DESIGN AND IMPLEMENTATION OF WEBGL-BASED MOBILE SYSTEM FOR 3D GEO-IMAGE FUSION

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Abstract: Geo-based images including satellite sensor images and airborne images are important data sources for information fusion with other types of geo-based images. Most researches for data fusion are inclined to focus on algorithm development, but 3D visualization for geo-based data fusion is more practical issue for user-side. As well, HTML5, now under international standardization, shows many advantages such as cross-platform operation without plug-in modules and useful APIs for mobile web app implementation. This study deals with these three themes: 3D geo-data fusion, mobile application, and HTML5. For 3D geo-image fusion, optical sensor images and SAR (Synthetic Aperture Radar)-processed images are basically used, with DEM and other air environment sensor images obtained in the observation field sites. With these data sets, this study is to implement mobile web app, combination of mobile web and native application. In client layer, user interface and user experience items are designed with HTML5, and 3D geo-image fusion and rendering process is performed using HTML5 WebGL. In this study, example cases using this implementation and actual data sets are demonstrated. It is expected that this approach contributes to produce value-added contents by 3D geo-image fusion visualization on mobile devices.

INTRODUCTION

Satellite images and airborne images are as the most important data sets in the geo-spatial application field. These geo-based images are processed and interpreted by optimal analytical functions in a variety of applications. In other frequent uses of these data sets, studies for multi-sensor image fusion are also citable. Moreover, web services of geo-based images are the big issues all over the world. However, most cases of them are base image sets for location search or show limited use cases. Also, public interests in climate changes covering local or global scales are increasing. Mobile application developments for geo-based data sets have been also regarded as one of important geo-based application (Kim and Lee, 2006, Lee and Kim, 2006, and Lee and Dong, 2008), although they are not dominant theme in the geo-based communities.

With this motivation, mobile web application system was designed and implemented to visualize for 3D geo-image fusion in this study. Technically, WebGL of HTML5 is used among many alternatives to achieve this target system. It is based on OpenGL ES 2.0 for Javascript, and is executing the web browser on desktop and mobile device. WebGL has many advantages. It supports graphic hardware acceleration without plug-in modules of flash. And, it is cross-platform and royalty-free API(Application Programming Interface). Kim and Lee (2012) studied the visualization issue of 3D terrain based on Three.js of WebGL frameworks. This study is an extension of the previous achievement. In this study, the image fusion strategy is the blending scheme provided by graphic pixel pipe, and CubicVR.js of WebGL frameworks is used to implement. Optical data for this fusion application in mobile web is KOMPSAT-2 satellite image, and SAR data is ALOS PALSAR satellite image. DEM data are reproduced by using the digital map in vector types. Several grid data sets of air environment are tested: Fine Dust, Ozone, Nitrogen Dioxide, Carbon Monoxide and Sulfur Acid Gas in the eight sites, as actual measurements.

BLENDING ALGORITHM OF WEBGL

WebGL is a cross-platform, royalty-free web standard for a low-level 3D graphics API based on OpenGL ES 2.0. It is regarded as a shader-based API using GLSL, constructing that are semantically similar to those of the underlying OpenGL ES 2.0 API. It stays very close to the OpenGL ES 2.0 specification, with some concessions made for what developers expect out of memory-managed languages such as JavaScript. WebGL brings plugin-free 3D to the web, implemented right into the browser such as Apple (Safari), Google (Chrome), Mozilla (Firefox), and Opera (Opera) (Khoros, 2011). WebGL has been updated to run on the mobile device as well as on the desktop. It supports the alpha blending effect. This is the process of combining a translucent foreground color with a background color, thereby producing a new blended color. Alpha blending modes are additive blending, subtractive blending, multiplicative blending, and interpolative blending in WebGL (Cantor and Jones, 2012). This study used CubicVR.js. Interpolative blending is the default setting in CubicVR.js, and types of the blending method can be changed.

3D FUSION WEB APPLICATION DESIGN

The mobile web application for geo-based image fusion was designed to run on the mobile web browser, as well as on the desktop web browser. Data sets of KOMPSAT-2 image and ALOS PALSAR were pre-processing for the further uses: conventional geo-rectification and location matching in the same extent. While, grid data sets of air environment information were generated from real-time data provided by AirKorea site (http://www.airkorea.or.kr). Air environment information formed five sensors in the eight sites: Fine Dust, Ozone, Nitrogen Dioxide, Carbon Monoxide and Sulfur Acid Gas. Figure 1 shows the fixed location of the sensor measurement site in the Google Earth. Table 1 shows the sensor data on 6 August 2012 and the three classes of air environment sensor data in the range of good, normal and bad. Figure 2 shows the environment gird data sets for each sensor. All values are in the safe range of the good class: Fine Dust (0~31), Ozone (0~0.04), Nitrogen Dioxide (0~0.030), Carbon Monoxide (0~2), and Sulfurous Acid Gas (0~0.02).

In this study, mobile web application system was the structure composing the server layer and the client layer. The actual data sets were stored and managed in the server layer, and CubicVR.js and JQuery are located in the client layer.

Figure 3 shows the basic scheme for system design and its components based on necessary open sources.

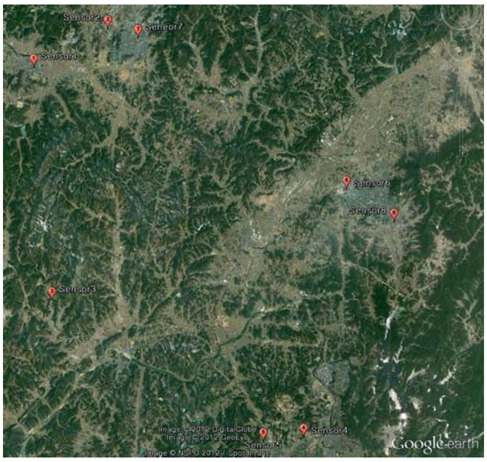

Figure 1: Eight area fixed environmental sensor location in Google earth.

Table 1: The sensor data on 6 August 2012 and air environmental sensor data class

Sensor Number	Fine Dust	Ozone	Nitrogen Dioxide	Carbon Monoxide	Sulfurous Acid Gas
	($\mu g/m^2$)	(ppm)	(ppm)	(ppm)	(ppm)
1	28	0.027	0.03	0.3	0.003
2	32	0.035	0.01	0.6	0.003
3	29	0.028	0.005	0.3	0.006
4	26	0.028	0.01	0.2	0.001
5	20	0.029	0.01	0.1	0.001
6	39	0.025	0.026	0.2	0.003
7	24	0.025	0.02	0.5	0.003
8	19	0.024	0.013	0.3	0.001

Figure 2: Grid data sets of air sensor information all class.

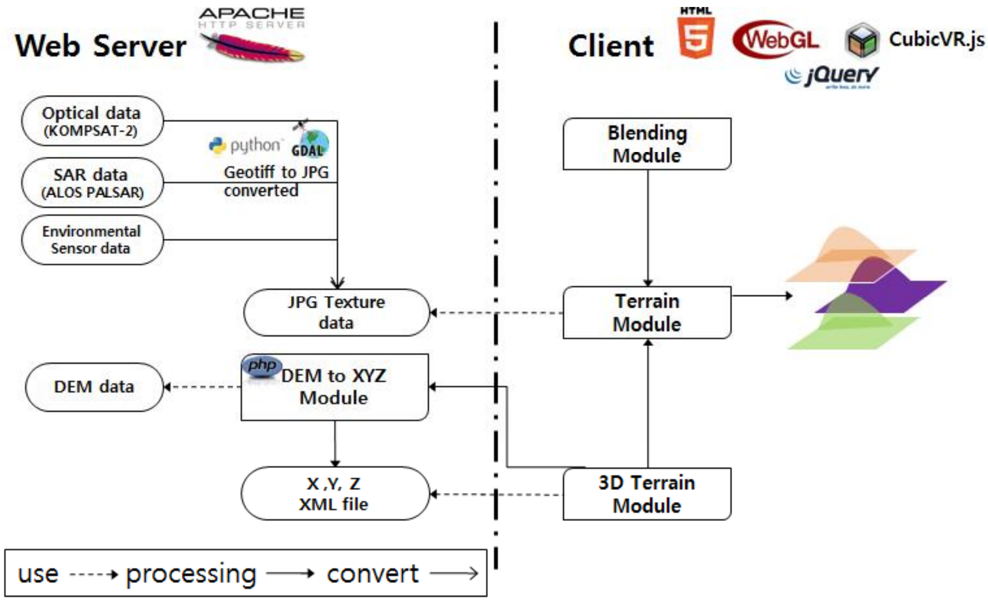

Figure 3: Mobile web application system design.

3D FUSION WEB APPLICATION IMPLEMENTATION

The mobile web application for 3D geo-based image fusion was tested on the Webkit browser of Android 4.0.4 in this study.

Figure 4 shows 3D viewing cases, draped on DEM with the texture image, geo-based images or grid data sets. Grid data is artificial data, because actual data on the same area on a certain date were in the good class showing no variation color. Figure 5 shows interface for 3D visualization and the blending process in the implemented mobile application, and some examples using optical image and grid data set are presented.

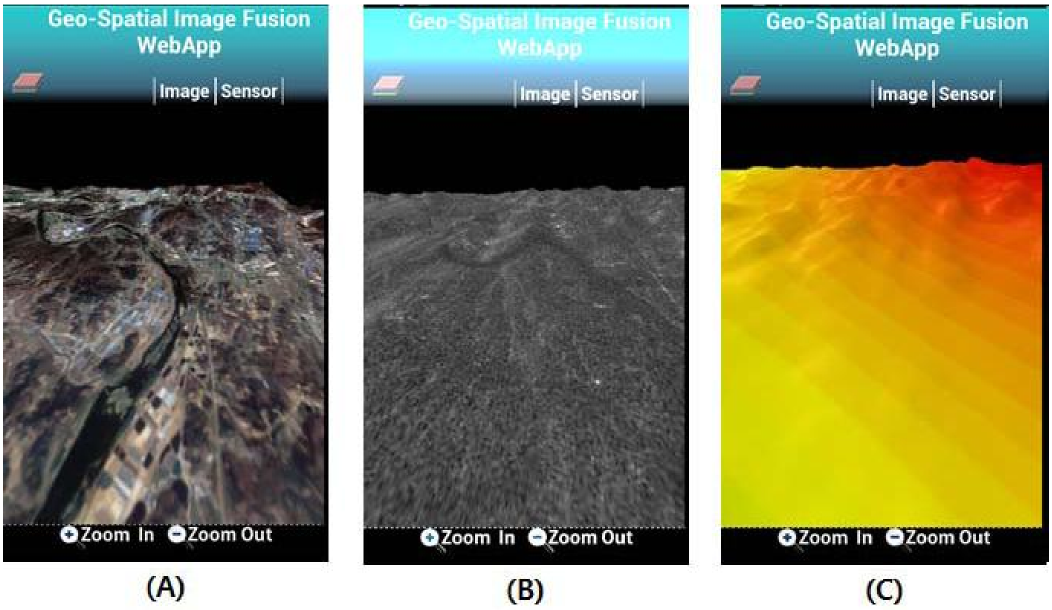

Figure 4: 3D viewing draped on DEM, (A) KOMPSAT-2, (B) ALOS PALSAR and (C) grid data set for artificial air environment information.

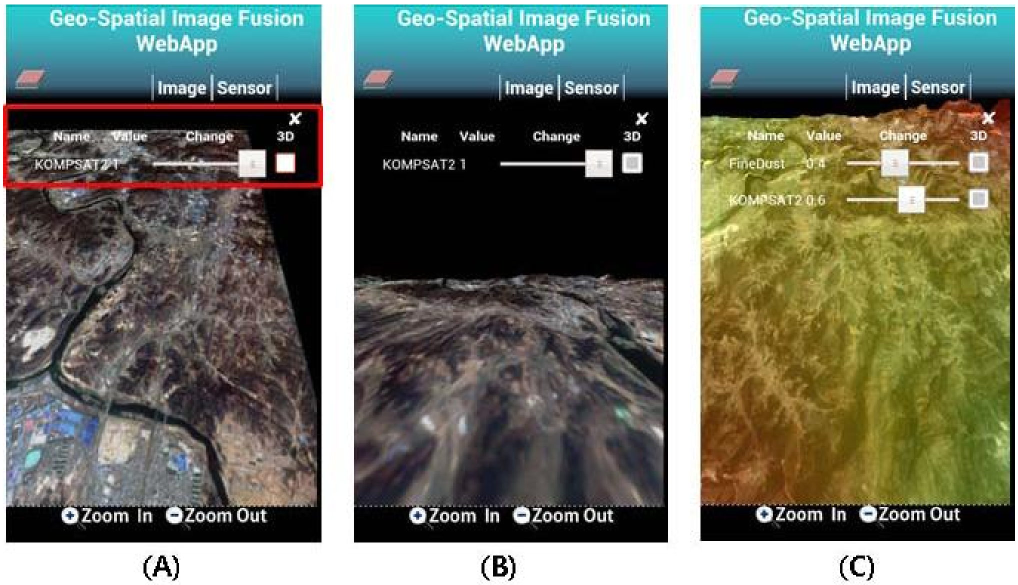

Figure 5: 3D geo-based image fusion application, (A) user interface for the blending process, (B) 3D visualization of KOMPSAT-2 and (C) the blending result for KOMPSTA-2 (Fig. 4(A)) and grid data set (Fig. 4(C)).

CONCLUDING

This study deals with these three themes: 3D geo-data fusion, mobile application, and HTML5 WebGL. In the client layer, user interface and user experience items in the proposed mobile application are designed with HTML5, and 3D geo-image fusion and rendering process is performed using HTML5 WebGL. The mobile web application for 3D geo-based image fusion was designed and implemented with the data sets such as optical data and SAR data and grid data sets of air environment information. Of course, other geo-based data sets are directly imported into this application, if they are processed as the standard geo data formats. This approach is independent of Google maps, so that local data and image sets can be manipulated as users' application purposes and further extensions. Soon after, this study is expected to help implementation of mobile web application using HTML5, to produce value-added contents by 3D geo-image fusion visualization on mobile devices.

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REFERENCES:

Cantor, D. and B. Jones, 2012. WebGL Beginner's Guide, Packt Publishing, pp. 210-216.

Khronos, 2011. WebGL Specification version 1.0, http://www.khronos.org/registry/webgl/specs/1.0/

Kim, K. and K. Lee, 2012. Visualization of 3D Terrain Information on Smartphone using HTML5 WebGL, Korean Journal of Remote Sensing, 28, pp.245-253.

Kim, S. Y. and K. Lee, 2006. Development of Mobile 3D Terrain Viewer with Texture Mapping of Satellite Images, Korean Journal of Remote Sensing, 22, pp. 351-356.

Lee, K. and S. Y. Kim, 2006. Development of Mobile 3D Urban Landscape Authoring and Rendering System, Korean Journal of Remote Sensing, 22, pp. 221-228.

Lee, K. and W. C. Dong, 2008. A Prototype Implementation for 3D Feature Visualization on Cell Phone using M3G API, Korean Journal of Remote Sensing, 24, pp. 245-250.