Development of a Data Conversion Module for the GIS Expression of Stream Information

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ABSTRACT: Ensuring the sound management of rivers is one way of improving the quality of people's lives. To efficiently manage rivers, a platform capable of handling hydrophilic data reliably is required. Various types of river data in South Korea are stored in each database by type. To improve the accessibility of these data, it is necessary to combine these data in a manner that will make them easily accessible to the users. River data are generally stored in various formats, such as in the geographic information system (GIS) formats (GeoTIFF and shapefile) and in text form.

In this study, a module that can churn out hydrophilic data as images by combining GIS data in various formats was proposed. This module was made using the open-source GDAL, and it was configured to read and receive the above-mentioned data. In addition, it was written in the C++ language to enable linkage with various libraries. The module reads GeoTIFF and shapefile data, which are GIS data, and various text data before reconstructing and outputting them as two-dimensional (2D) GIS data

The proposed module can read GIS data in various formats, analyze the aforementioned read data, and output them as 2D GIS data. As the module outputs various GIS hydrophilic data while functioning as a viewer, the user can easily view such data. In the future, this module will be developed as a 3D GIS module by combining it with a versatile 3D engine, such as OpenGL.

1. Introduction

Diverse software such as ArcGIS, ERDAS, ENVI, Q-GIS, and Google Earth have been used of late in geographic information system (GIS) researches. They are mainly divided into open-source modules and commercial modules. Both modules have advantages and disadvantages, but the open-source modules are relatively more specialized in terms of business simplicity. In the case of commercial modules, various licenses are required for a single product, which imposes a great financial burden as its jacks up the price of the product.

In this study, a specialized open-source-based module was developed to reduce such cost burden, and its performance was verified by mapping water surface data onto satellite images.

2. Overview of the Conversion Module Development

Various data are required for the effective management of waterfront data, including those on the river network, the river basin, the location of dams, the source and its coordinates, the administrative boundaries and numerical elevation, the population, and the rainfall. In the case of the waterfront data contained in the .shp group file, the location data dbf contains the data of the corresponding location. The structure of the .dbf file is divided into the header and content sections, with the former containing information on the composition and quantity of the items included in the content section. They are shared by the data number (index number) of the .dbf and .shp files. When an .shp file is read, the information of the .shp figures can be identified by reading the .dbf file of the corresponding number. The format varies for each .dbf file, and was constructed by reading the header file dynamically. Such information was expressed on the GIS-based map to make it easily understandable by the general users.

3. Module Development and Performance Verification

3.1 Development of an algorithm to combine .shp data and Landsat images

For waterfront data, the data provided in the .shp file format by the Korea National Spatial Data Infrastructure portal were used. A Shapefile consists of a * .shp format, a * .shx, * .dbf format with the same file name, and so on. The * .shp file is the main file and contains direct data for points, lines and polygons. The * .shx file is an index file that records information about the address where each object is recorded in the * .shp file of the data. * .dbf is a database file in which text information of each object is recorded.

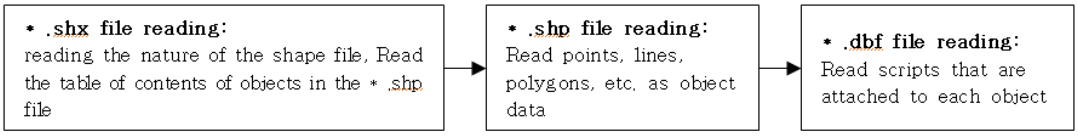

Figure 1. Reading process of Shapefile.

For GIS-based background satellite images, Landsat 8 OLI images provided in the GeoTIFF format were used. Two, three, and four bands of satellite images, which are generally used to represent images with RGB data with coordinate information, were used.

The program was developed using GDAL (Geospatial Data Abstraction Library) to read and output the aforementioned data. An open-source library capable of processing GIS data, GDAL can process a variety of GIS data. It can also be used for commercial GIS programs such as ArcGIS, ERDAS, ENVI, Q-GIS, and Google Earth. The program developed in this study was written in the C++ language.

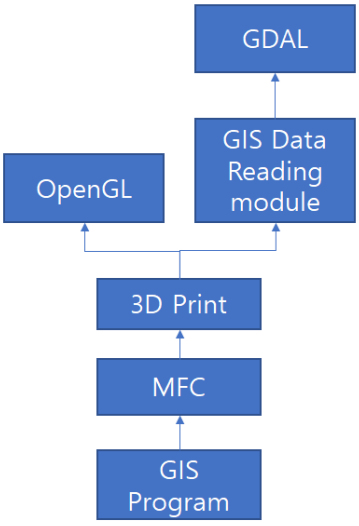

Figure 2. Algorithmic diagram.

3.2 Realization of the module and verification of the data processing performance

The readability of waterfront data was enhanced by mapping the information on waterfront areas onto the satellite images using GDAL. In addition, the topographic map of a random target area was transformed and expressed as shown in Figure 3 by applying OpenGL for 3D imaging, which is the future development goal. As such, it was confirmed that the mapping of waterfront data is possible via 3D imaging.

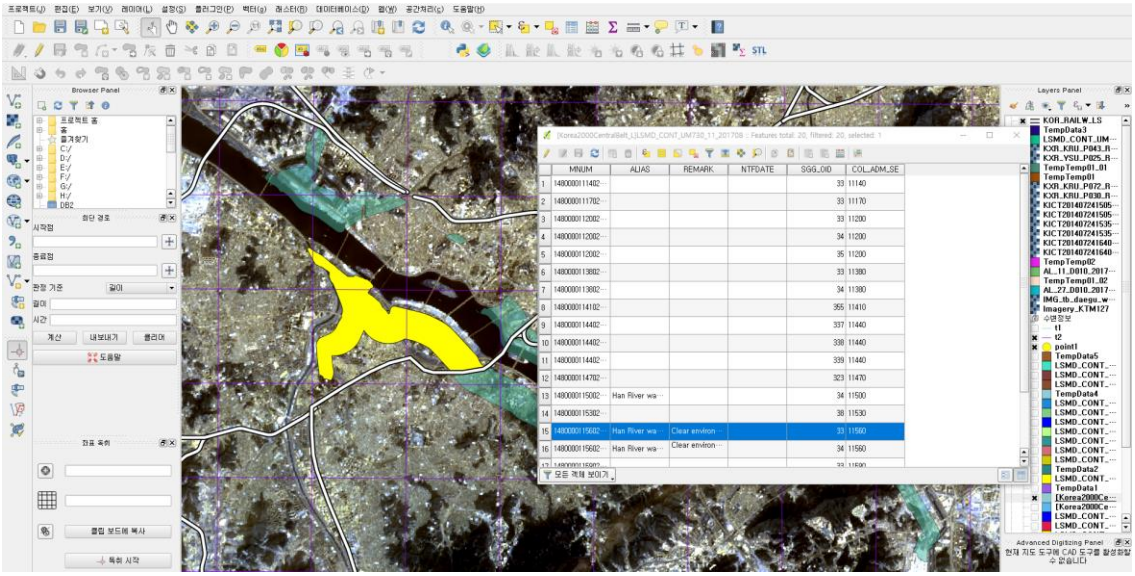

Figure 3. SHP file executed by commercial GIS program

The developed program was confirmed to be running in the Windows-based environment. It also demonstrated some improvements over the existing programs that have been dogged by a relative lack of versatility.

4. Conclusions

A program module compatible with .shp and GeoTIFF files, which are used for satellite imaging, was developed using C++ in GDAL, a library capable of processing geographic information system (GIS) data. The developed program can convert the GIS data of satellite images into Software images of waterfront data by mapping waterfront data .shp files onto the GIS data, or obtain information on a random point. The satellite images and videos obtained by mapping the locations of the waterfront onto the satellite images were put out as shown in Figure 4.

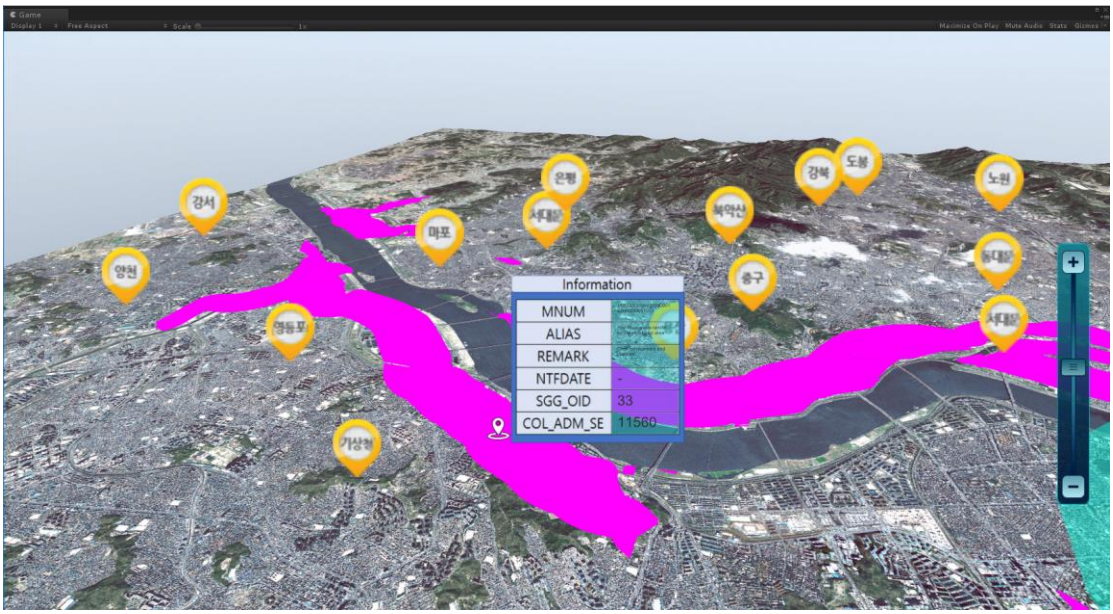

Figure 4. Development program mapping 3D-based satellite image and GIS information

The developed GIS platform that is independent from the existing commercial programs can easily convert data in the .dbf format into characters, images, and videos before outputting them, thereby enabling the users to

obtain information on random points. It also provides a basis for mapping waterfront data in various formats.

The module developed in this study provides a basis for enhancing the readability of GIS-based waterfront data in various formats by expressing them as images and videos. Thanks to the increased readability, the general users can understand them easily, thereby improving the versatility and usability and laying the groundwork for mapping various other spatial data as well as waterfront data. Furthermore, it is easy to add diverse waterfront data thanks to its increased versatility. It is expected that the module would be useful for utilizing spatial data besides waterside data.

It ishoped that the developed module will increase the value of waterside and terrain data in the future by expressing these in 3D. By eliminating the license issue associated with the existing commercial programs in the module development, the module is expected to contribute to the advancement of GIS-based software.

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