The presentation of the data received from temperature measurement is from the record of sensor monitoring stations. Those data were stored in the database without the process of spatial analysis. So, this was the process of getting data to show the real-time data in graphs from the sensor monitoring station that has recorded the database through the use of websites on the Internet, as shown in Figure 2.

Figure. 2. Examples of environmental factors. Measured temperature Show information on website

In addition, the researcher setting up Weather sensors of weather measuring sensor within the process of istSOS with the result showing in graphical format, as shown in Figure 3. The results showing though Sensor Observation service of the istSOS. This system manages and broadcasts environmental data integrating with a sensor system. The result showing was not complicated and could be developed its Web-GIS in Open Layers3 (Open source Mapping Client) to show the results in a map as shown in Figure 4.

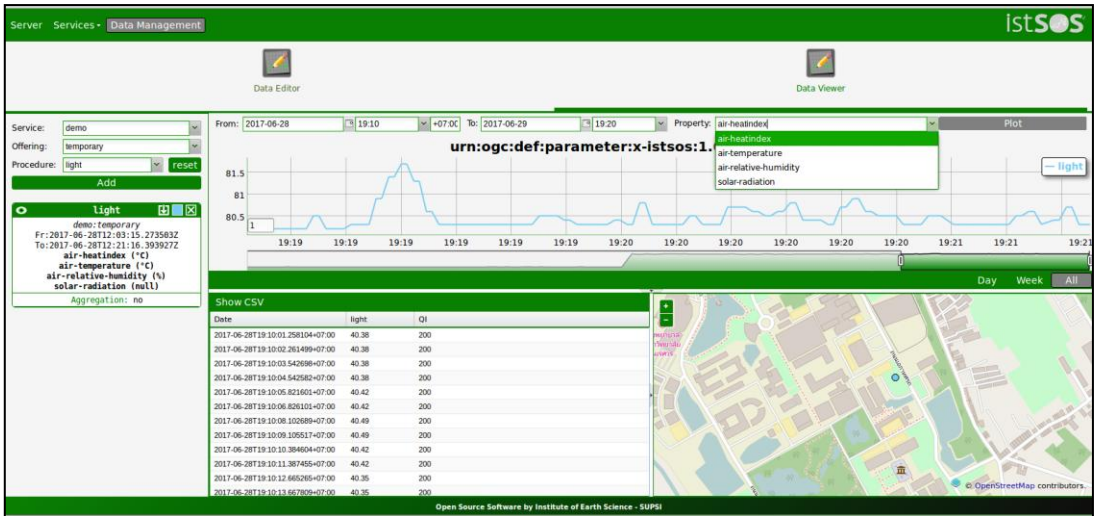

Figure. 3. Environmental Factor Display Relative humidity on istSOS system

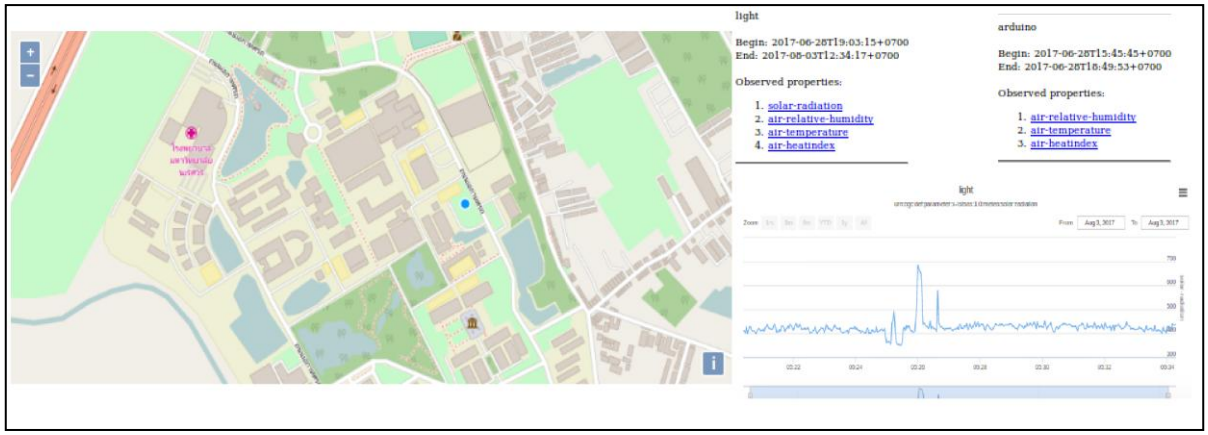

Figure. 4. Web GIS Development using Openlayers3 in Relative Humidity Measurement Display

4. DEPLOY WEATHER MONITORING TO WEB PROCESSING TO WEB PROCESSING SERVICE

The development of online weather monitoring are the process of WPS. It is a requirement of OGC for data processing using the Internet. An important part of the development of web based processing . (Hempelmann *et al.*,2017) Using ZOO-Project to work with open source software

Real-time data were taken to the database, analyzed, and showed results of the interpolation. To show the level of weather intensity measured by Grass GIS software. Grass GIS works as a library to connect with ZOO-Kernel and ZOO Service. ZOO-Kernel is the WPS server and the main part of ZOO-Project working similarly to the programs in Common Gateway Interface (CGI) which is used to identify the method of data management among web server and web browser, the standard method for the web service to transfer demands of users.

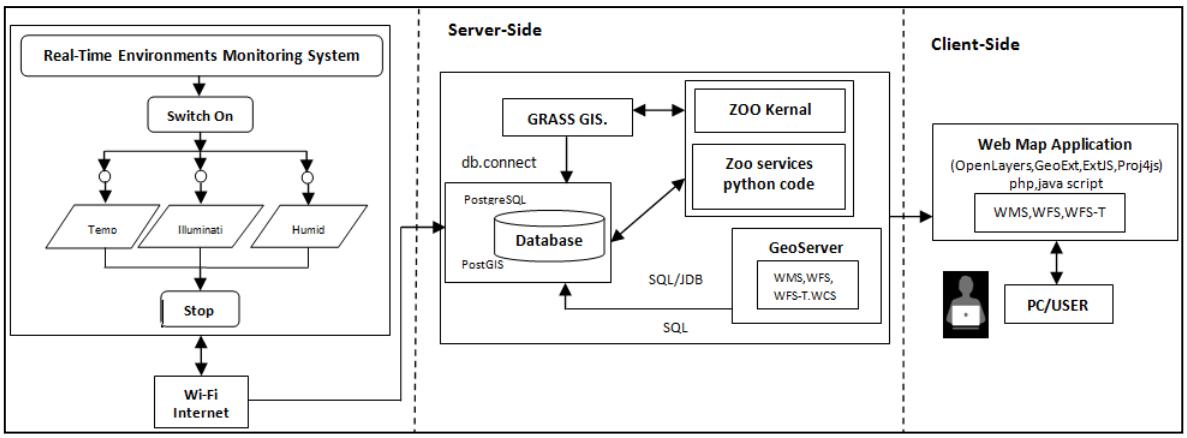

Figure. 5. The development Web based processing system

Figure 5. shows the server-side workflow which is the data analysis part. The data will be transferred to the store at PostgreSQL/PostGIS database and analyzed by using Grass GIS (Bergenheim *et al.,* 2009). The module within the program was used to process the data by applying *v.surf.idw* to evaluate spatial analysis value through Inverse Distance Weighted (IDW) interpolation. The major qualification of Grass Gis is that it works like a library connecting ZOO-Kernel with ZOO Service through ZOO Service Configuration File

(ZCFG). The analyzed data from ZOO Kernel and Grass Gis will be employed to develop the data showing on the webpage in Web Map Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS) formats by online service of GeoServer. Then, the Client-side will be developed its format by using JavaScript Library Map Framework from Heron-MC, OpenLayers, GeoExt, ExtJS, and Proj4js, to activate Web Map Service from MapServer.

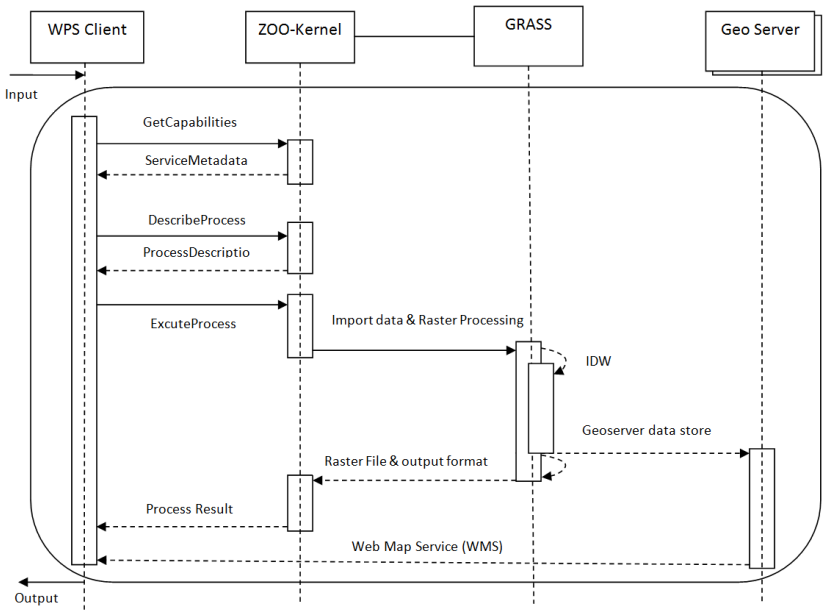

Figure. 6. uml sequence diagram The WPS and GRASS GIS

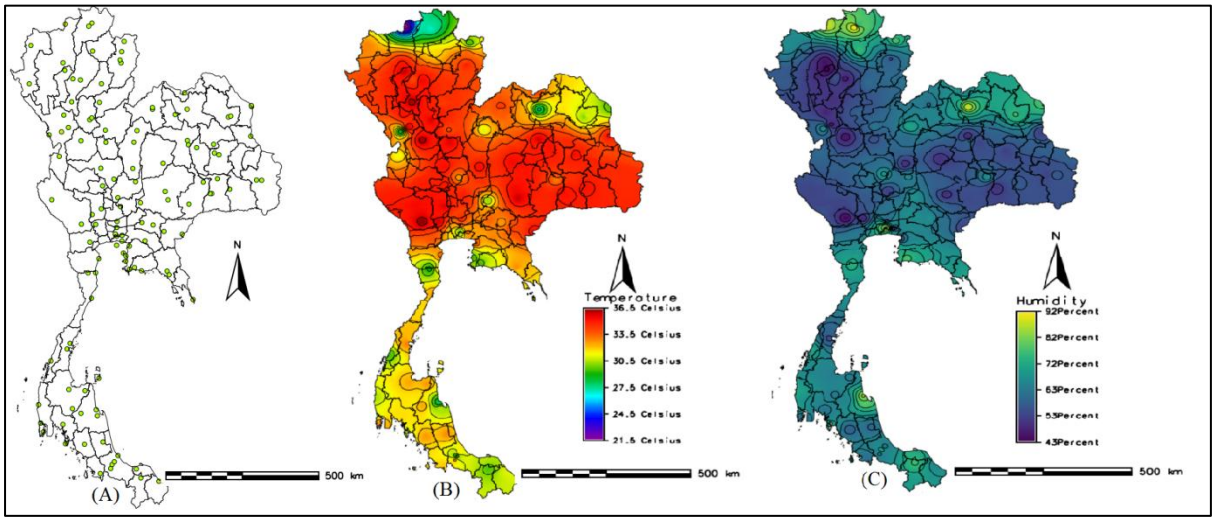

Figure 7. Results Example Instruction v.surf.idw The collected data is on 28/09/61; 13.00 from Thailand Methodological Department (A) and used in the process Inverse Distance Weighted (IDW) process shows the temperature density (B) And relative humidity (C)

5. RESULT AND DISCUSSION

Measuring real-time weather is the measurement of the air temperature. Relative humidity is the main factor in this study. the development of the system with an ability to follow up the increasing or decreasing value of the weather can help monitoring, warning, and showing the level of danger effecting on human livings. The system works and shows the results of the analysis for the intensity of the environmental factors within the study area. The development of the system applied ZOO and WPS systems and the user network connection was later developed within the Web application that connected with the database system. Users can check the data and show the results of the measured air environment from the calculation of real-time through Web Application.

6. CONCLUSIONS

The development of the online system to automatically analyze the real-time weather data, users can check the weather data from the system that measures the environmental factors and analyzes with spatial data by using interpolation. The analysis also applied the intensity of environmental factors to be integrated into the analysis; The results will be shown on the web application. As a result, users can check for accurate data which is shown in real time. The system has been developed via the low-cost software in which can be developed in open source free software. The developers can also develop the system through the low-cost hardware and software. It is convenient for many users because of its easy function and the results shown in a graphical format which are easy to read.

7. REFERENCE

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