Universal Automatic Data Conversion System for GIS Services

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ABSTRACT:

The current studies on automatic data conversion algorithms for geographic information system (GIS) services and related libraries are limited to certain platforms and thus provide low accessibility. To address these shortcomings, the proposed universal automatic data conversion system for GIS services is applied to the server/client model, and the first client transmits the files in the satellite image and shapefile (.shp) formats, which are GIS formats, to the server via the communication protocol. The server processes the data of the files in the satellite image and shapefile formats and then transmits the generated results to the client via the communication protocol. In other words, the universal automatic data conversion system for GIS services has a server/client-type system configuration, in which the client transmits the GIS file formats to the server and the server processes the file formats and transmits the results to the client via the communication protocol.

The system proposed in this study is not limited to certain platforms and can be applied in various platform environments. Therefore, it can facilitate the development of programs related to GIS services and can shorten the development time by strengthening the use and accessibility of libraries in the program development stage for GIS services.

Keywords: GIS, GeoTIFF, shapefile, multi-platform

1. Introduction

The geographic information system (GIS) service facilitates the understanding of a wide range of local information. To construct such service, it is necessary to have the capability of interpreting the existing GIS format freely and converting it automatically. The existing commercial programs with such capability, however, have some disadvantages: they are not easily accessible and their software licenses are expensive. To overcome such disadvantages, a network system that can transmit data is required, along with an automatic GIS data conversion system with good accessibility. In this paper, a general automatic data conversion system for the GIS service is proposed. Applicable to the server/client model, this system can transmit data with various formats, such as shapefile and satellite image data, from the client. The server then converts the data format, passes the data back to the client, and supports the output of necessary information. To ensure accessibility, open source libraries like GDAL, which is independent from the commercial program library, was used. The system proposed in this paper was able to analyze and transmit GIS data via various computer environments, without being restricted by a specific platform, and the development time was shortened by using an open source.

2. Main Discussion

2.1 Format conversion system

With regard to the GIS format, GDAL, an open source library, was adopted in the server to convert shapefile, which stores polygons of geographic information, and GeoTIFF, which stores satellite images. The format conversion system on the server operates as shown in Figure 1.

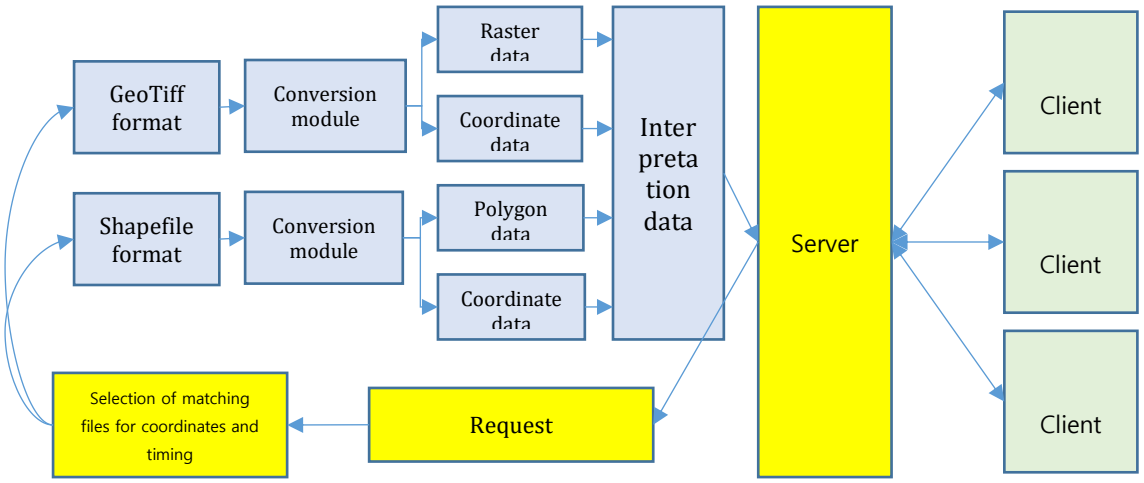


Figure 1. Overall structure

When a request is made between the server and the client, the GeoTIFF file and shapefile, which are both necessary GIS format files, are selected by interpreting the information on the matching location and time. The two files are converted by their respective modules while the raster, polygon, and coordinate data are converted to text data. The text data are then sent to the server module from which the request originated, and the server sends the requested data back to the client.

Each conversion module was developed using GDAL. GeoTIFF's conversion module extracts the coordinates and resolution of the geographic image data as well as the image (raster) data according to the required coordinates from the original GeoTIFF data. The shapefile conversion module extracts the polygon files and coordinates identified by the corresponding file in the bounding box. The interpretation data module converts the extracted data to a transmittable format. The server programs, including the conversion and server modules, were all written in the C++ language. Figure 2 shows the data extraction process from the remote-sensing images. Figure 2(a) shows the original image data; Figure 2(b), the extracted raster data; and Figure 2(c), the coordinate system data of the original image. Figure 3 shows the extraction process of shapefile. Figure 3(a) shows the shapefile output on a commercial program, and Figure 3(b), the interpretation of shapefile.

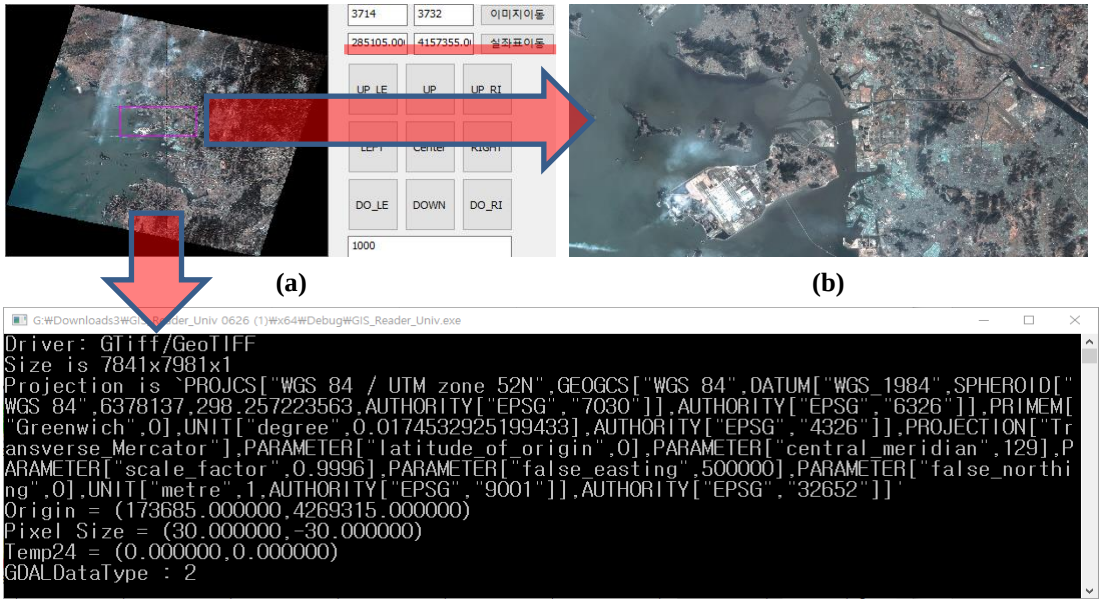
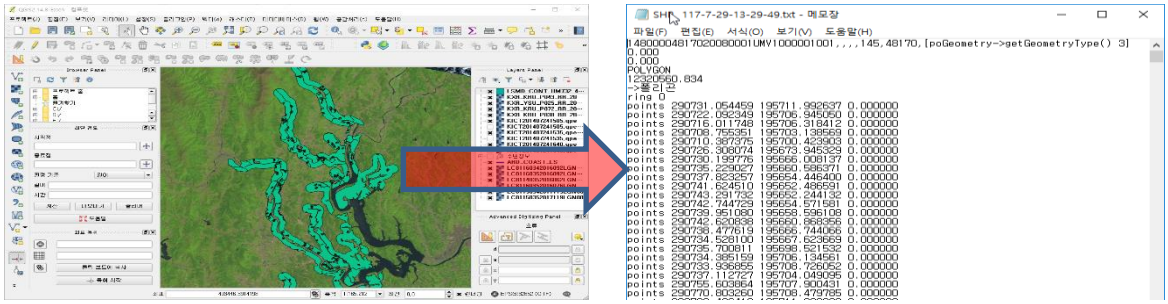


Figure 2. Data extraction from remote-sensing images: (a) original image, Landsat 8; (b) extracted raster data; and (c) coordinate data.



(a) (b)

Figure 3. Information extraction from shapefile.

2.2 Transmission system

In the client, data are inputted and outputted before they are converted by the server, an architecture that prompts the server-side program to consume much resource for format conversion. The client was written in the C++ language, but it could be developed for various platforms to ensure compatibility with the Android or Unity platform. The data transmission and processing process is shown in Figure 2.

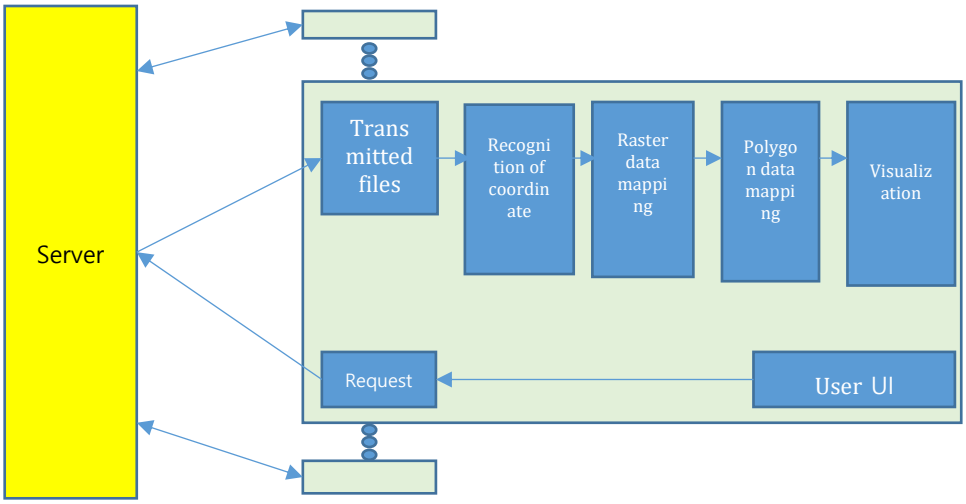


Figure 4. Data communication and output.

When the user requests for specific data through the UI, the server transmits the matching files. The transmitted data are reconstructed by the client, and visualized. When reconstructing data, the raster and polygon data should be mapped based on the coordinate system.

3. Results

The server was able to convert the data upon request, and send it back to the client. Through this process, the remote-sensing images could be converted and outputted by mapping them onto other GIS files. The mapping was performed based on the coordinates of each data. The results from the client side of this system can be seen in Figure 5. Figure 5(a) shows the mapping and output process on the 2D satellite images; Figure 5(b), the mapping and output process on Google Map; and Figure 5(c) and (d), the mapping and output processes on the 3D engine.

Figure 5. GIS output on various platforms.

4. Conclusions

Geographic information system (GIS) data can be converted to the general-purpose format before being transferred to each program. For the GIS service, it is possible to reduce the time required to manually convert the data, and the data conversion and output sections can be divided into the server and client sides, respectively, while the output platform can be chosen from a variety of selections. In addition, the development time was significantly reduced by using an open source in the said conversion process, and it was able to be used freely by building a system that is not dependent on the licenses of other commercial platforms.

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