Development of a Format Conversion Algorithm for the Commercial GIS Program Display of Rainfall Radar Data

Hyeong-Hun Kim[1], Change-Heon Park[2], Jang-Bae Lee[3], Hyeon-Cheol Park[4]

[1]Institute of Spatial Information Technology Research, GEO C&I Co., Ltd., 435 Hwarang-ro, Dong-gu, Daegu, Republic of Korea. E-mail: hhkim@geocni.com
[2]Institute of Spatial Information Technology Research, GEO C&I Co., Ltd., 435 Hwarang-ro, Dong-gu, Daegu, Republic of Korea. E-mail: chpark@geocni.com
[3]Institute of Spatial Information Technology Research, GEO C&I Co., Ltd., 435 Hwarang-ro, Dong-gu, Daegu, Republic of Korea. E-mail: jblee@geocni.com
[4]Institute of Spatial Information Technology Research, GEO C&I Co., Ltd., 435 Hwarang-ro, Dong-gu, Daegu, Republic of Korea. E-mail: hcpark@geocni.com

ABSTRACT:

In this study, a file conversion algorithm was proposed to display rainfall radar data in commercial geographic information system (GIS) programs. The rainfall radar data that were used in this study were local moisture index data measured at 1-minute intervals and provided raw data for a specific area. The provided raw data were converted to images to be interpreted as GIS data and to be viewed by universal image viewers. In addition, coordinate data files were created to be used in commercial GIS programs. Using this method, it was possible to visualize the provided raw data and to display the rainfall radar along with the satellite images of the corresponding area in commercial programs like QGIS and ArcGIS.

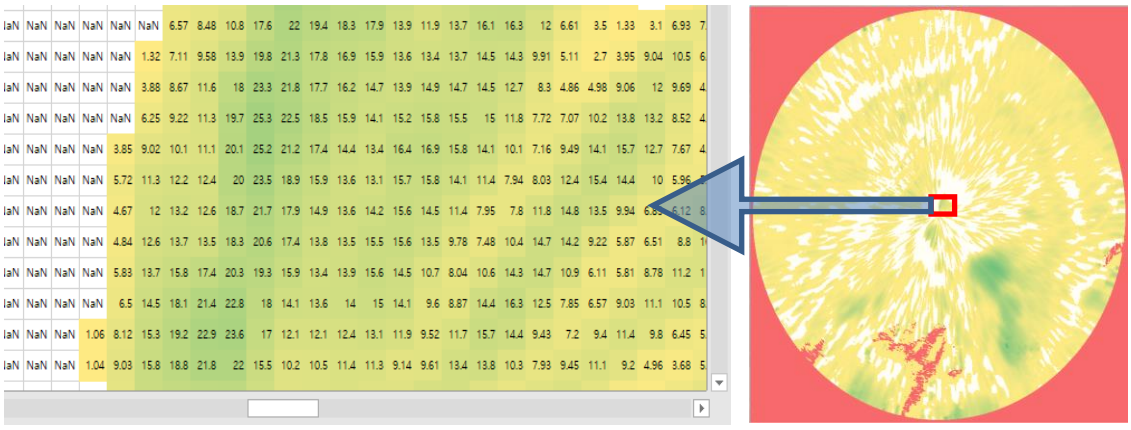
Keywords: Rainfall radar, data convert, GIS, shapefile

1. Introduction

Rainfall radars, which are operated in many countries to observe rainfall, can observe both rainfall and snowfall based on the detected data output, and the raw data delivered by the rainfall radar is provided in text form, which is difficult to use universally. To make the data practical for general use, it is necessary to map and convert them to other geographic information system (GIS) formats. Therefore, the rainfall radar data need to be converted to other formats compatible to GIS programs such as QGIS and ArcMap before overlaying them with GIS data. Choi et al. proposed a method of converting rainfall radar and GIS data, and of mapping them on the terrain information in the Unity 3D engine before outputting them. The disadvantage of such method, however, is that the conversion process is not automated. In this paper, a method of efficiently processing a large amount of radar data by automating the above-mentioned process is proposed. The devised method made it possible to read and analyze a large amount of raw data in a folder, convert them to raster data according to the presented legend, and give the GIS coordinates applicable to the raster data to make them compatible with the existing commercial GIS programs.

2. Data Format Conversion Process

The data from the rainfall radar indicate the amount of rainfall around the installation area in the form of a disk. The outputted data can be expressed as a matrix. In this study, the data were expressed as 800×800 matrices. The value of each consisting element can be represented as a real number, and an area without data can be treated as a null value. In this study, any massive chunk of such file data was automatically converted and used as GIS data. The data from the rainfall radar are initially outputted in binary form. The data with completed primary processing for quality control are then used as distribution copies and are composed in the ASCII format. Figure 1 shows the use of the Excel program to identify the data manually. Figure 1(a) shows a close-up of a specific area, and Figure 1(b) shows the entire area.



(a) (b)

Figure 1. Structure of the initial rainfall radar raw data used in this study.

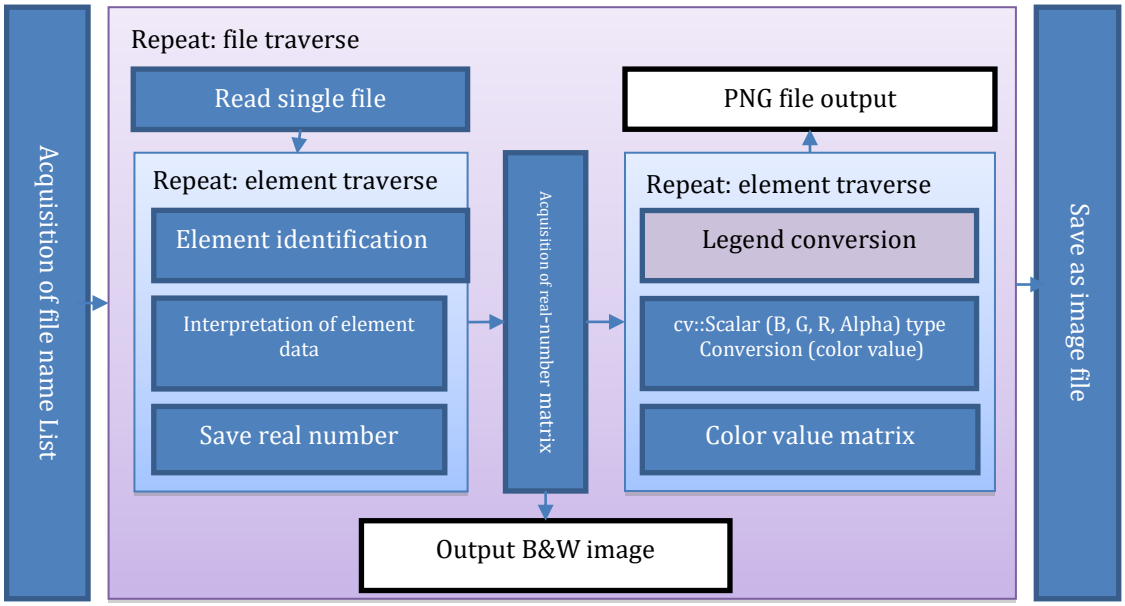


Figure 2. File reading and interpretation process.

Figure 2 above shows the conversion process. The conversion program that was developed for this purpose was composed in the C++ language, and OpenCV is used for outputting image files. A list of file names is obtained from the input file list. The process is then repeated for individual files. In the file-by-file iterative operation, a single file is read, and its elements are sorted. The elements are sorted via iterative operation, and the sorted element data are then interpreted and stored as real numbers. A real-number matrix is obtained from the input files through the above process. It is possible to extract a monochrome image from the real-number matrix data and output it as a monochrome image file. Another method is to convert the entire matrix by assigning red, green, and blue (RGB) and alpha values to each consisting element by specifying the colors according to a predetermined legend, and outputting a color image file. The RGB and alpha values were assigned to the matching elements and were then stored using the cv:: Scalar type provided by OpenCV. Alpha values are meant to handle null values during the data conversion. To represent the alpha values, the data were saved as PNG files, and the OpenCV library was used for the storage function.

The data that were used in this study were X-Band data, which were provided by the Korea Institute

of Civil Engineering and Building Technology (KICT). The provided data had a 100m^2 resolution, and the original images measuring 800x800 were enlarged to 808x808 by adding four elements each to the top, bottom, left, and right sides. Figure 3 shows the raw data.

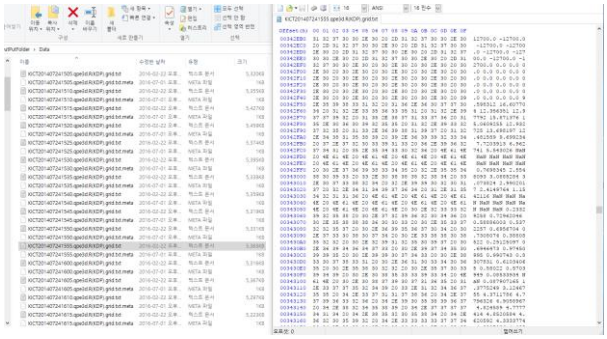
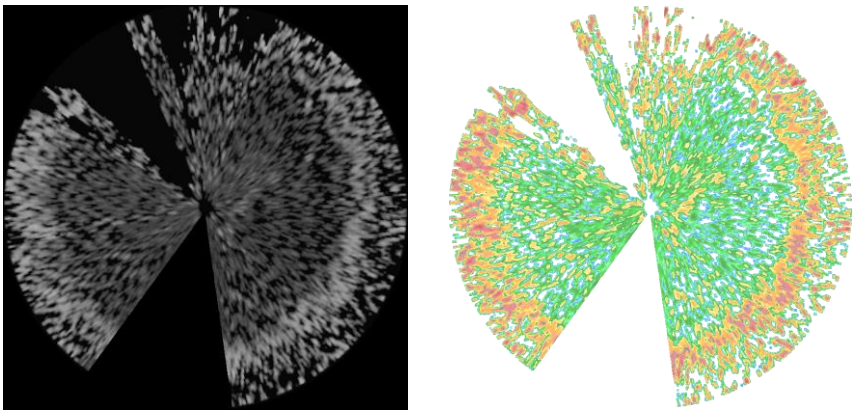


Figure 3. Radar raw data file.

The filename of the image to be saved is decided depending on the input filename. Figure 4 shows the converted radar data. In the image, (a) shows an image that was converted to a simple gray image, and (b) shows a color image that will be used in GIS.



(a) **(b)**

Figure 4. Rainfall radar data converted to image files: (a) gray image (*.raw); and (b) color image (*.png).

The following program was developed in this study for the iterative performance of these operations. The program reads a large amount of rainfall radar data, traverses them by data type, converts the matrix data to image data, and outputs the data as a file. Such process is shown in Figure 5.

Figure 5. Program execution process: (a) selection of a file list; (b) conversion to a file; and (c) converted file.

To use the converted radar data in a commercial GIS program, the resolution information per pixel of the image and the coordinates to place the image on are required. A WLD file used in commercial programs such as QGIS was created, and the data were recorded in the file to manage the resolution and coordinates of the image.

3. Results

By assigning GIS data to the converted data, it was possible to use the data as follows. It took about 30 seconds to process 96 individual radar data during the conversion with the process shown in Figure 6.

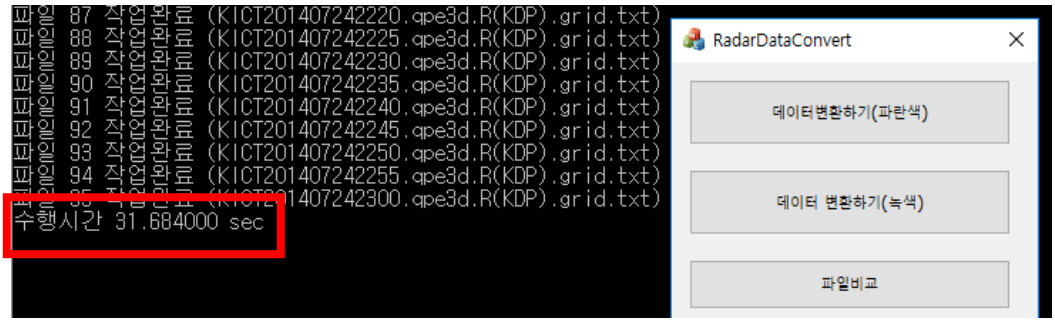
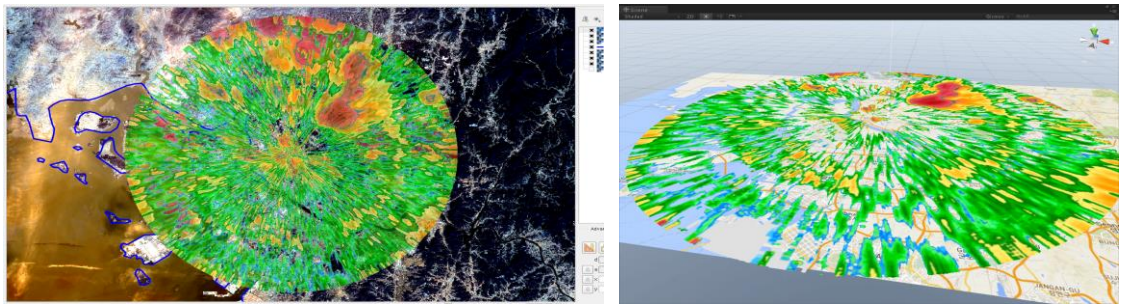


Figure 6. Processing results output console.

Figure 7(a) shows the output screen of QGIS, and Figure 7(b) shows the output of 3D GIS that was separately developed. The algorithm that was used here was able to convert the rainfall radar data appropriately according to the legend. It is also shown that the output data are compatible with the GIS data.



(a) **(b)**

Figure 7. Execution results and output of the GIS platform and 3D engine.

4. Conclusions

In this study, a system that automatically outputs rainfall radar data as image files according to the legend was developed. This system enabled the automatic conversion of multiple radar files within a short time, and the normalization of the conversion process. The developed algorithm was compatible with other geographic information system (GIS) data in a commercial GIS program, thereby improving the users' access to radar data. It was also demonstrated that the development period could be shortened by using GDAL, OpenCV, and other open source libraries. It was also proven that the conversion to GIS data can be done without depending on other platforms in the process. In addition, the data usability was improved so that the output results could be used in other diverse platforms.

ACKNOWLEDGEMENT

This research was supported by a grant (17AWMP-B079625-04) from the Water Management Research Program funded by the Ministry of Land, Infrastructure, and Transport of the South Korean government.

REFERENCES

C. Lee, "Construction, operation and utilization of rainfall radar observation network of Ministry of Land, Infrastructure and Transport," The Magazine of the IEEK, 40.2 (2013): 32-40.

Korea Meteorological administration, http://www.kma.go.kr/weather/images/rader_integrate.jsp, release 10. 8 (2017)

H. CHOI, et al., "Development of the visualization prototype of radar rainfall data using the unity 3D engine." Journal of the Korean Association of Geographic Information Studies 18.4 (2015): 131-144.

B. Jang, et al., "A Visualization Method of High Definition Weather Radar Information for various GIS Platforms." Journal of Korea Multimedia Society 16.11 (2013): 1239-1249.