KOREAN EAST COAST SHORELINE DETECTION PLAN USING KOMPSAT-3 IMAGES

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Shoreline information is an important baseline data for national territory management and land utilization. Shorelines have changed due to the recent earth environment changes and coastal environment development. Also, shorelines, one of the main indicators of territories, are investigated each year based on site surveys, for consistent management and monitoring. Such investigation requires a large group of personnel and takes much time due to the limits of site surveys. Therefore, shoreline monitoring has limitations in personnel, economy, and time. To address these problems, a shoreline detection method using high-resolution KOMPSAT-3 images was suggested in this study. The use of satellite images can reduce the time and labor consumption in shoreline monitoring as the satellites regularly take pictures of broad areas within a short period of time, and the short time that it takes to investigate the shoreline can prevent shoreline changes from occurring during the investigation. After reading the images, NDVI and NDWI were calculated and then binarized based on 0. The land areas from the two images were united, and contour lines were extracted from the united image as vector data. The land area was detected by removing the noise based on the sizes of the extracted contour lines. The shorelines were divided by region for calculation, and they were later integrated to speed up the calculation.

Keywords: KOMPSAT-3, shoreline, contour, NDVI, NDWI

1. INTRODUCTION

Shoreline information is an important baseline data for national territory management and land utilization. Shorelines are continually changing due to artificial causes like indiscriminate sand collection, land reclamation, and development of tourism resources, and due to natural causes like typhoons, tidal waves, shore erosions, and sea level rise. Furthermore, the global environmental changes caused by global warming and the abnormal climate changes have emerged as international issues, and countries with shores have raised the need for detecting and monitoring shoreline changes due to the rising sea level. Coastal erosion has been progressing rapidly of late in the east coast of South Korea, causing damage to the life and property of the residents, resource depletion, and destruction of the ecosystem. Even though investigations based on field survey are being conducted every year in South Korea for the continuous management and monitoring of the country's shoreline, such investigations have human, economic, and temporal limitations. To address these limitations, this paper proposes a shoreline survey method based on the high-resolution KOMPSAT-3 satellite images.

2. STUDY AREA AND DATA

An automatic shoreline detection algorithm was developed in this study using a band calculation and edge detection algorithm based on the KOMPSAT satellite images, and a prototype of such algorithm was developed. The KOMPSAT images have four band data (i.e., R, G, B, and NIR) and allow the extraction of various data therefrom through band combinations. The shoreline detection method finds boundaries through the division of water (sea) and land, and general images have limitations in boundary division. To clarify the division of water and land, the normalized difference water index (NDWI) images are extracted through band calculations, and the extracted images are binarized to divide water and land. Islands and inland waters are removed from the images with water/land divisions, boundaries are extracted using the edge detection technique, and the accuracy of such boundaries is verified.

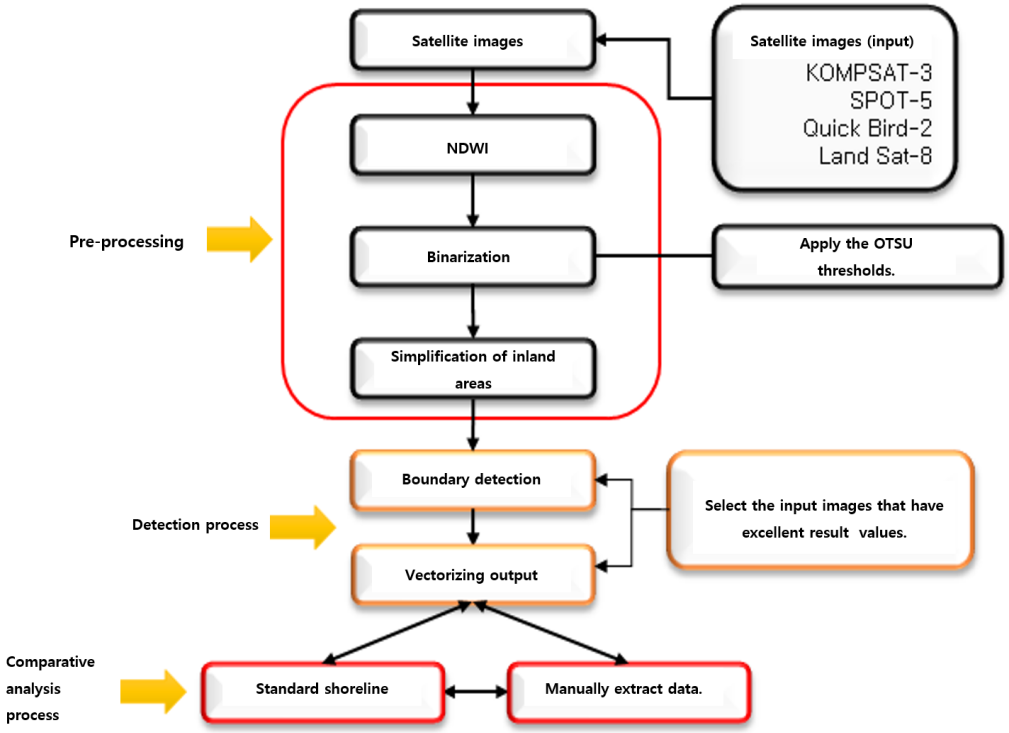

Fig. 1. Shoreline detection method

After the extraction of the shoreline data through the process shown above, the accuracy of such shoreline data was verified based on the standard shorelines, and the shorelines that had been directly extracted by the researchers and using the shoreline edge detection (SED) algorithm were designed.

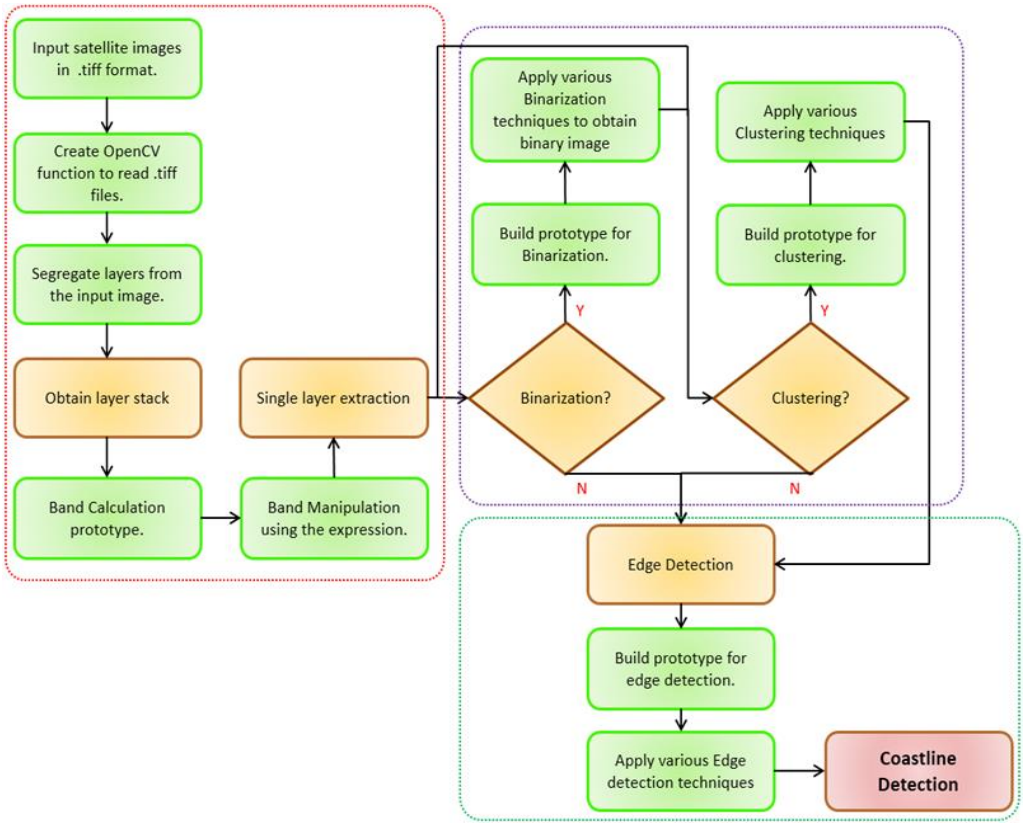

Fig. 2. Design of the shoreline edge detection (SED) algorithm

The South Korean east coast shoreline data were extracted using the SED algorithm. The East Sea was selected as the test bed because it has a smaller difference between the high and low tides, and simpler coastlines compared to the South and West Sea.

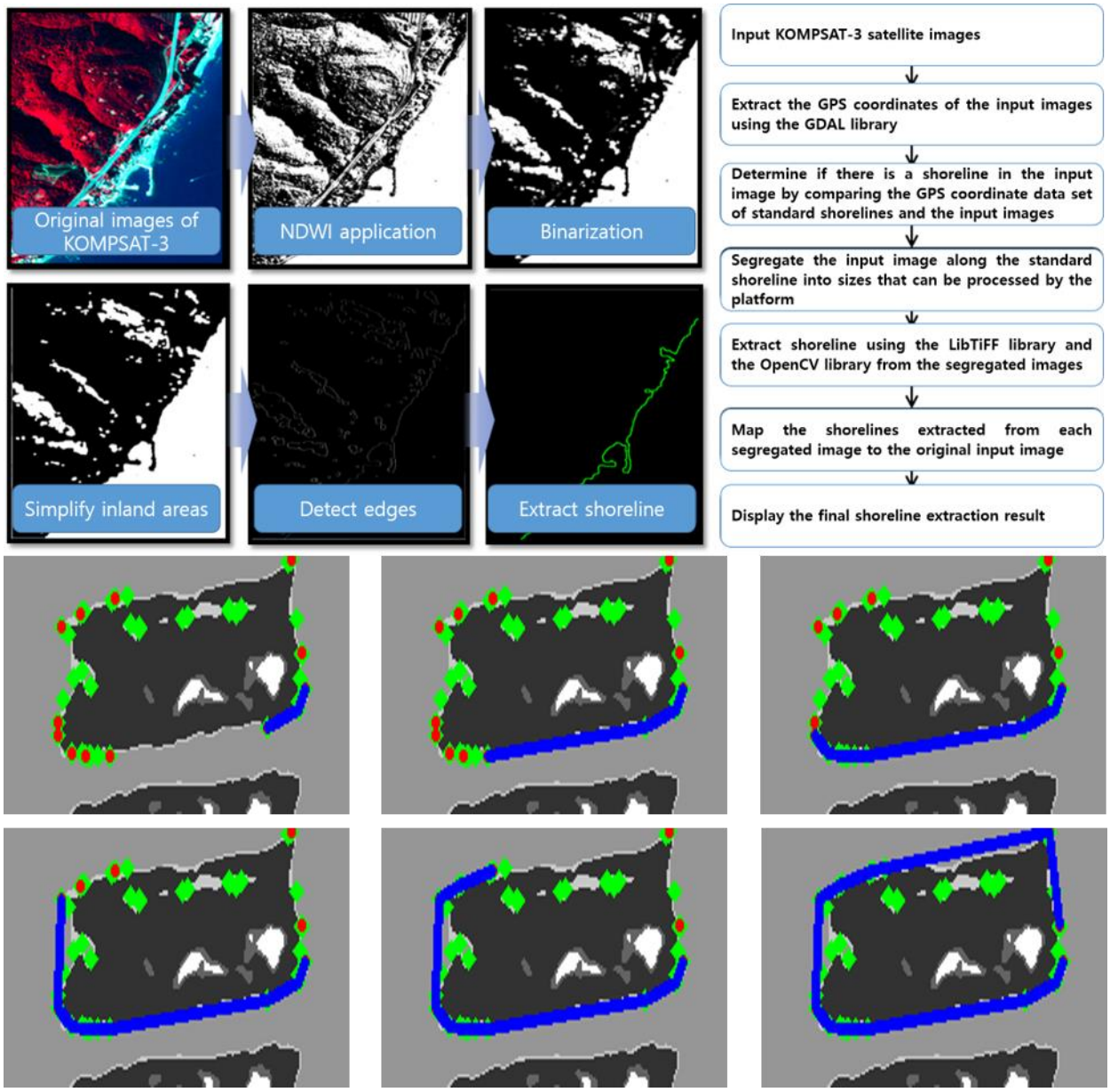

Fig. 3. Boundary information detection method

The contour data were extracted based on the convex hull algorithm, and the standard production method provided by ESRI was used to create shape files based on the extracted data. The shape files were created to allow the commercialized GIS program to use the information, and property data such as contour figure data and the forms of farming facilities were inputted simultaneously.

4. STUDY RESULT

As a result of this study, many edges other than shorelines were detected from the high-resolution satellite images, such as those from KOMPSAT-3. Errors were also found in the water/land divisions because the pixel units were small and various spectral values existed due to the high resolution. The unremoved inland waters in small pixel units were expressed and appeared in the edge detection process, but some errors could be removed through repetitive training, and only the shorelines can be extracted using such information as the detected edge length. Higher accuracy can be expected in the future if training for various spectral values will be supplemented.

5. CONCLUSION

South Korea conducts complete shoreline surveys every year through ground surveys using GPS equipment, and the results obtained from the previous year are provided for the following year. Thus, the shoreline monitoring lacks speed and has low efficiency because much cost and time is invested in it. Furthermore, cliffs and other areas that people cannot approach have much lower accuracy. The present study is expected to solve such problems. Even though the proposed shoreline monitoring method cannot enable the acquisition of more accurate outputs compared to the ground survey, the shorelines can be continuously monitored, and the efficiency can be maximized because the cost and time will be reduced. If studies on the South and West Sea as well as on the East Sea will be carried out in the future, it is expected that the study results will be used as the basic data for policymaking related to the country's shorelines, and will contribute to the development of the domestic satellite image utilization.

6. ACKNOWLEDGEMENT

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7. REFERENCES

- NOBUYUKI OTSU., 1979. A Threshold Selection Method from Gray-Level Histograms. Electro technical Laboratory, Chiyoda-ku, Tokyo
- JOHN CANNY., 1986. A Computational Approach to Edge Detection. Artificial Intelligence Laboratory, MIT
- Kim, B.S., 2001. A Study on Artificial Reef Suitability using Satellite Remote Sensing and GIS. Kyungil University
- Park, K., Jang, E.M., 2004. A Study of Marine Aquaculture Management Strategies Using Remotely-sensed Satellite Data - A Case Study on Hallyeo Marine National Park and Tasmania -. Journal of environmental impact assessment / v.13 no.5 pp.231-241
- Yang, C.S., Park, S.W., 2006. Facilities Analysis of Laver Cultivation Grounds in Korean Coastal Waters Using SPOT-5. Journal of Korean Society dor Marine Encironmental Engineering/ v.9 no.3 pp.168-175
- Yang, C.S., Moon, J.E., Park, J.K., 2007. Detection Approach of Laver Cultivation Grounds Using Optical Satellite Imagery. KSRI2007, pp167-170
- Park, J.H., Suh, Y.C., 2013. GIS-Based Suitable Site Selection for Aquaculture Using Scope for Growth of Styela Clava. Journal of the Korean Association of Geographic Information Studies, 16(3), pp.87-90
- Jo, Y.S., Hong, S.J., Kim, H.C., Choi, W.J., Lee, W.C., Lee, S.M., 2010. Development of Bivalve Culture Management System based on GIS for Oyster Aquaculture in Geoje Hansan Bay. Journal of the Korean Society of Marine Environment & Safety
- Yang, C.S., 2010. Prototype Development for Management System of Coastal Farm Facility Using Satellite Data. IPET Final Report