DEVELOPMENT OF WEB MAP APPLICATION FOR MAXIMIZING EMERGENCY VEHICLE SERVICE AREA FOR ELDERLY PEOPLE

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ABSTRACT

The purposes of this study were 1) to study and analyze accessibility level of emergency medical service and 2) to develop a web application to locate EMS vehicle parking place in order to cover emergency medical service for elderly people. The web map application was developed using open-source spatial analysis Javascript library i.e. Leaflet and OpenRouteService. The aging population dataset of Thailand collected from Humanitarian Data Exchange was used to analyze 8-minutes-coverage of emergency medical service. The web application allows EMS planners to interactively locate desired standby points for emergency vehicles which can access to elderly people within 8-minutes service areas. The number of elderly population within service areas that correspond to any standby emergency vehicle parking spots would be calculated. The planners could daily use to allocate all available emergency vehicles to maximize the efficiency of services; or it would assist the planners to locate new emergency vehicles to new standby locations for serving the most effective areas without any duplication to other vehicles in the network. The application was tested in some major cities in Thailand and it showed admirable results. This study can be used as a guide for the EMS management to plan the covering of emergency service in order to improve the service efficiency; the relevant organizations will be able to reduce the possible losses in the future.

1. INTRODUCTION

United Nation defined that any countries which have number of over 60 years old population more than 10 percents of total population; these countries will become “aging society”, and more than 20 percents; those countries will call “aged society”. Nowadays, several countries in all over the world have being changed to aging and finally become aged society. Thailand is one of the countries that will turn fully to aged society soon in this decade. The National Statistical Office of Thailand (2018) reported that population aged 60 and above in year 2015 was approximately 13 millions or 19.2% of total population. The number would increase according to prediction model to be approximately 20 millions for population aged over 60 in year 2035, which is about 35% of total population. Thailand established the National Committee of Senior Citizens to provide current policies and programs in order to support older population in Thailand which focused on health, living and care, and social protection (Jitapunkul and Wivatvanit, 2009).

Emergency Medical Service (EMS) is one of a national service which the citizens lived in Thailand can publicly use. The number, 1669, is hotline number which can be used to call emergency vehicle (EV) to pick up people in case of accidents and any sicknesses. In Thailand, the emergency vehicle service is managed by a national organization called “National Institute for Emergency Medicine (NIEM)”. NIEM centrally organizes the EV

service in all over country including both vehicles from public and private hospitals, and also vehicles from independent organizations in form of the voluntary foundation. Every major city of each province in Thailand has at least one voluntary foundation that operates the service cooperated with hospitals within the city.

While every city in Thailand will soon turn to be aging and aged society, the EMS become more and more important. There are more aged people will need the EMS service in nearly future, especially in big cities with very complex transportation network and very traffic. Conventionally, the hospital's EVs stand by at the hospital. However, the EVs from voluntary foundation mostly stand by in any places distributed all over the city area according to the agreement with other foundations in the same city. It comes to state a problem that the standby locations of EV might not be able to cover the need of elderly people in the city.

In this study, a prototype of web map tool was developed in order to assist to better manage the standby locations for emergency vehicle in Thailand. The tool was created using open-source spatial analysis Javascript libraries and frameworks i.e. Leaflet, and OpenRouteService. Aged population dataset of Thailand collected from Humanitarian Data Exchange was used to analyze 8-minutes-coverage of emergency medical service. The web application can interactively be used as a guide for the EMS management to plan the covering of emergency service in order to improve the service efficiency; the relevant organizations will be able to reduce the possible losses in the future.

2. OBJECTIVES

2.1 to study and analyze accessibility level of emergency medical service.

2.2 to develop a web application to locate EMS vehicle standby spot in order to cover emergency medical service for elderly people.

3. FRAMEWORK AND METHODOLOGY

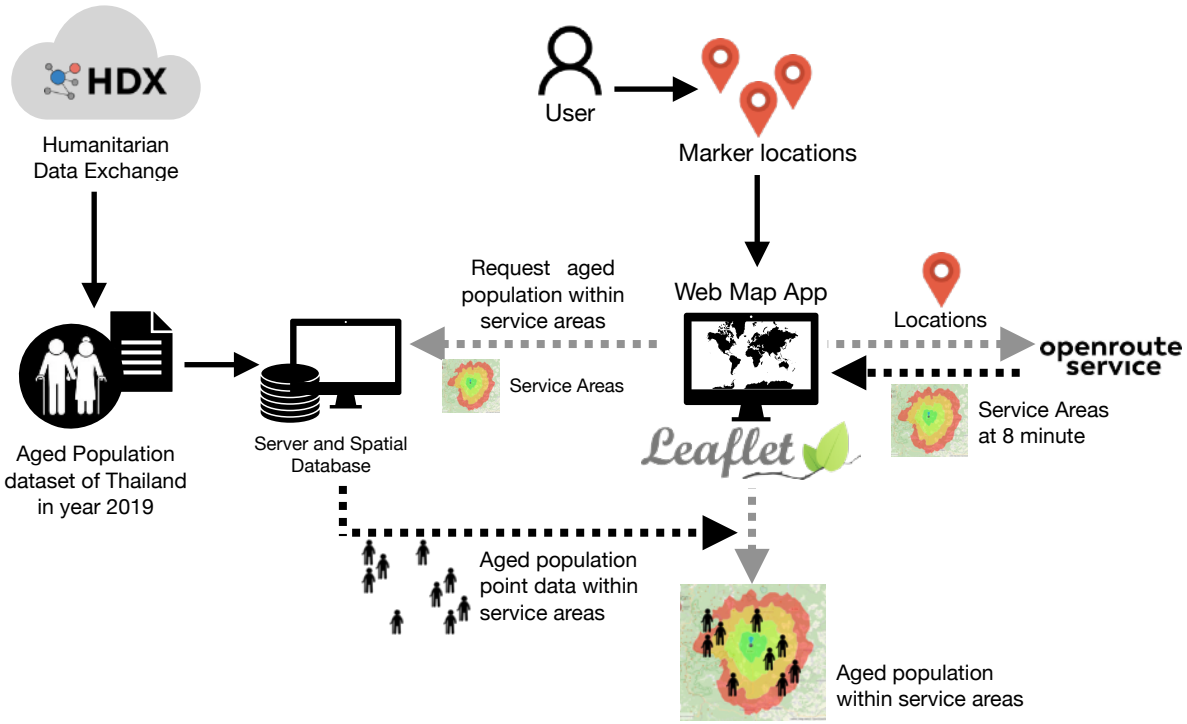


Figure 1. Conceptual Framework

Figure 1 represents the framework of this application. The aged population in year 2019 , which is in form of 30x30 meters resolution image, was collected from humanitarian data exchange (HDX). The dataset was converted into vector format and uploaded to PostgreSQL database server system. A web map application was simply developed based on Leaflet.js library. The application was designed allowing users to define markers on the map in order to retrieve location information.

Once users determined desired location as standby positions for emergency vehicles, the web application would send a request to the database server according to the bounding box of markers defined to collect aged population within the bounding box. Whereas the web application also send location information to open route service to generate the 8-minutes service area based on submitted locations. Then the web application used spatial query in PostgreSQL to find the aged population which were within those service areas. Finally, the web application would calculate number of aged population within the service areas and report to the display.

4. IMPLEMENT THE APPLICATION

As described in the last topic, there are four major issues to be described: aged population information, web map interface, using OpenRouteService to generate the service area, and using spatial query to evaluate aged population within the service area. This section discusses each component in the way that were used in this study.

4.1 Aged population from HDX

Aged population data was downloaded from humanitarian data exchange website (https://data.humdata.org/). The data was in 30x30 meters Geotiff raster format— so it needed to be converted into vector data format as shown in Figure 2. Each point contains number of population data in the attribute table. The data was imported to PostgreSQL database system to provide as a service.

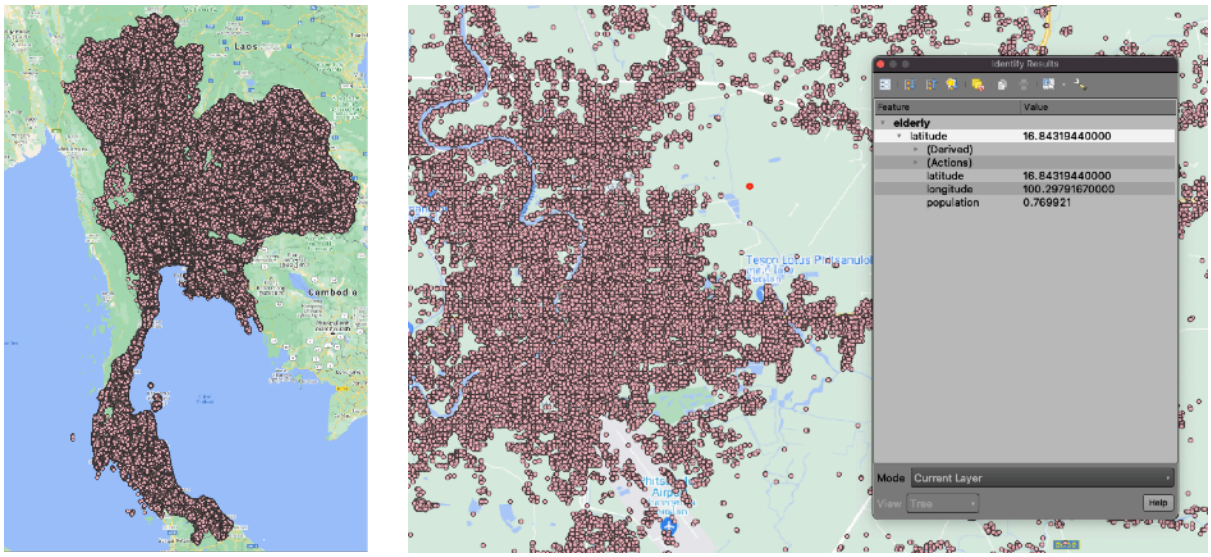


Figure 2. Aged Population from HDX

4.2 Web map interface development

The web map interface was simply developed using traditional web programming languages and using web map javascript library called Leaflet.js. In the application, users can choose the area and locate desired markers which is the standby spots for the EVs (in this prototype level, only 5 spots can be determined) as shown in Figure 3.

Figure 3. Web map interface and tool to locate standby spots for EV

4.3 Generating service areas using OpenRouteService

When the user already located standby spots for the EV in an area, service areas can then be generated using OpenRouteService API. In this study, the service areas were created based on 8 minutes traveling time which is critical time to rescue patients in traumatic cases. Figure 4 represents examples of service area generation of Phitsanulok and Bangkok city. The service areas generated would measure from the standby spots covering 8 minutes traveling time along the road network.

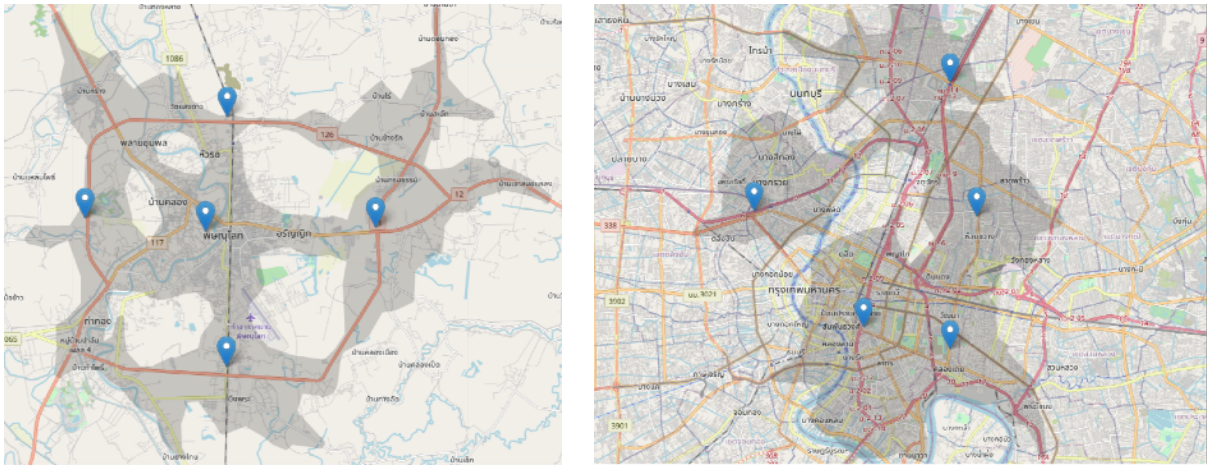


Figure 4. Example of service areas of Phitsanulok and Bangkok

4.4 Evaluating aged population within the service areas

The service areas generated in the last section was sent as spatial logical request to the spatial database to compute the number of aged population within the service areas. The spatial SQL was used in order to filter the aged population point in the database which are within the service areas. The number of aged population was reported in the web page as shown in Figure 5.

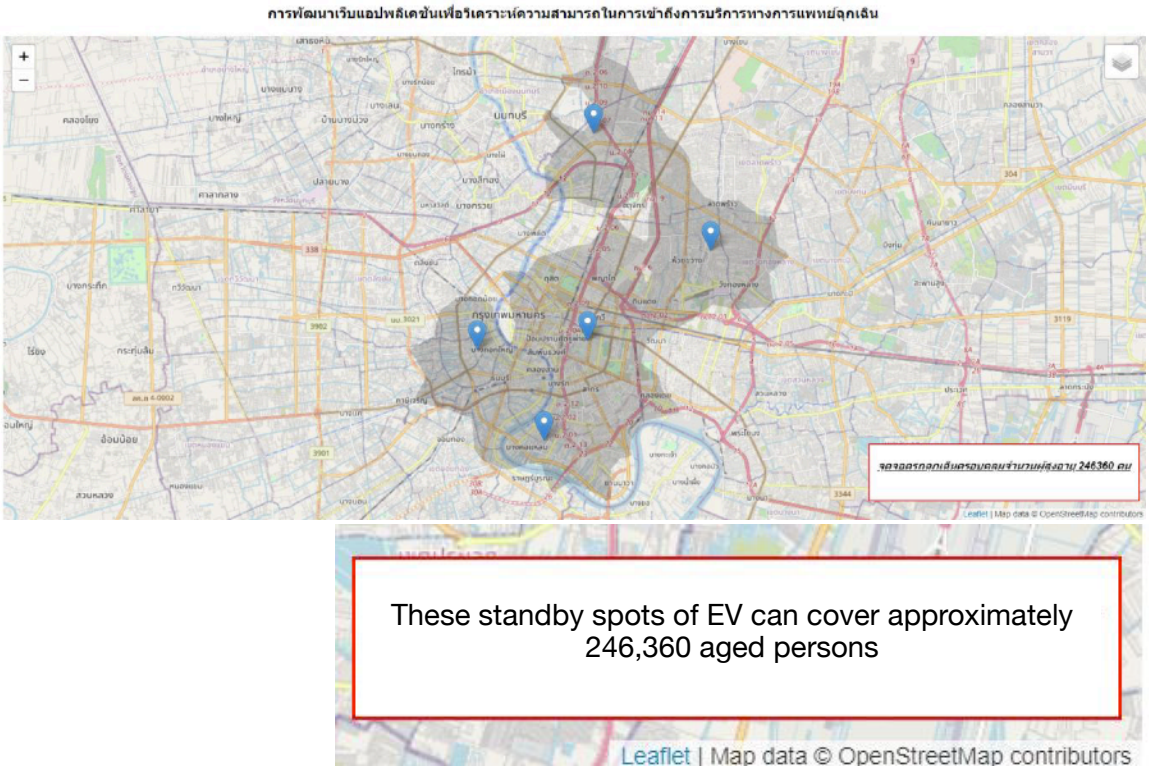
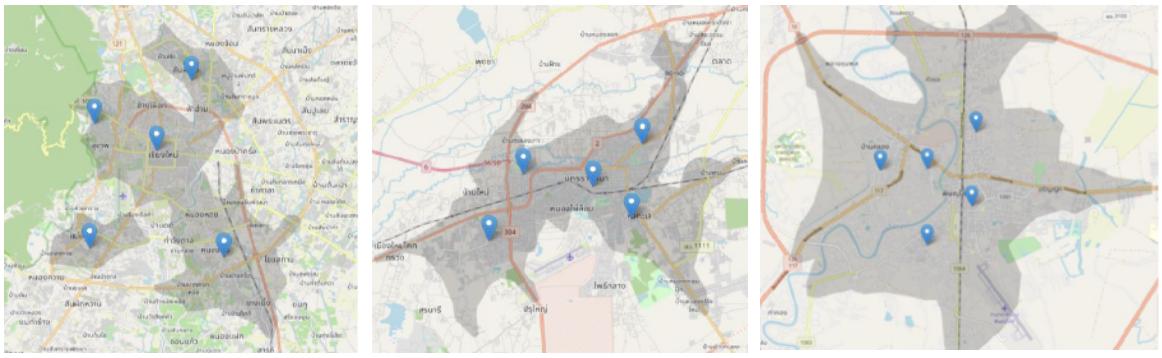
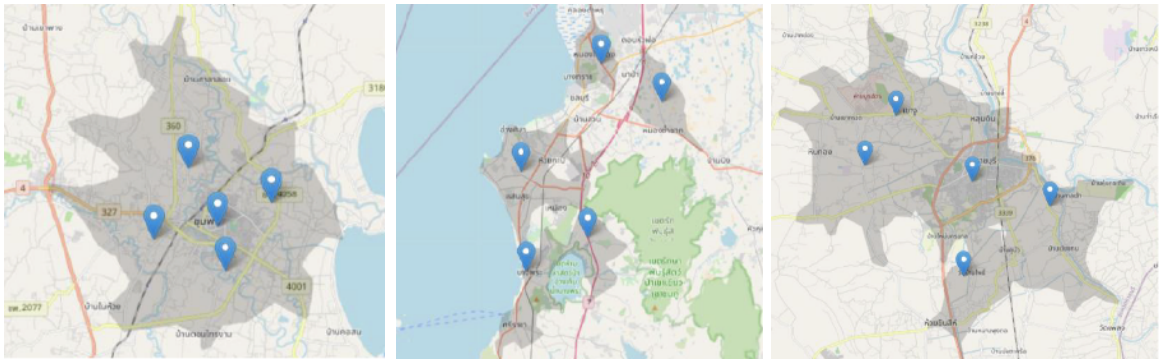


Figure 5. Example of 8-minutes service areas and number of aged population



Chiang Mai: 36,590 Nakhon Ratchasima: 21,371 Phitsanulok: 18,776



Chumphon: 6,564 Chonburi: 37,864 Ratchaburi: 14,885

Figure 6. Applying the application to some examples of city in Thailand

5. TESTING THE APPLICATION

As shown in Figure 2, the web application can be used in every city in Thailand. This section would represent some examples of city in Thailand which used this application to estimate the number of aged population within the service areas. Figure 6 represents six sample cities to create service area to calculate the number of aged people within the service areas. For example, if we planned to locate 5 standby spots for EV all over Chiang Mai city as shown in the figure, these 5 emergency vehicles could access to 36,500 aged people within 8 minutes. Therefore users can use the application to find the best standby spots that serve as many as aged people.

6. SUMMARY AND RECOMMENDATION

This prototype was developed by taking advantage of open source libraries and frameworks including Leaflet.js and OpenRouteService to create a simple application which can use to maximize the service of EV in the emergency medical service. Leaflet.js is ideal javascript library to create a web map with many splendid mapping tools and useful plugins. The OpenRouteService is perfect free API services for routing service and isochrone generation. The Humanitarian Data Exchange is a fine resource that provides demographic data in very detail up to 30x30 meters resolution covered the whole country. The application can be useful for planning suitable standby spots for emergency vehicles in order to maximize the coverage of service area.

Nonetheless, this is only a prototype stage that depict possibility to use big data in the open source web map application. It is feasible to make this application more efficient in several ways. For instance, we can extend the capability of the web application to find the best standby spots according to cluster of aged population without trial and error; we can also add up other map data layers to the application such as total population, other vulnerable demographic information or even accident incident points (Piyathamrongchai, 2018).

7. REFERENCES

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