FLOOD RISK FIELD SURVEY USING MOBILE GIS IN PUA SUBDISTRICT, PUA DISTRICT, NAN PROVINCE, THAILAND

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ABSTRACT

This research paper presents the application of flood mobile field survey in Pua subdistrict, Pua district, Nan province by using free and open source software. Geographic Information Systems (GIS) technology is ideally suited as a tool for the presentation of data derived from continuous monitoring of locations and used to support and deliver information to environmental managers and the public. Combined with Google API AppSheet, it extended web capabilities to provide real-time data from notified activities. Both geographical data and remotely sensed and geo-referenced image data were provided, and the ground truth of Google map remote sensing was recognized and also further recommended for capability study. This application provided the opportunity to visualize and grasp the current situation of the flood and thereby managed to offer prompt decision making as an action plan immediately needed.

1. INTRODUCTION

Natural disaster compounded by climate change causes more than $500 billion in losses every year (As Natural Disaster Rise, 2017). In particular, flooding is one of the most frequently occurring natural catastrophic events (Sanyal and Lu, 2004) impacting human lives, infrastructure and environment around the globe (Klema, 2014: Schumann and Moller, 2005: Anusha and Bharathi, 2019). Floods are among the most devastating natural hazards in the world and wildly distributed leading to significant economic and social damages than any other natural phenomenon (DMSG, 2001; Haq et al., 2012). Climate changes and human-induced land-use interventions are defined as important factors causing the flood hazard. There is a mutual trigger situation that the urban areas are the most influenced areas from flooding and also urbanization is the most important reason of the formation of flood (Ozkan & Tarhan, 2015). Remote Sensing has made substantial contribution in flood monitoring, mitigation and damage assessment that leads the disaster management authorities to contribute significantly. Geographic Information Systems (GIS) technology is ideally suited as a tool for the presentation of data derived from continuous monitoring of locations and used to support and deliver information to environmental managers and the public. GIS based spatial analysis and visual elements are used frequently in recent years for the detection of flood hazard areas and for the preparation of maps. GIS applications based on database and analysis tools have logical and mathematical relationships between the layers (Kourgiala & Karatzas, 2011).

Mobile GIS is a mature technology which takes geospatial technology beyond the walls of an office. Therefore, mobile applications have extended to field use which allows the user easy access, storage, updates, analysis and real time visualization of field data. Till recently, mobile GIS applications were mainly used as a navigation or location-aware system. Mobile GIS technology nowadays offers a potential alternative to fill the gaps of traditional GIS systems. With mobile GIS technology, officers and many other field workers have the potential to access the enterprise geospatial data from the server-side to accomplish their tasks with high level of accuracy. More importantly, it is also possible to update these geospatial enterprise data in real time (Choosumrong et al., 2016: Jeefoo, 2019).

The main objective of this research was to develop the mobile GIS field survey by using open source software for correcting flood risk hazards in Pua subdistrict, Pua district, Nan province, Thailand

2. MATERIAL AND METHOD

2.1 Study area: Pua subdistrict, Pua district, Nan Province

Pua subdistrict, Pua district, Nan province in the northern part of Thailand (Figure 1) was selected as the study area. Pua subdistrict comprises of 12 villages and covers an area of 23.9 sq.km. with geographical location between 19°9’ N to 19°12’ N and 100°52’ 30’’ E to 100° 55’ 30’’ E. It is mostly covered with forested mountain, with an approximate elevation of 310 meters about mean sea level.

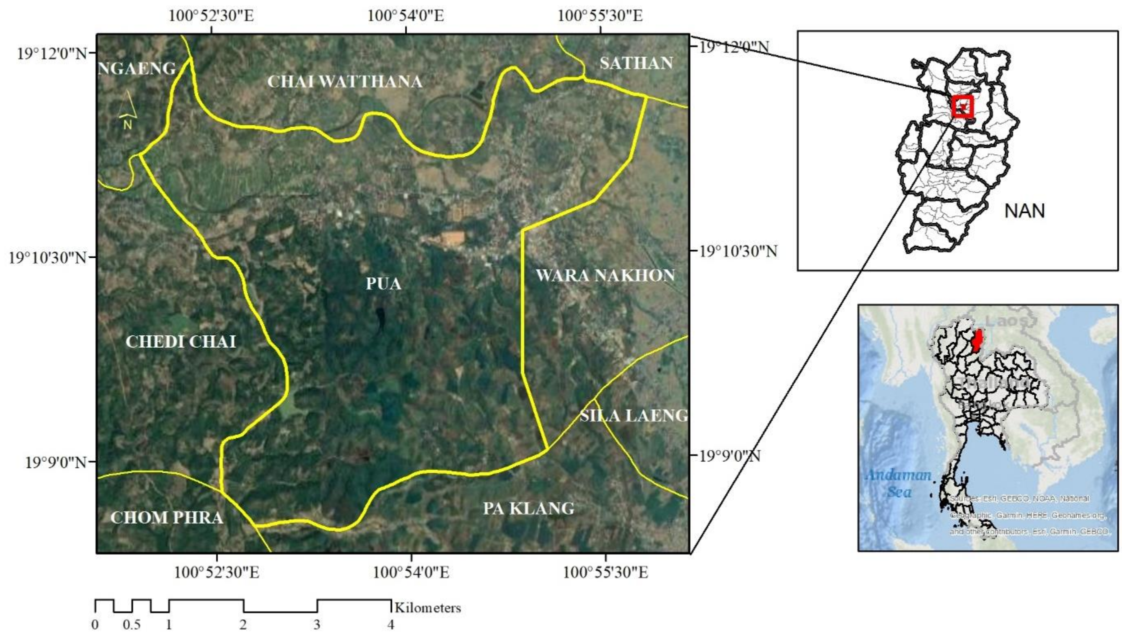


Figure 1. Geographic location of the study area.

2.2 Method

A smartphone running Android/iOS operating system was chosen to be a field device. The chosen smartphone was used for sending the flood risk field survey data in real-time to the base of operation to serve various purposes of field surveys. Real-time data availability provides many advantages.

Figure 2 shows the architecture of the flood risk field survey application. The application running on the device has two major modules: the map module and the survey module. The map module is used for retrieving the location data from the Google Maps. This location will be sent along with other types of data to the cloud server, and it can be used to pinpoint the current location of the device when displaying a map. The second module is the survey module. This module takes care of getting the information from the flood data collector including type of the report, description, latitude-longitude and images.

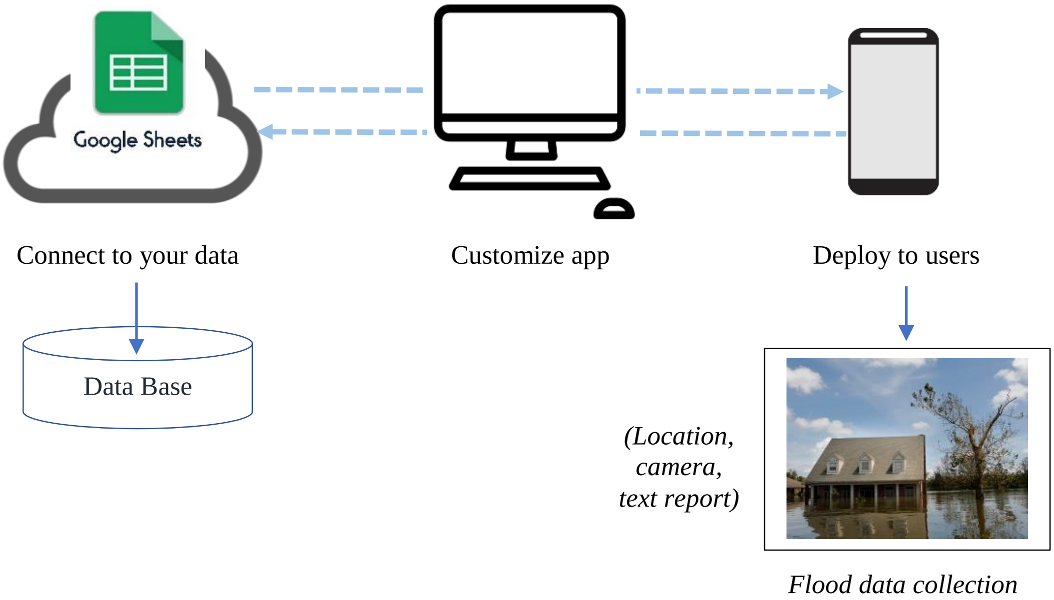


Figure 2. Architecture of the flood risk field survey application.

When the field data collector fills in details by clicking on the SURVEY button, the data will be sent to the cloud server via Wi-Fi network or mobile network (3G/4G/5G).

The system was being used in Pua subdistrict, Pua district, Nan province, Thailand. Field data collectors had the basic information of all the flood or flash flood in the area database such as elevation, slope, geography, climate, culture, etc. that was collected. However, they were unable to identify the location of the flood situation.

Google Sheet created the flood database and triggered the build app on AppSheet website (Figure 3 and Figure 4), https://www.appsheet.com/.

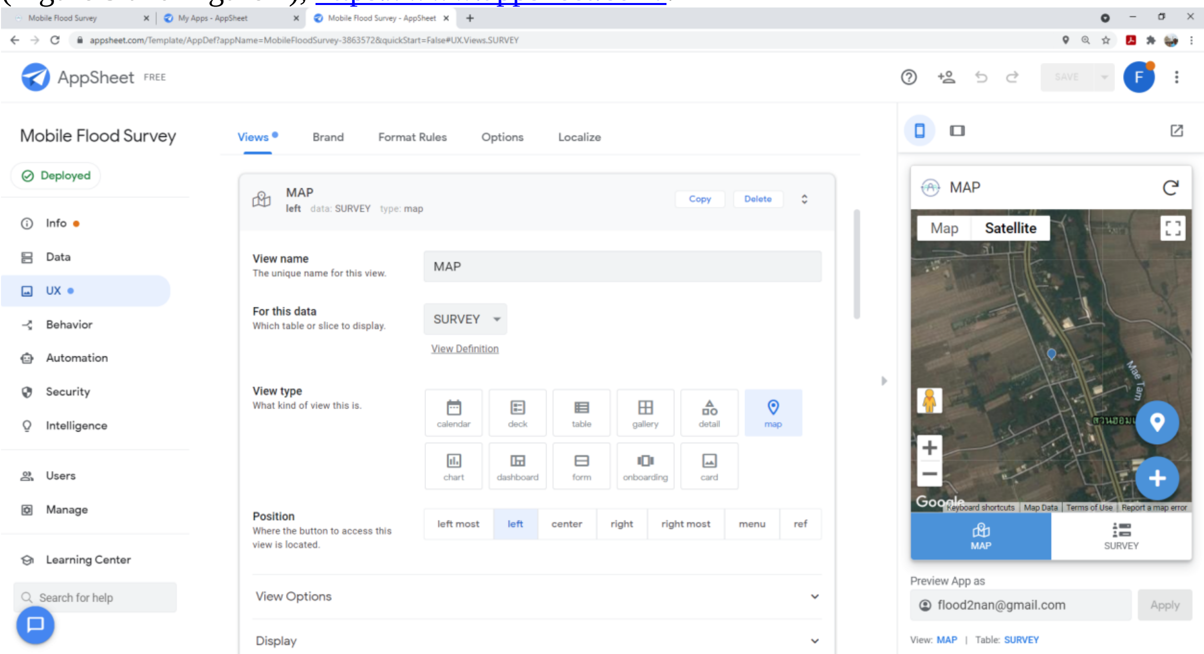


Figure 3. MAP page build app.

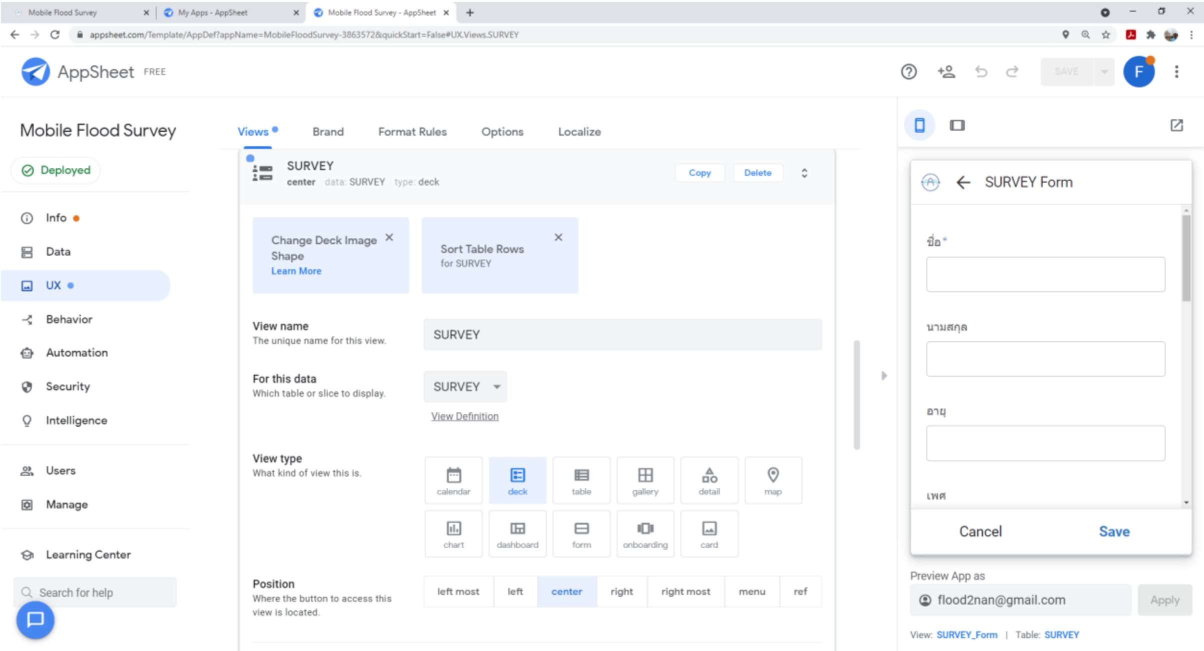


Figure 4. SURVEY page build app.

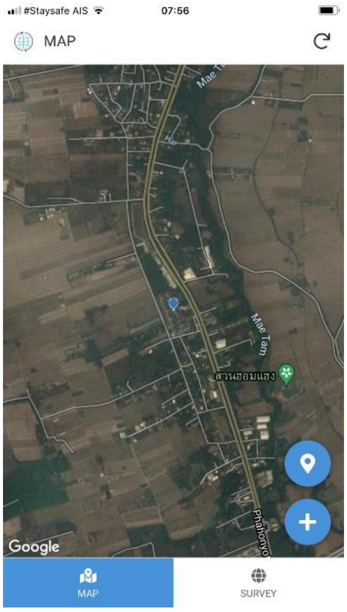
The server-side provided access to geospatial data and performed online spatial requests such as find, spatial query, measure, and closeness analysis based on requests made by from client-side. On the other hand, the user at the client-side could navigate and display through separate GIS layers of the geospatial data hosted by the server-side.

Application of the mobile side of the system was concentrated on the mobile GIS application. The previous application was used for field survey report from the geospatial field survey. The GPS location in the smartphone was adept of pinpointing the current lat/long location automatically. Once the existing location had been reached, the user would be able to start inserting the data using the input form.

3. RESULTS

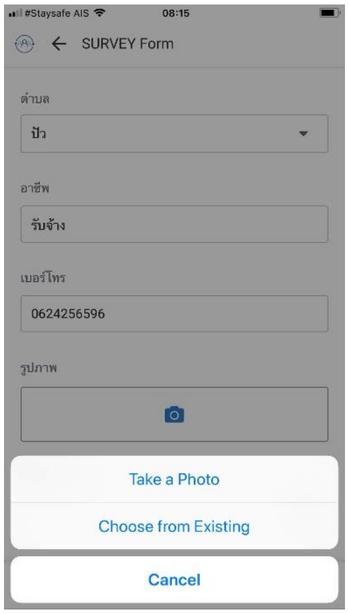
The application of the mobile-side of the system was concentrated on the mobile GIS application. The previous application was used for flood situation report from the geospatial filed survey. The collectors got access to the app, then identified their existing location. The GPS location in the smartphone was adept of pinpointing the current location automatically. Once the existing location was found, the user started inserting the data using the SURVEY form.

Figure 4 below shows some screenshots of the application.

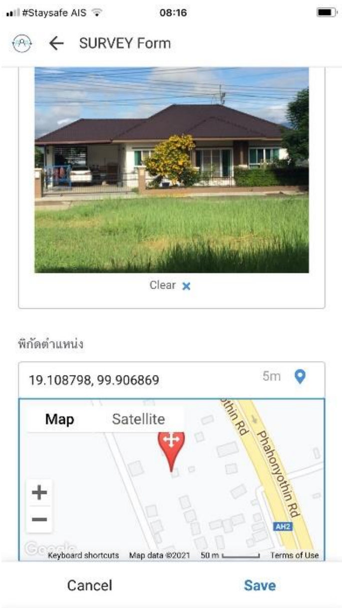


a) Main page, MAP

b) Database table with reporter, age, gender, address functions

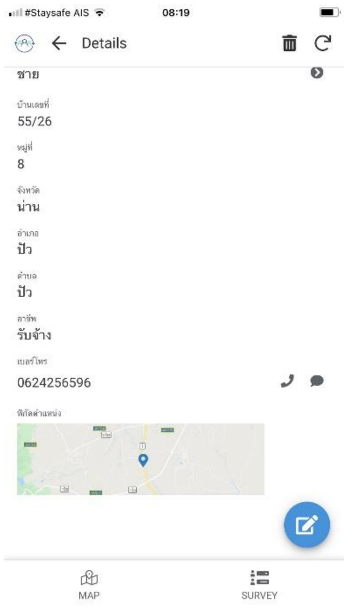


c) phone, camera, location functions



d) photo input and location automatically

e) SURVEY page



f) Database, reported

Figure 4. Screenshots of the flood risk field survey application.

The implementation of the flood data collection using mobile GIS field survey consisted of the software used and details of item software version. The flood risk field survey using Mobile GIS technology was designed and developed with a user-friendly main interface (Figure 4a). The main screen of the application provides access to the reporting tools. Reporting tool for field data includes data and image files of current location (Figure 4 (b, c, d, e, f)). The application development environment and tool are shown in table 1.

Table 1. Application development environment and tool.

No.	Flood Risk Field Survey using Mobile GIS	
	Software and Hardware	***Software***
1.	Server	Cloud Server
2.	Operating System Server	Windows 10 Enterprise
3.	Web Server	AppSheet
4.	Application Server	AppSheet
5.	Database Server	Google Sheet
7.	User Interface	AppSheet
8.	Client Web Browser	Chrome, Firefox, Internet Explorer, Safari

The web interface for flood risk field survey is shown in Figure 5. The collectors can visualize the reporting points of real time field survey that send data, and they can make use of that data for recording and analyzing purposes.

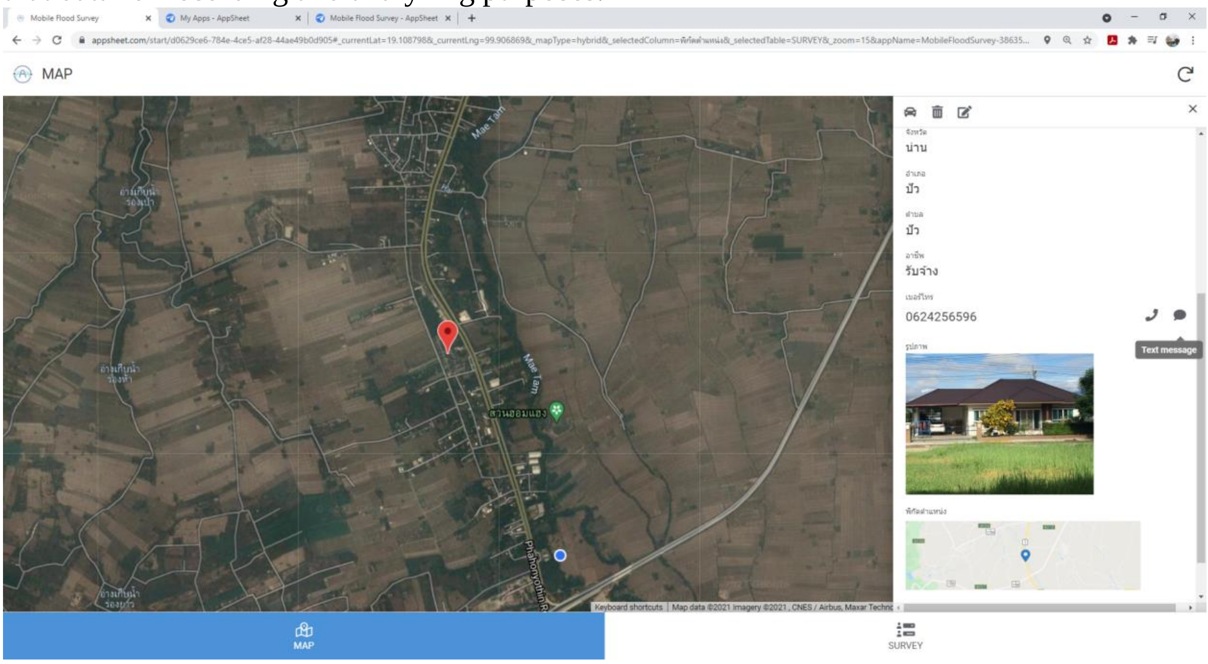


Figure 5. Web interface for flood risk field survey.

By clicking on a pinpoint which was the location of the house that was flooded on the map, the information associated with the image such as latitude, longitude, flood status, reporter, and date was automatically linked with geographic data such as names of subdistrict, district, and province.

4. CONCLUSION

Google Maps provides its source of base map and user friendly applications. Freeware products can be easily and quickly downloaded and installed. The interface is well organized and easy to follow. Data recording tools are fairly user friendly, easy to figure out, and supportive to users with multiple data forms for output and sharing. This is a good free mobile tool, especially in the context of training others to use it, given its simple and easy to understand design. The implemented mobile GIS platform provides the basic GIS functionalities and location. The new generation of mobile network technology advances rapidly, and the storage capacity of intelligent communication terminal increases substantially. So that the mobile GIS has become the new hot spot following Desktop GIS and Web GIS (Wu, 2012: Jeefoo, 2014). The client/server GIS framework that was developed was an independent application, which could be run in every modern mobile smartphone without requiring any other additional software. This application helped the field parties to gather data from flood risk field survey and provided inputs for monitoring and protection.

5. ACKNOWLEDGEMENT

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