DEVELOPMENT OF AUTOMATED DISPLAYING SYSTEM OF NUMEROUS REPORTS FOR SATELLITE BASED SURFACE WATER MAPS

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Abstract: At present, satellite and GIS technology are being developed rapidly and also widely used, particularly in water management in Thailand. Satellite can monitor change in water surface over time. This paper used satellite data to monitor water surface in the reservoir on the east region of Thailand and convert data to PostgreSQL in Geo-database format. Data was also executed and processed by script from Python language, in order to produce report on water surface change by time, to be shown in graphic scale and table, as the report on water planning and management.

1. INTRODUCTION

Change detection in various resources, both natural and man-made, depends largely on satellite images for decades. With temporal acquired images, the data, then, being processed with the Remote Sensing software, and other application software enable the users in analyzing the data of classification. As shown in the classifying groups, the boundary is shown, with the position displayed and can be compared to the real global position. After the temporal data is calculated, the changes in term of statistical results is found, which showed in both graphic and tabulation display. These data are mainly used in analyzing and predicting the expected outcomes for high efficiency in both administration and management.

Presently, data distributed via www on GIS shown in two-format: Thailand Flood Monitoring System [1] and Flood Management System[2], along with data on natural disaster to public and private sector, including those who are interested as well, as in Fig. 1 and 2.

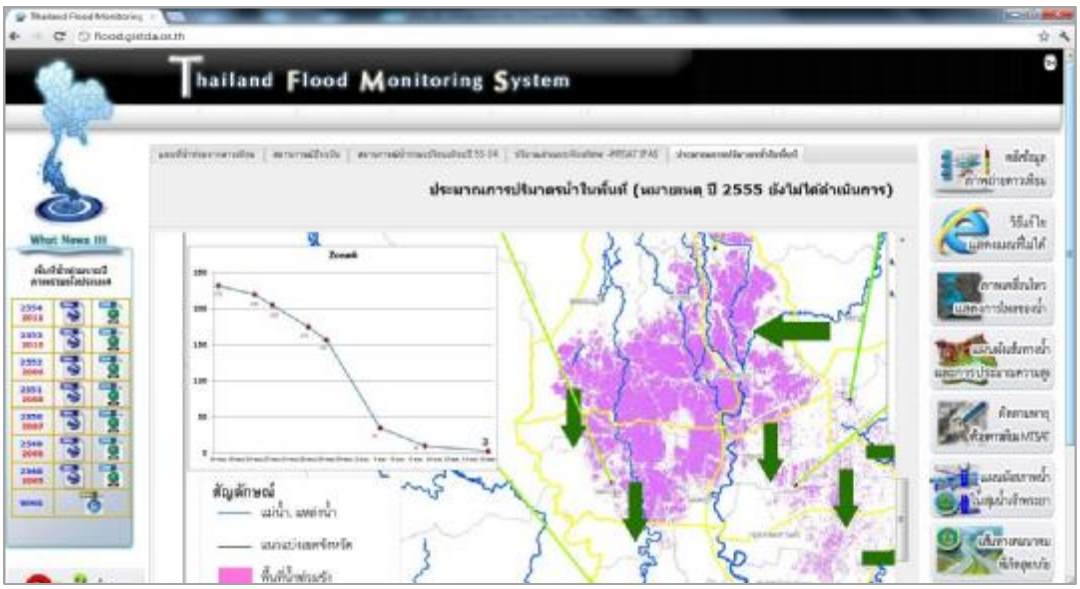

Fig. 1 shows the water volume in the country with TMS

From Fig.1, the overall data of the country, is displayed and it is also being distributed by the PDF downloading on a weekly basis. The volume data are derived from the GIS program in PDF, which enables the users in the utilization, particularly for field applications

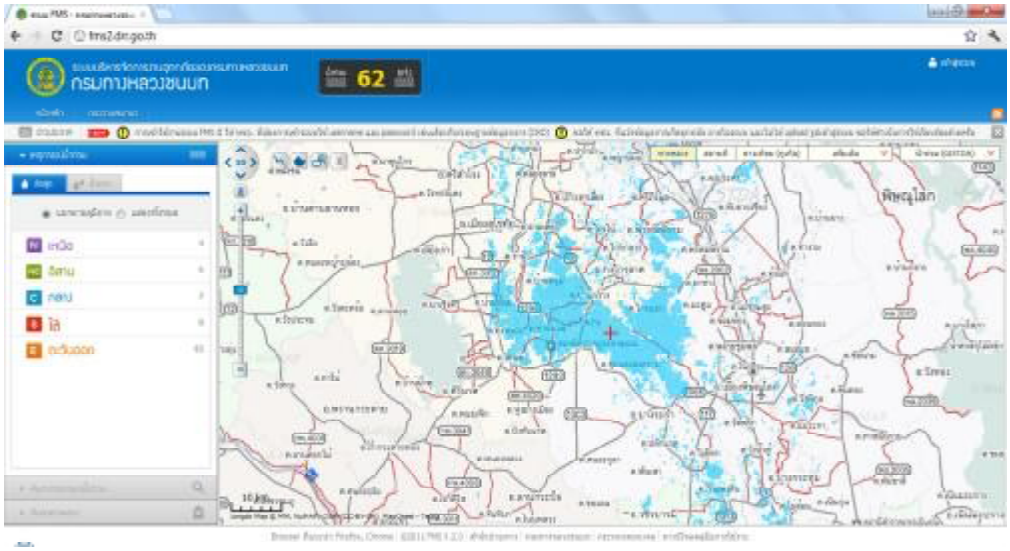

Fig.2 Display of the FMS2 online map

Fig. 2 shows the data from web mapping software which enables users in the interactive mode with multi-scale map together, with zoom-in and zoom-out tools whereby the user may choose the specific area by panning. In addition, the user also defines the outcome, and there are a number of applications and various open source software which may be applied to an interactive map which leads to reports in formats. In this paper the system is developed as follows: Section 1 as previous cited; Section 2 will touch upon the background on open source software; Section 3 the design and development; Section 4 on results and Section 5 on the conclusion and discussion.

2. BACKGROUND

Relevant technology literatures were reviewed and sets the system design was conducted as follows:

2.1 GEOSPATIAL DATA

Geospatial data represents the real global geometric position with GIS data. As widely known in terms of vector and raster image, the first, vector represents the main position in point, line, and polygon formats, with the size depending on the map scale, and the map scale depends on the survey details of the author. Furthermore, vector also links to the attribute data, in order to explain the detail and status of the object, for example, the school position is shown with a name, location, and numbers of teacher or student. On the other hand, raster represents object which is formed by a number of cells or pixels, arranged in rows and columns, with each pixel representing the microwave reflectance upon the particular characteristic of the object, along with the reference number, including the horizontal/vertical ratio object with a name cell size or resolution, in meter per pixel unit.

2.2 GEOSPATIAL FILE FORMATS

Both digital vector and raster may be stored in various formats, as given by the encoding under the geoinformatics software developer's standard. There are a number of format, known as OGC Standard (Open Geospatial Consortium)[3], which enables the developer to use these file formats. Furthermore, there is also a development on library, known as GDAL[4] and OGR[5], which is commonly used in data conversion from one format to the other.

Formerly, vector and raster data were in digital format. However, presently, the data are in RDBMS software storage, with various software, e.g., MS SQL, Oracle, SQLite, MySQL and PostgreSQL. This storage type allows the end users in data correction. In addition, there is also a function on high efficiency data processing and managing on the so-called Geodatabase.

2.3 INTERNET GIS TECHNOLOGY

This is one of the internet technology application to the geoinformatics, whereby the developers create the middle ware program, as the medium for the transferring, managing, and analyzing the data amongst the end users, which is also known as map server. Nowadays, this is developed and becomes the system architect along with the cooperation of the client tier, server tier, database tier, and network tier, leading to the interoperability and standard under the OGC, which is the common standard for data exchange among the users, even with different data format, as shown in Fig.3

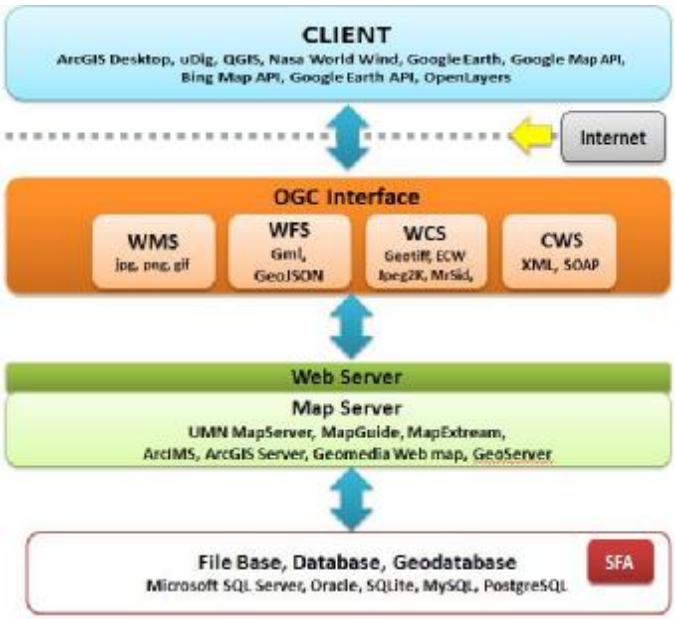

Fig.3 Internet GIS Architecture

2.4 REPORTS

This shows the results from the operation, with display of geoinformatics normally in terms of the comparison data of object area volume, with different time frame, with graph or table. For graphic information, x represent time frame and y represents area volume, we, then, show the data in formats as objectives, e.g., linear graph represents the tendency in data changing in various time frame, along with the expected outcome as well. In addition, bar chart represents the ratio of data, which we may find the incorrectness of the data set, when the data set shows different number. In the display by tabulation, this shows the object area volume as specified in the time frame, most of the data divided in the administrative boundary. For example, if we would like to know the water resources volume in the administrative boundary and if there is a report on the water resource volume under the sequences of the country administrative boundary, from 77-province, 878-district and 7,446-sub-district. If any of these boundaries shows no water resource, the data is zero. Furthermore, if we would like to display a number of data set in one table, the cross tabulation format will be used.

2.5 WEB SERVICE

The web service is software support for data exchange, including the data processing among computers via the network. JSON[6] and XML format are commonly used in the communications. In addition, web service under OASIS and W3C standards support the languages, e.g., Java with Servlet, Python CGI, PHP and ASP.net.

3. DESIGN AND DEVELOPMENT

3.1 SYSTEM ARCHITECTURE DESIGN

The author designs the map server in the interactive format, including the report on the www platform. The said technology, then, linked by the internet, leads to all of the end users : the surfers. In this regard, the two factors to be integrated are GUI, of course, with user friendly, and high-throughput, i.e., high efficiency, quick in downloading, and serve the high traffic as well. The author also provides in FTP protocol, in case of supplying a number of data, including the fault-tolerant[7], which guarantees the accuracy of the data, even in difficult period

and the lost of data during the transaction. Hence, the author employs the High-availability cluster[8] in the developed model and system architectural is shown in Fig.4

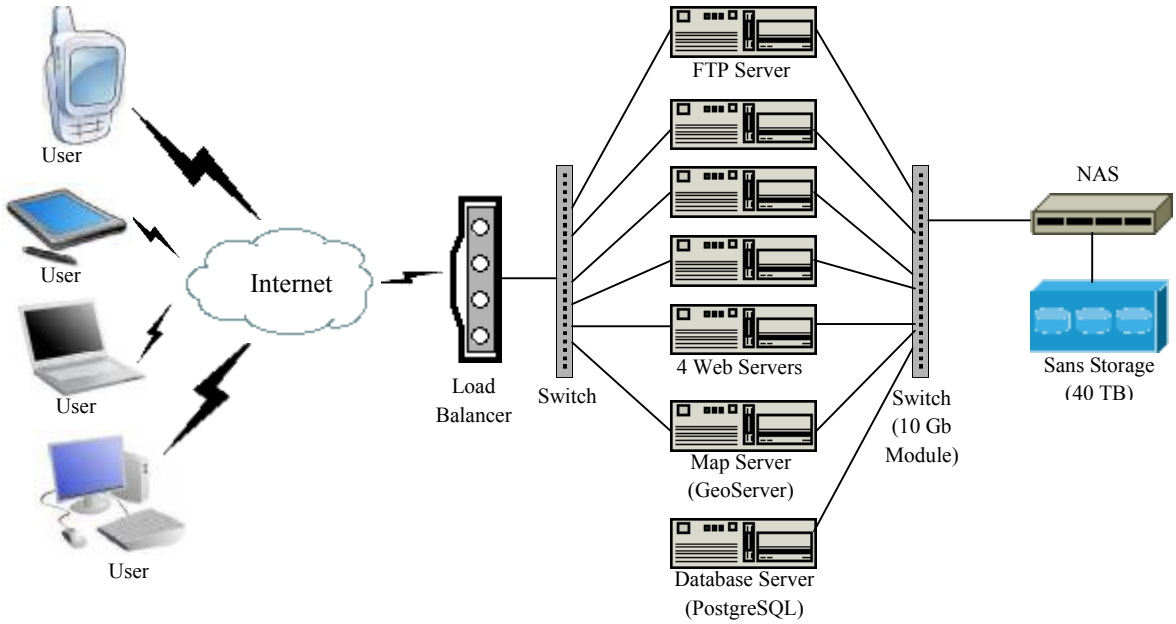

Fig.4 System Architecture

3.2 SYSTEM DEVELOPMENT

The author will touch upon the system development from the IT applications.

1. The clients are 1) web mapping; this shows the map which is ready to receive the order in the annex, correct, or delete the data, then process under the request standard while being sent back to the server, under the OGC standard. 2) the web application; this is the platform in the intake data, with web mapping consort. There are a number of tools that the client may select the administrative boundary in various levels, then show the report that included all boundaries along with the relevant data layer. The client, in this case is based on HTML, JavaScript, CSS, jQuery[9], and OpenLayers[10]

2. The servers are 1) server for processing and providing the GIS, which under the synchronizing between map server and web server. The process starts from modifying of raw data into picture file, along with the W3C standard before delivering to the client. In addition, these software groups are under the response of OGC standard and 2) web service; this provides the data from client's request, then, the summation of the area is calculated, after that, the data is then transmitted to show to the client, along with the processing into the PDF format by server under GeoServer, Python-CGI Script, ReportLAB[11] (Python package)

3. The database, with the report data, in PDF format, and data management software, also known as Geodatabase. This has functions on spatial analysis and geoprocessing, which is a tool for the system, under the PostgreSQL and PostGIS[12] (PostgreSQL extension) software development.

3.3 System Performance Design

This topic touch upon the efficiency enhancement technique in server, which is caching; this reduces the server's resources by the processing only from repetition of web document preparation, such as the repetition on request from client, whereby the server skips the data processing through data response. However, this may has the negative on 1) data obsolete, the author designs the cache control in order to update the document, just only the modified document and 2) the time consuming procedure, the author then uses the part of cache control in the partially data preparation to serve in a quick time, the rest will be input to the system to follow the client's on demand. In addition, this is from Python-CGI.

4. Results

Web GUI and System Process

From the said chapters, the author designs and develops the spatial data report service from LandSat-5 TM, in order to monitor the changes of water surface area in the country, as shown in web GUI form as follow:

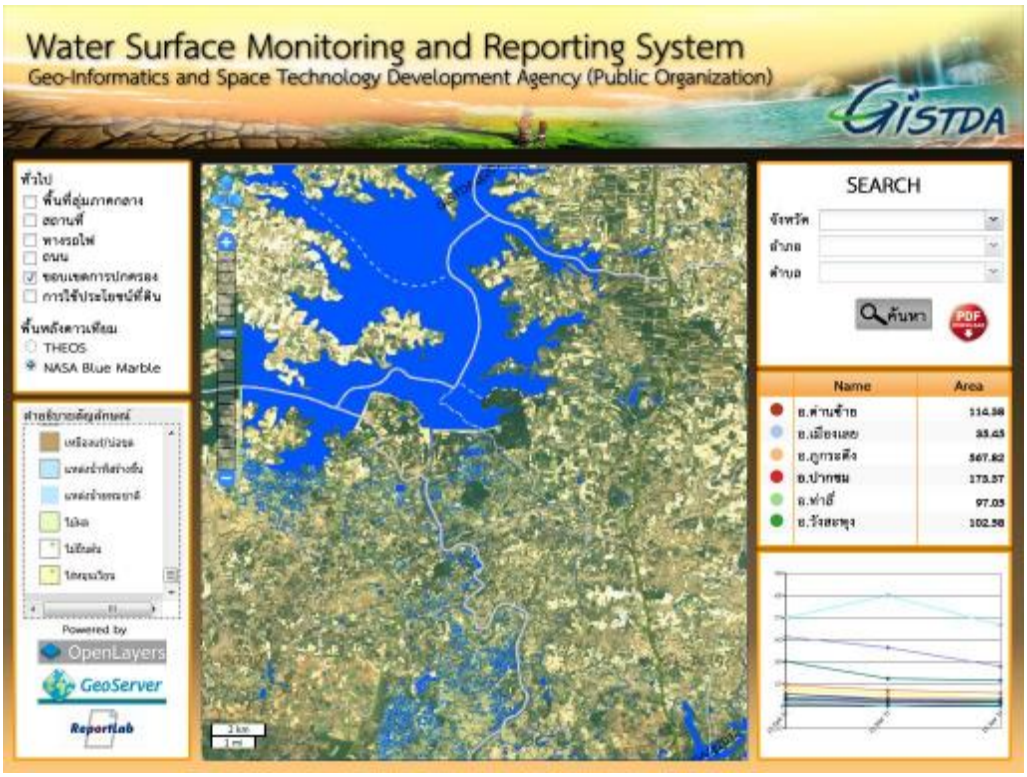

Fig. 6

4.1 Components of the new system and procedure

The author displays the components of the new system as in Fig.7

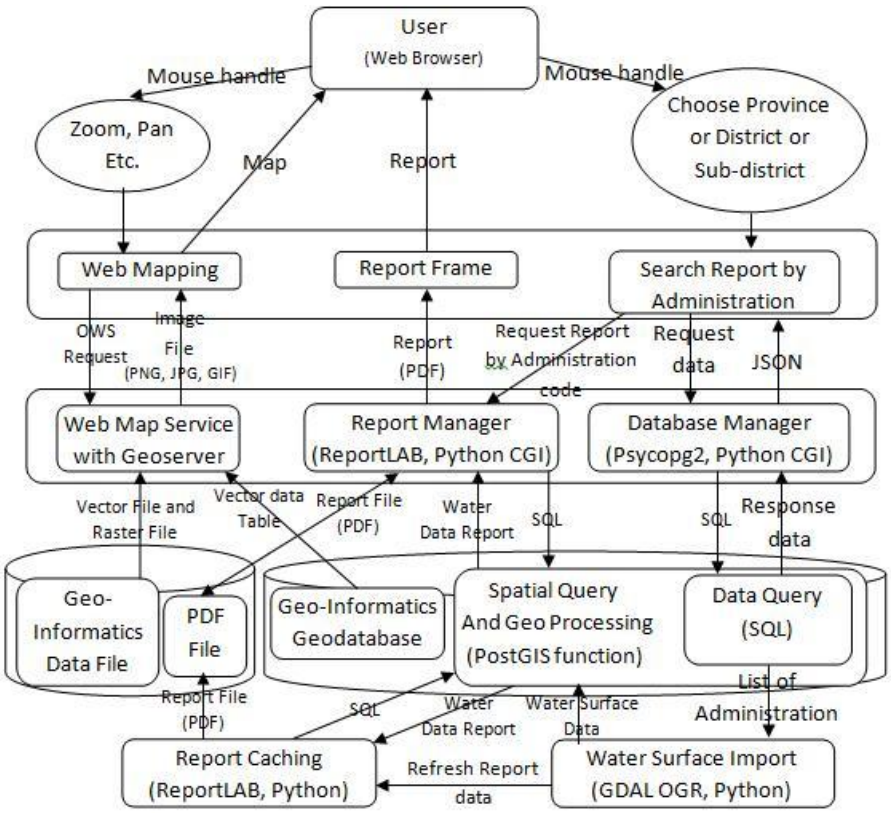

Fig.7 The components of the new system

Components of new system

1. The user starts the web browser program, then, use the web GUI URL to activate the system.

2. After this, the web browser will connect with the server via http protocol, and will show the web GUI on screen as in Fig. 6.

3. From Fig.7, the components will show as follows:

- Mapping; this shows in map in interactive with the user, and the basic tools are pan, zoom-in, zoom-out, zoom to extent, map scale, map index, table of content, active layers and legend.
- Search Report by Administration; this prepares the tool in finding the area in the administrative boundary, in province, district, and sub-district respectively, along with the creation on PDF report document as chosen area by the user.
- Report Frame; this shows the data in the administrative boundary, specified by the user. The data may be saved in file or printed.

4. The use of mapping, in this case, user may find a number of tools, e.g., zoom-in, zoom-out or pan, the data then being converted into OWS request, with open layers, and forwarded to server with geoserver platform. From this, geoserver will process the command and data of Geospatial data as requested by the user, then converted into pic which is shown on the webpage in the web mapping section.

5. In Search Report by Administration section, after the selection of administrative boundary from the given tools, then 1) the code of administrative boundary will forward to database manager, along with SQL statement to the database, in order to find the extent of the administrative boundary. After this the extent being sent to web mapping in order to have the openlayer show the administrative boundary 2) the code of administrative boundary then proceed to report manager to connect the database, along with SQL statement to the database, in order to find the particular administrative boundary. After this, the data will intersect to the water resource data in a given period of time, to create the water resource data in the administrative boundary, including the calculation of water resource data, then, the data being forwarded to this water report back to the report manager to report in a PDF file with the report frame.

4.2 In geoprocessing, to create the report data, the report manager will send SQL statement to PostgreSQL, for geoprocessed to sent the report data back to report manager. The data on water surface from satellite image classification will be imported to the postgreSQL database for storing the data in the given time. From this, after the Search Report by Administration sends the code of administrative boundary, the report manager will recheck whether the data is previously in the PDF or not; if stored, then the file will be sent to report frame; however, if not, this will be proceeded to the administrative boundary code by query of the geometry data, under the water surface data set, being processed by ST_intersection. The outcome is the geometry data of the water surface data set in the administrative boundary. Then the user will calculate the area from geometry by ST_area function, then the water surface area data set is sent back to report manager to create the PDF along with the result in the report frame.

4.3 Report caching from pic shown in Fig. 7; firstly, before the user starts using the system, the author creates the water surface report of all administrative boundary in PDF file and stored for delivering. After user starts, in case of any importing of water surface data from the new pic classification, the new one then forwarded to the database, after this, water surface import will send the SQL statement by using the ST_overlap function, with the geometry data of the administration and geometry data of the new one as the initiative data. After this, the details for the overlapping of administrative and the new data on water surface, will be sent back to water surface import, in order to send the data to report caching, and create the report as shown in the same as report manager.

5. DISCUSSION & CONCLUSIONS

The author complies a number of techniques in providing the spatial data report by web server, and the outcomes is in web application form. The users may access via the internet, under the web mapping scheme, in order to find the water resources, along with the satellite images. There are tools in finding the administrative boundary, down to sub-district, also known in Thai as Tambon, with the graphic displays of the changes on monthly basis. In this, the

author uses Google Analytics service[13] in compiling the users data, then analyzes in the downloading the PDF files with the Log File analyzing outcomes. From the FTP Server, the author counts on number of downloading files to find the Throughput of the data serving. Furthermore, the GeoServer program will display the using of mapping data. In addition, since this system is quite new, the author needs to wait for more user recognition. It is also expected that there might be more users of the system during the dry season. In the near future, the author will use the framework in other applications to serve the data on changes, e.g., forest acreage, cash crops – paddy field, including the data on changes from natural disaster, like forest fire and floods, to provide the spatial data in others field.

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