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Development of Service Oriented Framework for Geospatial Field Data Management and Analysis

Niroshan BANDARA* and Venkatesh RAGHAVAN**

*大阪市立大学大学院創造都市研究科, Graduate School for Creative Cities, Osaka City University, 3-3-138 Sugimoto, Sumiyoshi-ku, Osaka 558-5858, Japan. E-mail: niroshansnj@gmail.com
**Graduate School of Engineering, Osaka City University, 3-3-138 Sugimoto, Sumiyoshi-ku, Osaka 558-5858, Japan.

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1. Introduction

Field data collection is one of the important and basic tasks for any geoscientific investigation. Geospatial field data can be collected based on human observation as field surveys. Also, field data can be collected by utilizing field sensors. With the development of technologies such as GNSS and proliferation of GPS enabled smartphones, geospatial field data aggregation has become more conceivable than ever before. Moreover, there are various ready-to-use software tools to facilitate collection, management and sharing of field data using mobile devices. On the other hand, nowadays mobile applications which are running in mobile platforms are capable of connecting to variety of external sensors over wireless channels such as Bluetooth. However, there is a lack of proper implementation in field data collection, storage, sharing and analysis with human and external sensor gathered data. Therefore, this research aims demonstrate on how the geospatial ecosystem comprising of Open Source Software, Open Data and Open Standards can be leveraged for deploying geospatial field data management and analysis platform with human and sensor inputs.

2. System and Methodology

ODK that provides tools to facilitate collection of georeferenced data and transmit to a centralized server in near real time is used to deploy the proposed system along with Android Sensor applications such as Ardui2Andro and ODK Sensor app. Moreover, human and sensor integrated data collection method, data sharing and geoprocessing are the main enhancement implemented in order to provide a comprehensive framework for Geospatial field data management and analysis. Both data sharing and geoprocessing tasks are compliant with Open Geospatial Consortium Web Services (OWS) standards allowing for interoperability and scalability. In the present system, Web Map Service (WMS) and Web Feature Service (WFS) have been used to offer data oriented interoperability. Further, Web Processing Services (WPS), which is designed to standardize the way that geoprocessing algorithms are made available on the Internet has been used to facilitate instantaneous and remote processing of geospatial field data. ZOO-Project which enables existing open source libraries to interact through its WPS framework has been used to facilitate WPS in this system. The system framework demonstrates the seamless integration of field data with desktop as well as Web GIS software. The various Open Source tools used to deploy the framework is shown in Figure 1.

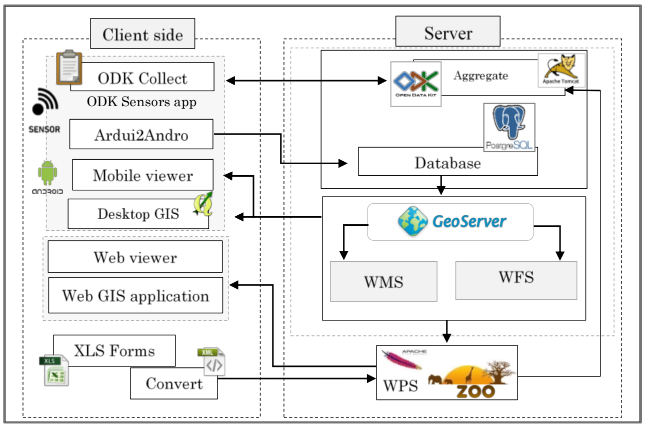

Figure 1 System architecture

3. Work-flow and System Implementation

The workflow for geospatial field data management and analysis system is depicted in Figure 2, consists of a server-side and client-side component. Firstly, administrator has to create forms which can be designed using LibreOffice and upload it to ODK Aggregate. Next, users download the forms to their mobile devices and start to collect/aggregate field data. Most importantly, ODK facilitates gathering of georeferenced and multimedia data such as photo of the location, also text and number values. In addition, special row/parameter needs to be defined in the form when user wanted to enable the data collection from external sensors via Bluetooth. Then user can add human observation data along with external sensor data in separate pieces. The collected forms can be uploaded to ODK Aggregate server when the internet is available and store them in the spatial database. The stored data is automatically published as WFS and WMS. Moreover, it can be visualized or further processed. Besides, visualization facilities are extended via mobile application as well. The process can be done either by using desktop application or Web application and user can visualize the WPS results using bowser client for rendering dynamic map on a web browser.

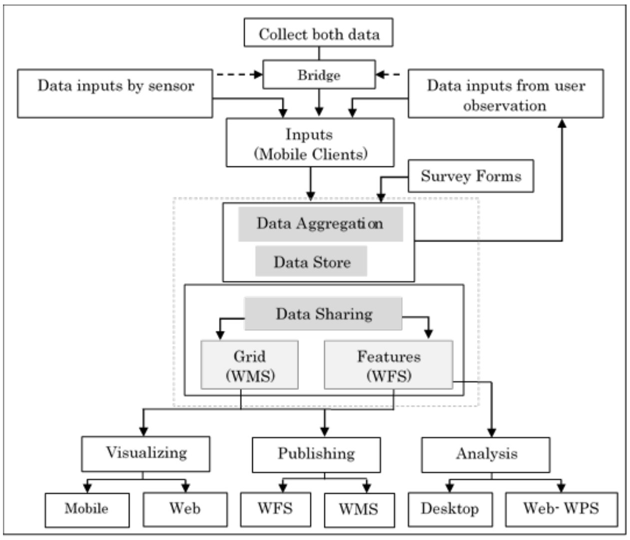

Figure 2 Workflow

4. Results and Discussion

Firstly, a form has to be created for the field survey and the parameters need to be identified based on the purpose and study. The system has been deployed for an imaginary flood mapping survey in order to evaluate and demonstrate the functions of the system. After collecting data, it can be seen in ODK Aggregate and also be directly displayed on Web Viewer as described in Bandara et al, 2016. This study tries to emphasize the further development. As of, data can be imported to QGIS in two different ways. First method is to connect the PostgreSQL database directly (Figure 3) to QGIS, the second way is to import as WFS (Figure 4). It allows user to save layers as ESRI Shapefile.

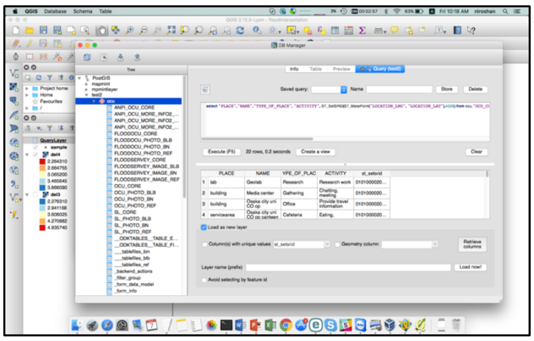

Figure 3 Data import to QGIS from PostgreSQL

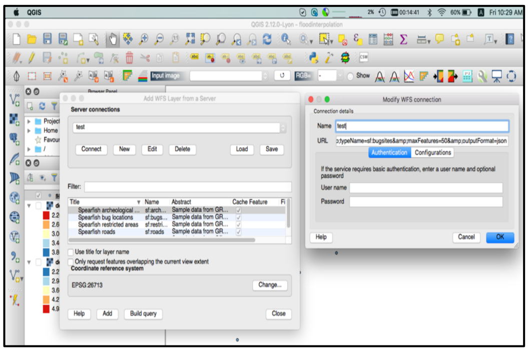

Figure 4 data import to QGIS as WFS

As a demonstration of further analysis in QGIS, the flood depth levels are interpolated water surface elevations using Inverse Distance Weighting (IDW) algorithm for generating the water depth map (Figure5).

But, the field party or decision makers may need to view the processed results instantaneously. Access to software and knowledge regarding operation of desktop GIS could be lacking. In order to overcome these limitations and facilitate geoprocessing and visualization on a web browser, WPS for spatial interpolation using *gdal_grid* function is deployed using ZOO-Project. Collected data is automatically processed the water depth model is shown in the same web interface (Figure 6).

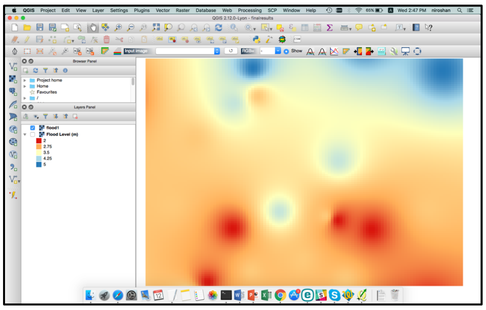

Figure 5 Water level interpolation map processed in QGIS

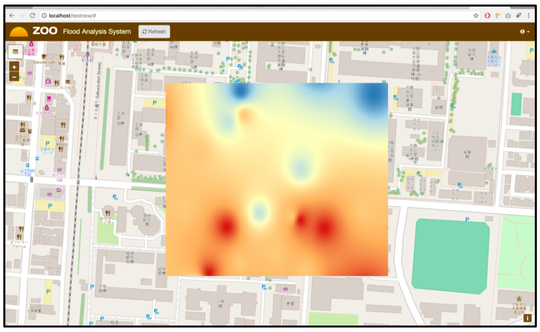

Figure 6 Web processing result

Similarly, functions such as visualizing sharing and analysis (Figure 7) can be made with the data which are collected from external sensors.

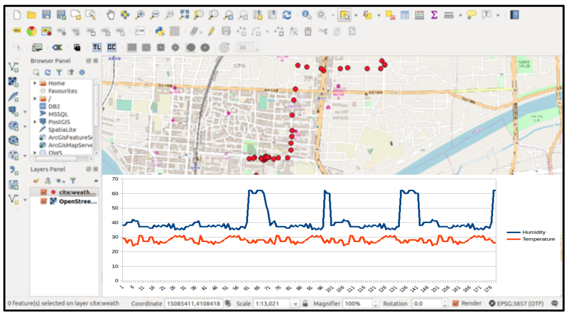

Figure 7 Data analysis from external sensors

5. Conclusion

The system described in this article provides functionality for simple visualization, archiving and managing, seamlessly exchange of geospatial data with desktop GIS and online geoprocessing. The result demonstrates the efficacy of the system to deliver solution for varies geospatial data collection, management and analysis needs, and it can be utilized in varies disciplines.

6. Reference

Bandara, N., Raghavan, V., Yoshida, D. (2016) *Development of Field Data Monitoring and Evaluation Platform using Customizable Mobile Application and Web-Mapping Tool*, Geoinformatics., vol.27, no.2, pp.114-115