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Geo-Data Visualization on Online and Offline Mode of Mobile Web using HTML5

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Abstract— **Mobile devices including popular smartphone contributes to efficiency improvement of on-site data processing. Mobile environment for real-time data processing needs some additional aspects besides desktop ones, as the style of mobile app, mobile web and mobile web app. Generally, mobile app provides internal storage service so that offline data processing is possible. But mobile app needs separate development according to different types of devices or operating systems, even to different sizes of display panel of mobile devices. Geo-based data are composed of vector and raster formats from complex structure, compared to other data sets including image data and multimedia data. Hence, even though mobile applications development for geo-based data is more complicated than other ones, users' demands with respect to geo-based data processing functionalities on mobile environment are increasing in these days. Mobile web supported by technical basis of HyperText Markup Language5 (HTML5) is regarded as useful service type combining geo-based data processing modules and mobile environments, because it does not require user' downloading or installation of programs and just needs web browsers. Indexed DB Application Programming Interface (API) within this international web standard provides offline data storage functions on mobile environment. Using this API, data sets can be permanently stored into mobile devices, not cache memory. Among numerous geo-data functionalities, visualization topic is basically and commonly used in most mobile services. This study presents an implementation case of mobile web app with geo-based data visualization processing on online and offline mode. Types of geo-based data sets are base map of Open Street Map (OSM), OSM vector layers with Extensible Markup Language (XML) contents and high resolution satellite images of optical sensor. It is thought that the result of this implementation can play a role to create intelligent mobile application fields using both geo-based data sets and earth observation satellite image sets.**

Keywords— HTML5, Indexed DB, Offline Map, Mobile Web

I. INTRODUCTION

As the IT technologies develop rapidly and the mobile devices in the markets are equipped with the web browsers that match their desk-top cousins in performance, now it has become more convenient to enjoy the web services. Today, the users are able to download and install the necessary web browsers and applications as they need. There are many different fields in which applications and web services are provided in line with such an IT trend. However, the mobile devices, which are designed with the convenience and mobility in mind, have less capacities or performances in comparison with the desk-tops. Therefore, instead of having each device store all the data or perform high-profile processing, many such systems use the server-client structure.

Especially, in case of the visualization of the maps, which is one of the major geo-based services, the servers call up pre-processed map data and visualize them on a real-time basis. There are some solutions with which, at the desk-tops or the mobile applications, one may download the map data directly and visualize the maps even without having the network access. Some of the most representative examples include Google Map and gvSig Mobile. In case of Google Map, it is targeted on the normal users, and the application downloads the map data of the desired area and saves it in the mobile storage, so that the data can be visualized even off-line. gvSIG Mobile provides a more professional service, which include editing of the data. As such, the part of visualizing the map off-line is needed by both the normal users and the professional users. However, the shortcoming of the solutions provide via mobile applications is that they are dependent on the operating system.

In a recent attempt to resolve the shortcoming of the mobile applications, which is being dependent on the operating system, some are using the services based on the web technology. Java, Flash, or other plug-in features, which were commonly used by desk-top web services, did not work on the web browsers on mobile devices. For this reason, alternative web technologies were announced, and there are many recent researches and services utilizing them. In the field of spatial information, there has been a number of studies using HTML5 (Hyper Text Markup Language 5), which is a web technology [1],[2],[3]. However, most of these studies cover the web services that are provided with the network connection. A web service with

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which the spatial properties information can be edited off-line was implemented [4]. Still, the studies on visualizing the map data on mobile web is at their beginning stages, and it is not possible to apply the existing visualization methods to apply them. Therefore, a variety of web technologies are needed.

For this reason, in this study, the technologies that would allow visualization on the web browsers without a network connection were considered and the system that could be used for many services in the future was designed.

II. HTML 5 API STOAGE TECHNOLOGY

There is a way that can be used to save data on a mobile web browser, which is the cookies. However, this technology has many limitations, such as the security vulnerability or the limitations on the size of the storage.

In the HTML 5 API, a variety of storage technology is being provided in order to resolve such limitations. The Web Storage, Indexed DB, and Application Cache are such technologies. These technologies are not the same, and it is important to choose the right technology for the right context. In this study, all of the three storage technologies were used in order to design the service that could be used not only on-line but also off-line, as well.

The web storage is a client storage supported by most of the mobile web-browsers and can hold only a small amount of date. They can be divided into the session storage and the local storage. They are mostly in the same forms with the cookies technology that has been used in the existing web technology, only with enhanced security and usability. The Session Storage uses the memory of the browser to store data, which is removed when the browser or the tab is closed. The Local Storage stores the data on the local memory. Therefore, when the web-browser or the tab is closed, the entire data saved in the memory will be preserved. However, the normally recommended volume of data to be used on the web storage technology is around 5MB.

The indexed DB can store a large amount of data. As the storage itself does not have any limitations in size, it can save data in accordance with the capacity of the mobile storage device and be managed through transactions. The Web Storage and the IndexedDB are all technologies that are used through the NoSQL method.

The Application Cache is an HTML 5 API that is developed for the off-line applications that minimize the online traffic and are run at local level. The Application Cache allows the user to access the web pages even when the system is off-line, and the resources saved locally can be loaded up very fast. Also, when the same website is visited again, the resource will be downloaded again only when there is a change with the resource. Otherwise, the system will use the resources that has been saved already, giving more speed. In order to use the Application Cache, a file named Cache Manifest is required, as it contains the list of the resources required to access the web page. This file is a normal text file and used by designating a parameter named 'manifest' in addition to the html tags of an HTML document. In this study, too, the Application Cache has been used to provide the resources necessary for an off-line visualization.

In this study, in order to prevent the data from being erased even when the web-browsers are terminated, the Local Storage technology among the Web Storage technologies was used. Also, this study used the Application Cache in order to save the resources when accessing the web page off-line. And, IndexedDB technology was also used in order to save and use files of larger sizes.

III. DESIGN AND IMPLEMENTATION RESULT OF OFFLINE WEB USING TECHNOLOGY OF HTML 5

Fig. 1 shows the diagram of the system used for this study. It is mainly composed of the data management server, which is used to manage the data and accommodate the administrator page, and the web client, which can be accessed by the mobile web browser. In the administrator page, the OSM raster data can be downloaded, and the Raster Tiled data is saved in the server. In this case, the different data downloaded through the SID is divided.

This study is based on the mobile web browser, instead of the desk-top web browser. And, it is also possible that, if the mobile device downloads the Raster Tiled data, it can be overloaded. Therefore, in order for the mobile device to receive the data without a load, each data should be saved by making a JSON type list. And, the mobile web browser is downloads the converted information. Fig. 2 shows the result of accessing the administrator page. When the admin page is accessed for the first time, a screen that looks like Fig. 2(a) will be displayed. Fig. 2(b) represents selecting the scope of the data and downloading the data.

Then, the desired area is marked by a rectangle, and the corresponding data can be downloaded. The data downloaded from the admin page is saved as a list of JSON.

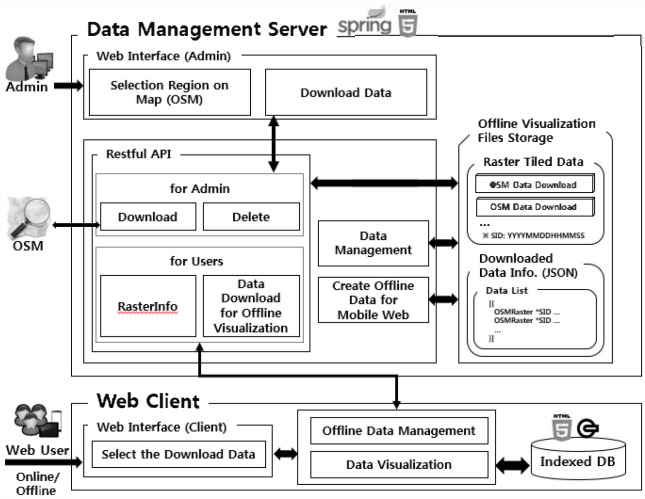

Fig 1. System Diagram.

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Fig 2. Result of accessing the administrator page (a) Main page (b) Selecting the scope of the data and downloading the data.

The data downloaded from the admin page is saved as a list of JSON. It is comprised with the maximum and minimum values of the altitude and longitude shown in the admin page for each set of data, as well as the Map Title, and SID, etc. The SID is saved in a format of YYYYMMDDHHMMSS. It is used to identify the data if there were several sets of data under the same Map Title.

In this study, a Nexus 9, a type of mobile device, was used to test the visualization of the map online and offline using the web browser installed in the device. Figure 4 show the result of accessing the client web page using the mobile device online. As shown in Fig. 3(a), the user may press down the select bar to access the list of the OSM raster data saved in the server. Here, they user may click the data he/she wishes to download. Then, as shown in Fig. 3(b), the map moves to the relevant area, and the Map Title and the SID among the saved data is displayed, in order to allow the user to confirm that that is the exact data he/she wants to use.

Lastly, the user clicks the 'Download' button on the upper right corner. With this, of the saved data, the data selected by the user is identified with the SID and saved in the IndexedDB of the mobile web browser.

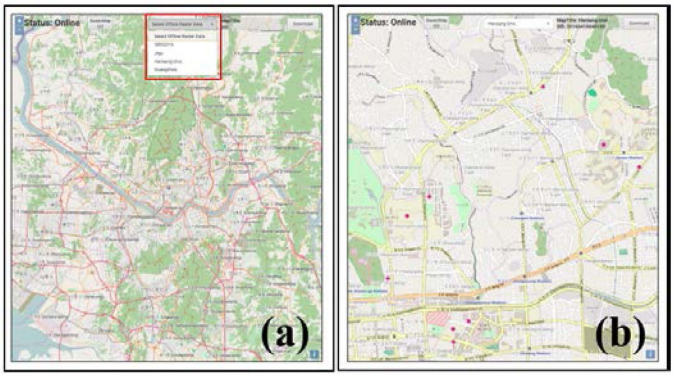

Fig 3. Client online mode (a) visualization of the list that has been downloaded on the server, (b) selection of the data and visualization of the relevant data.

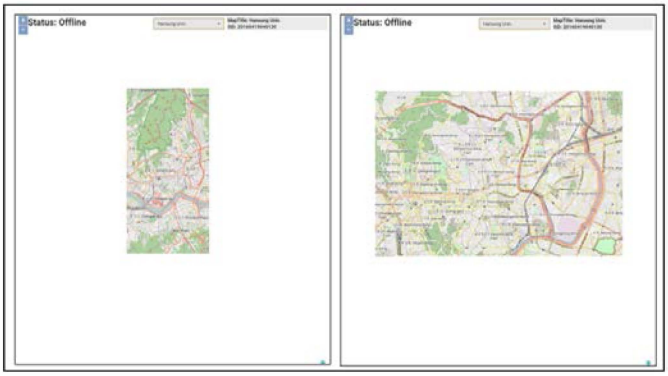

Fig 4. The Offline mode of the client: Visualization of the data saved in the IndexedDB.

Fig. 4 shows the result of visualization of the data that was saved in the IndexedDB after accessing the web page of the client through the mobile device offline. The status is shown as Status: Offline on the upper left corner, which signifies that the mobile device of the user is not connected to the network.

IV. Conclusion

In this study, the storage technologies that could allow visualization of the spatial information offline among the APIs of HTML 5 were briefly reviewed and a test development of a system using this technology was conducted. The developed system is at its early stage. Therefore, of the spatial information data, the OSM raster data was downloaded and saved. Then, the data saved during the offline mode was visualized.

Future enhancement of the system would allow the map services by Google Map and other service providers and the free-of-charge vector data provided by OSM to be downloaded and saved by the normal users as well as the experts, while they could be visualized and edited as desired in special locations where they are not connected to the network.

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