Development of Near Real-Time analysis of Heatstroke Risk Information Service that affects to the elderly person based on Web Map Service

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Abstract

The number of elderly or citizen who is over 60 years old has been increasing every year which results in Thailand's turning into aging society and the population structure change. In addition, the labor structure has changed in order for elderlies to work. The majority work in agriculture and fishing fields.

According to the global warming, the temperature keeps higher every year. Thailand as the tropical country has been effected by the higher temperature. The disease found in summer is heatstroke, the sickness ever occurred only in summer. The elderly who are in the risk group must be taken care of.

The objective of this study is to present the application of Open Data Kit (ODK) technology to collect the elderly data which can reduce the error and time period to record the data. It also helps the data surveying and collecting to be effective and accurate based on the clients' demands. Moreover, the application supports the development of heat index resulting in heatstroke in elderly, higher than 32 degrees Celsius, which makes elderly to be in the risk group. The data analysis will employ the developed Open Source Software and support projects. FOSS4G is the GRASS GIS, ZOO, and Web Processing Service that have been developed to be the web application, which can present the data in graph and map on the internet. The clients can monitor the real-time risk point of heatstroke through the internet without any payments.

Keywords: Web Processing Service, Open Data kit, Heat Index, Zoo-Project Platform, Foss4G

Introduction

The number of the elderly or citizen who is over 60 years old has been increasing every year due to the fact that the birth rate has been reduced. This situation results in Thailand's turn into an aging society and the change in population structure. In addition, the labor structure has been changed to those elderly to work. According to the survey of labor in 2017, it was found that there are 2.36 million male elderlies working, and 1.70 million female elderlies working, 4.06 million elderlies in total, or 35.8 percent of the total number of elderly, 11.35 million people. Considering the elderly's work since 2013-2017, it was found that the number of working elderly

keeps increasing every year, from 3.45 million people in 2013 to 4.06 million people in 2017. The elderly's career in 2017 was found to be agriculture and fishery, 56.5 percentage (National Statistical Office, 2017)

Heatstroke is the recent issue because of the changing weather that generally happens in summer. Heatstroke is the symptom of a body receiving higher than 40 degrees Celsius, the maximum temperature a body can bare, by being in the sunlight, doing exercises, or playing sports in hot weather for a long time. The obvious symptoms are being exhausted, languishing, queasy, headache, dropping blood pressure, fainted, faster breathing, and arrhythmia. People with these symptoms who cannot be helped and treated in time, it may cause to death. The risk group includes general labor and farmers. The other risk group who is in need to be more taken care of because of the heat includes children, elderlies, expecting mothers, and patients with heart diseases and blood pressure. Summer in Thailand faces higher temperature and continuing heat during daytime. Meteorological Department has forecasted that the temperature in Thailand in summer will be 35–37 degree Celsius around the country, and the highest temperature will be 42–43 degree Celsius in April, especially in Northern and Northeastern regions. Heat is one of the reasons effecting on people's health, from the general sickness to death. Regarding the heatstroke situation from 2014 to 2016, it has been reported that there were about 2,500–3,000 patients each year, tending to be higher and the highest number was in April–May (Department of Health, 2017). It was also found that the number of patients with heatstroke in 2013 was 98 and in 2016 was 2,457. The number of patients was higher especially in April every year. (Strategy and Planning Division, Ministry of Public Health 2016)

The evolution of information technology has changed according to the era. At the present, various kinds of information science have taken a role in daily life. Computers have been used in workplaces. Advanced science and technology have developed the facilities for the more convenient, faster, and more accurate works, as well as for supporting the analysis and decision making to access the data more conveniently and faster. Geographic Information Science is one of the important factors that has taken a role in working, planning, and accessing data for supporting any decision making and distributing geographic information science data, especially Web Processing Service (WPS) that is the standard protocol of OGC. It cooperates with other service protocols such as WMS, WFS, WCS, and SOS. This technology can access the area–based analysis from web interface that can receive and transfer data through the internet. Clients using this technology do not need to adhere with the format and type of the software.

Therefore, the researcher is interested to study the integration of Geographic Information System (GIS) by using Open Data Kit (ODK) to store the elderly's data. This is because this ODK can reduce the error and time period of data collecting. The study also investigated and developed the heat index measuring system, which affects of heatstroke in the elderly.

Methodology

Field data collection of elderly using ODK

Before installing ODK Aggregate, clients have to install Tomcat, Java, PostgreSQL/PostGIS. After installing ODK Aggregate, clients have to set up the instructions for managing area-based data such as creating a database and username/password to control the right to access the database. Then, clients have to design the form to survey and collect the field data and the form to store the field data of the elderly. The design has been done from the consult between researchers from Thai Health Promotion Foundation, hospitals, Sub-district Health Promoting Hospitals, Sub-district Administrative Organizations, and youths from Kho Rum Sub-district, Phichai District, Uttaradit Province. Then, ODK Collect have been installed on the smartphone and connected to the server (Figure 2).

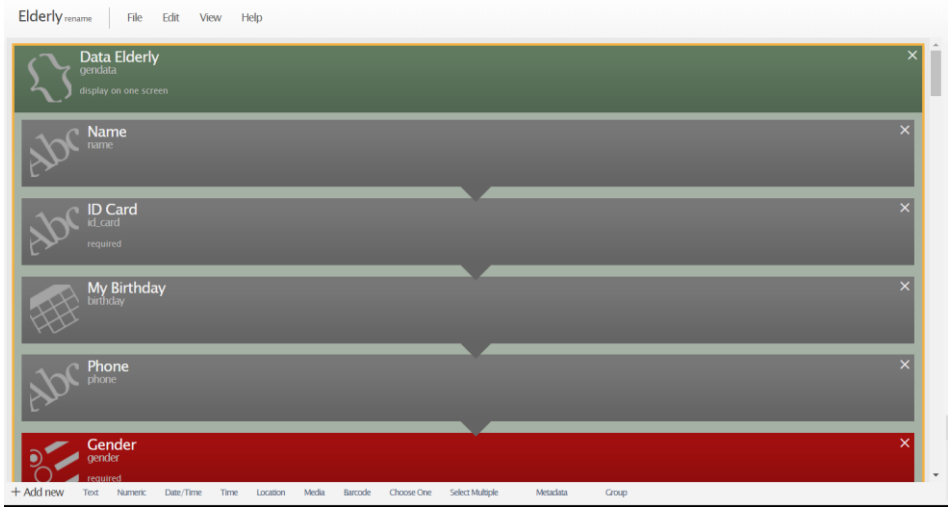

Figure 1 The form for the elderly in the storage field

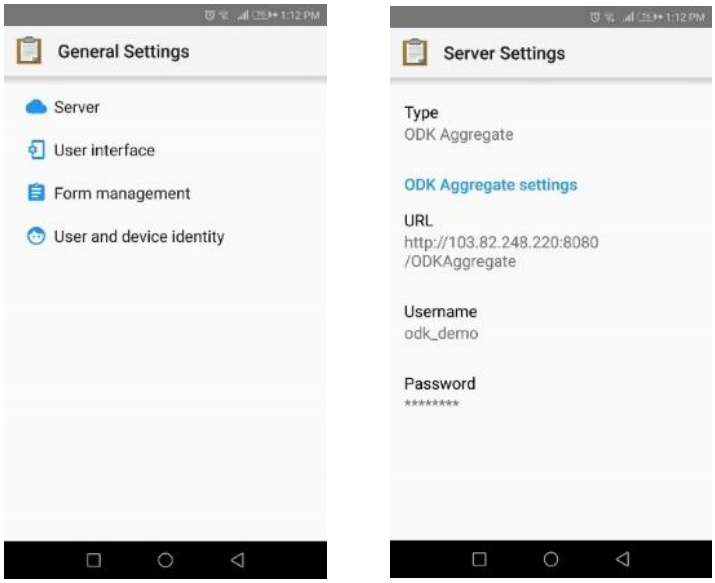

Figure 2 Connecting ODK COLLECT with SERVER

Finally, the created form have been downloaded to ODK application for exploring the field of data storage into the ODK Collect application ,which the survey form for storage elderly include General information, Diseases, Risk behavior, the location, and the picture of the elderly

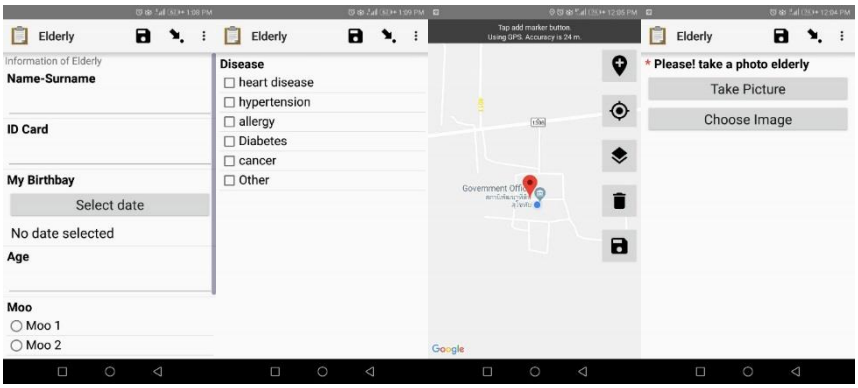

Figure 3 For example, the form used to survey the elderly

Near Real–time Temperature and Humidity data acquire from TMD.

To access the data of temperature and relative humidity in XML format to be stored as the area–based database in PostgreSQL/PostGIS by using PHP language, it is operated by inserting into the area–based database. The operation starts when the computer connects to the internet. The system will access the data service website http://data.tmd.go.th /api/Weather3Hours/V1/, through API (Thailand Meteorological Department API: TMDAPI). The data from TMD will update every 3 hours. The system will ask for the temperature and relative humidity values in XML service formats, which its instruction was written with PHP and SQL. After getting XML, PHP. XML parser will read and convert the data into columns and rows before transferring it into the database, as shown in Figure 4.

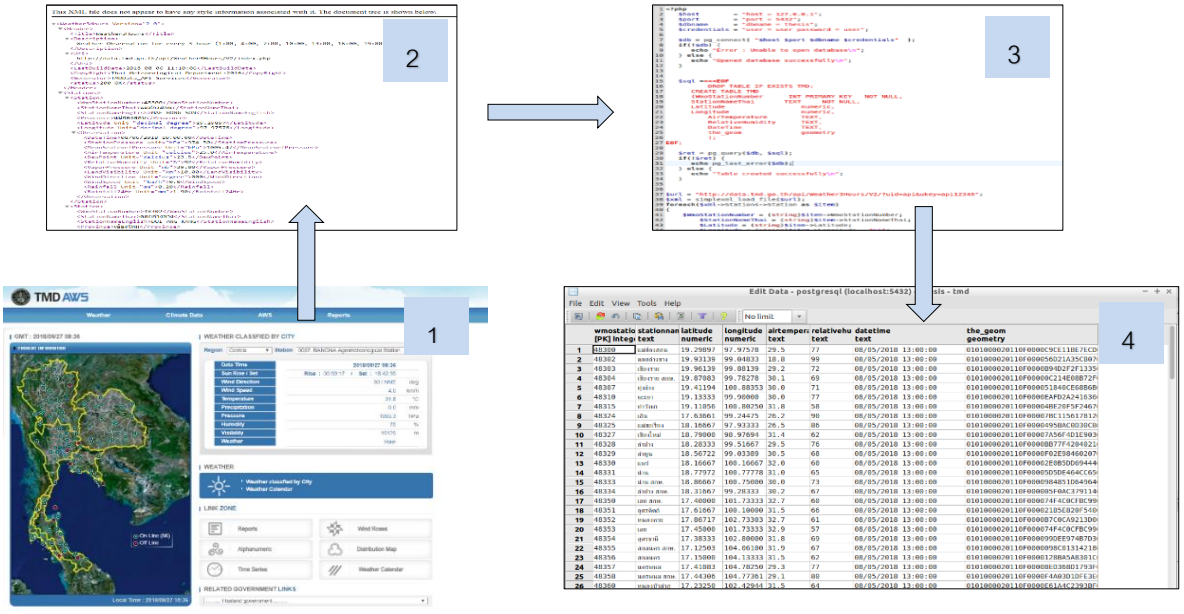

Figure 4 Temperature and humidity are stored in a spatial database

The development of system analysis heat index affecting heat stoke among the elderly on web map service.

In this step will be the development of a system for Elderly Data Analysis and Heat index as automated processing on Web Processing Service, which it is designed to standardize in the development of web map service

Principles of Data Analysis Heat index on the web processing service to start from. GRASS GIS connection with PostgreSQL/PostGIS to retrieve the temperature in air and relative humidity, using the module is in the program, which is a module that is used to connect to the database is db.connect and r.mapcal for calculating the approximate heat index values that affect the disease heat stork in seniors. From recipes to estimate the heat index of Stedman (National Weather Service, 2021)

$$HI = -42.379 + 2.04901523 \times T + 10.1433127 \times RH - 0.22475541 \times T \times RH - 6.83783 \times 10^{-3} \times T^2 - 5.481717 \times 10^{-2} \times RH^2 + 1.22874 \times 10^{-3} \times T^2 \times RH + 8.5282 \times 10^{-4} \times T \times RH^2 - 1.99 \times 10^{-6} \times T^2 \times RH^2$$

T = the temperature in air (°F)

RH = relative humidity (%)

Since Stedman has stated that the equation of heat index of Stedman is appropriate and can be adapted to the sultry weather in summer when the temperature is 26.7 degrees Celsius and relative humidity is 40 percent (National Weather Service, 2021) Thailand is a Tropical Savanna Climate country, so the temperature in summer is approximately 26 degrees Celsius and the relative humidity is approximately 45 percent (Meteorological Department), which follows Stedman's statement.

Area-based data are analyzed by accessing the module to process the heat index data (v.surf.idw). The data are analyzed by Inverse Distance Weighted (IDW) by using heat index calculated in PostgreSQL/PostGIS. It will show the results of heat index that cause heatstroke in elderly. The system analyzes heat index automatically, as shown in Figure 5.

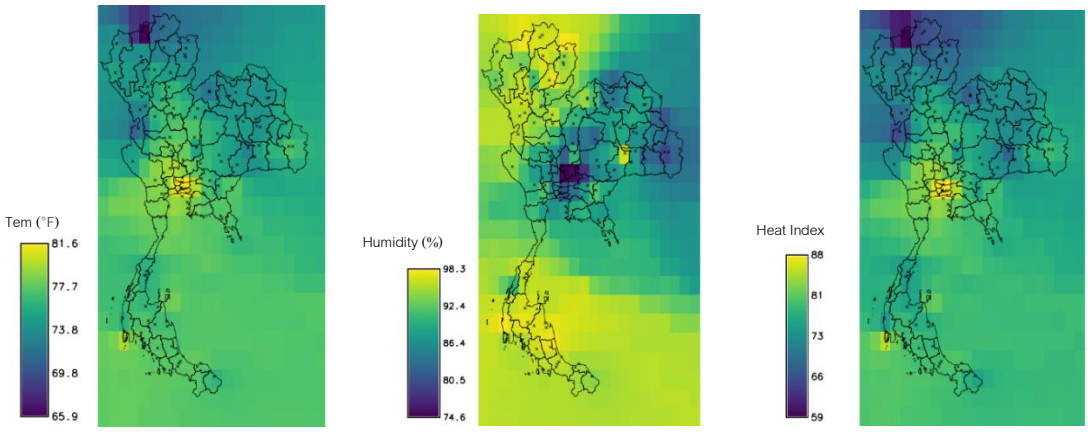

Figure 5 Analysis of temperature, humidity, and heat index by using the v.surf.idw module

Data classification, the heat index. There are 5 levels using modules r.reclass in Table 1. (Gadiwala et al, 2008) Then remove the output that is sent to PostgreSQL/PostGIS. The heat index data is then analyzed against the position of the elderly with field recordings with ODK, as shown in Figure 6.

Table 1 The effect occurs because of the heat. (Gadiwala et al, 2008)

Heat Index (°C)	HeatIndex (°F)	Effect
Less than 27	Less than 80	Normal is not harmful
27–32	80–90	Fatigue
32–41	90–105	Be very careful. Heat Exhaustion
41–55	105–130	Heat cramps.
More than 55	More than 130	Heatstroke .

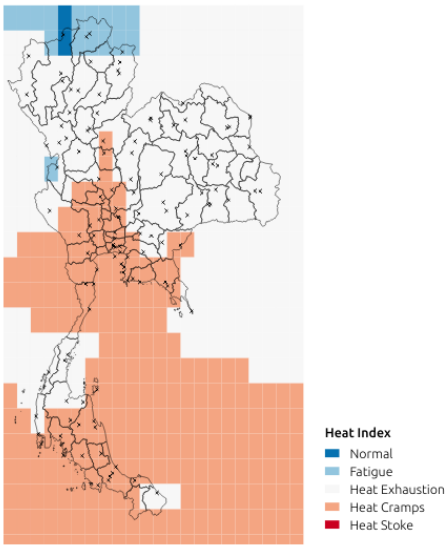

Figure 6 Classification of heat index to disease, heatstroke that affects the elderly

Conclusion and Discussion

ODK can be adapted for surveying and collecting field data of elderly through portable devices with Android and ODK operations. ODK is easy to install because it follows the OGC standard and it connects to the database directly. The form will automatically create the database so clients do not need to create it again and it can be developed with GeoServer, MapServer, and PostgreSQL/PostGIS. Clients can design the form as their desire when background knowledge and skills in advanced program writing are not necessary. The ODK can work both online and offline. In addition, it accepts image file, video file, audio file, and location-based data, as well as presents the data surveyed on the online map. This reduces the period of data collecting and saves costs for collecting field data.

The development of the analysis system of heat index that causes heatstroke in elderly is the operation of analyzing temperature and relative humidity by using Inverse Distance Weighted (IDW). The heat index will be analyzed with the location of the elderly collected by ODK. The system will categorize elderly according to their diseases that are risk for heatstroke. The heat index that is higher than 32 degrees Celsius will cause the elderly to be at risk of heatstroke. The system was developed through ZOO and WPS systems without any payments for software. Clients can also check the real–time risk point of heatstroke in elderly via internet.

References

Bandara, N., Fenoy, G,. Raghavan, V., & Yoshida, D. (2016). *Simplifying integration of field data and GIS: A WPS approach.* International Conference on GeoInformatics for Spatial– Infrastructure Development in Earth & Allied Sciences (GIS–IDEAS.

Bandara, N., Jayasingh, Raghavan, V & Yoshida, D. (2016*). Development of Field Data Monitoring and Evaluation Platform using Customizable Mobile Application and Web–Mapping Tool.* Thesis, Osaka City University.

Basinger, M., Jeffrey–Coker, F., & Mod, V. (2013). *Open Data Kit: Implications for the Use of Smartphone Software Technology for Questionnaire Studies in International Development*. Retrieved August 5, 2017, Retrieved from https://fsg.afre.msu.edu/Mozambique/.

Department of Health, 2017.

Gadiwala, M. S., & Sadiq, N. (2008). The apparent temperature analysis of Pakistan using bio– meteorological indices. *Pakistan Journal of Meteorology, 4*(8). 15–26.

National Statistical Office, (2017).

National Weather Service. (2021).
Retrieved from https://www.wpc.ncep.noaa.gov/html/heatindex_equation.shtml.

Sittichai Choosumrong. (2022). *The Online GIS*. Geographic Association of Thailand, Phitsanulok.

Strategy and Planning Division, Ministry of Public Health 2016.