Geological Boundary Detection for Satellite Images using AI Technique

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Abstract - *Many image processing and analysis techniques have been developed to aid the interpretation of remote sensing images and to extract as much information as possible from the images. The choice of specific techniques or algorithms to use depends on the goals of each individual project. For each application it is necessary to develop a specific methodology to extract information from the image. To develop a methodology it is necessary to identify a procedure based on image processing techniques that is more adequate to the problem solution. In spite of the application complexity, some basic techniques are common in most of the remote sensing applications named as image registration, image fusion, image segmentation and classification. Hence, proposed method aims to present the use of image processing techniques to solve a general problem on remote sensing application. In proposed method, we examined some procedures commonly used in analyzing remote sensing images by using a novel method of Particle swarm optimization technique (PSO).*

Key Words: **Image Processing, Satellite images, particle swarm optimization, 2D convolution**

1. INTRODUCTION

Satellite images have many applications in meteorology, oceanography, fishing, agriculture, biodiversity conservation, forestry, landscape, geology, cartography, regional planning, education, intelligence and warfare. Images can be in visible colors and in other conducted using specialized remote sensing software.

Satellite image processing has proven to be a powerful tool for the monitoring of the earth's surface to improve our perception of our surroundings has led to unprecedented developments in sensor and information technologies. However, technologies for effective use of the data and for extracting useful information from the data of satellite image processing are still very limited since no single sensor combines the optimal spectral, spatial and temporal resolution. The conclusion of this, according to literature, the remote sensing still lacks of software tools for effective information extraction from Satellite image processing data.

For many parts of the world, medium to high resolution remote sensing satellites will only acquire data after the satellite has been programmed to do so. In these circumstances, coverage of the affected area is likely to be delayed and possibly missed. However, when major disasters unfold, most satellite operators will schedule imagery collection, even without confirmed programming requests, either on humanitarian grounds or in the hope of data sales. These all the satellite image processing drawback effects the whole disaster mitigation process, so we are processing the novel techniques to integrate the system by various combination of algorithm to amalgamate the geological boundary data with geohydrology data and lithosphere data like HI climb mountains, terrain, sedimentary basin, rifts etc. The proposed method will focus on flood rescue and mitigation mainly. The objectives of proposed method is to present an advanced method for combination of multi-spectrum RGB images for multi-spectrum image fusion. The proposed method can be used to analyze the maxima features in a particular image.

2. LITERATURE SURVEY

Aparna Joshi and Isha Tarte discussed damage identification and assessment using image processing on post disaster satellite imagery. SLIC i.e. simple linear iterative clustering is used for segmenting which is a simple method to decompose an image in visually homogeneous regions which is based on spatially localized version of k-means clustering. Random forest algorithm is used for classification which works by creating a set of decision trees from randomly selected subset of training set, aggregating the votes from different decision trees to decide the final class of the test object. This algorithm has high accuracy results. [1]

Milad Janalipour & Mohammad Taleai concentrated on building change detection after earthquake using multi-criteria decision analysis based on extracted information from high spatial resolution satellite images. Adaptive network based fuzzy inference system is used which is a combination of fuzzy systems and neural networks. To address real world problems, ANFIS is extremely useful as it addresses objective knowledge as well as subjective knowledge i.e. knowledge including mathematical models and design requirements. [3]

This paper by D.C. Mason, L. Giustarini, J. Garcia-Pintado, and H.L. Cloke investigates whether urban flooding can be detected in layover region using double scattering between ground surface and walls of adjacent buildings. The method estimates double scattering strengths using SAR image in conjunction with a high resolution LiDAR height map of the urban area. A SAR simulator is applied to the LiDAR data to generate maps of layover and shadow and estimate the positions of double scattering curves in the SAR image. [4]

Weixing Wang, Nan Yang, Yi Zhang, Fengping Wang, Ting Cao, Patrik Eklund, analyse road features, road model, existing difficulties and interference factors for road extraction. Secondly, the principle of road extraction, advantages and disadvantages of various methods and research achievements are briefly highlighted. Conclusion states that single method is not enough to get optimal results of road extraction thus various methods need to be combined in order to be used in real applications. [5]

The method proposed by DejanVukadinov, Raka Jovanovic is based on canny edge detection and threshold. Proposed algorithm consists of five main steps viz. image extraction, histogram matching, Gaussian blur filter, locally adaptive threshold, edge detection. The system is tested using different artificial island of Dubai coastline. Though the images are very complex, results obtained are accurate. [10]

3. METHODOLOGY

3.1 System Architecture

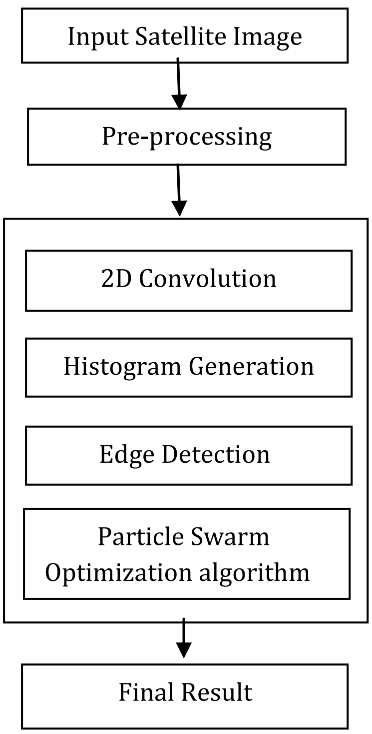

Fig -3.1: Architecture of System

The system consists of the following main steps:

1. Read the source image into input.
2. For pre-processing step, the input image is converted to BMP format from RGB format.
3. BMP format dataset is analysed into red, green and blue plane which helps analysing each pixel individually.
4. Histogram is generated which helps in differentiating red, green and blue plane from which net deterministic value for each pixel differentiation.
5. Training parameters are obtained from histogram differentiation which are integrated with intelligence i.e. particle swarm optimization algorithm.
6. Various convolution models for various planes are generated. Then geological parameters of pixels obtained from histogram technique are compared with convolution results.
7. A 3D matrix is obtained from convolved results where each dimension refer to a particular geological boundary with pixel differentiation of land-water, water-Greenland, and land-Greenland.
8. Non pixel data generated from convolution is removed then it is integrated with PSO.
9. PSO decides the maxima and minima in convolution models supplied to it as input.
10. PSO technique integrates the similar color pattern on a particular pixel boundary of our convolution model. Similarly it does for other dimension and our color pattern on that particular image is generated which is our final output.

This method is tested on before flood and after flood satellite images of Kerala obtained from NASA website. Pre-processing is carried out which coverts image from RGB to BMP format and differentiated red, green and blue planes. It generates histogram and convolution models for both images and final result. The difference between two outputs can be seen clearly w.r.to geological boundary detection.

Results obtained are as follows:

Fig – 3.2 Input Image

The input image is the satellite image of Kerala captured post flood which occurred on August 22nd 2018. The image is in JPEG format.

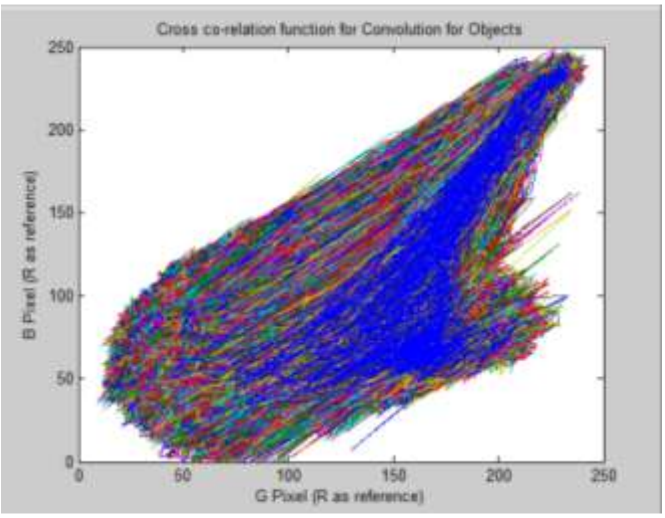

Fig- 3.3 Convolution of green and blue plane keeping red plane as reference

The 2D convolution is obtained for green and blue plane keeping the red plane constant. It is seen from the result of convolution that blue color is highlighted from the convolution of green and blue planes.

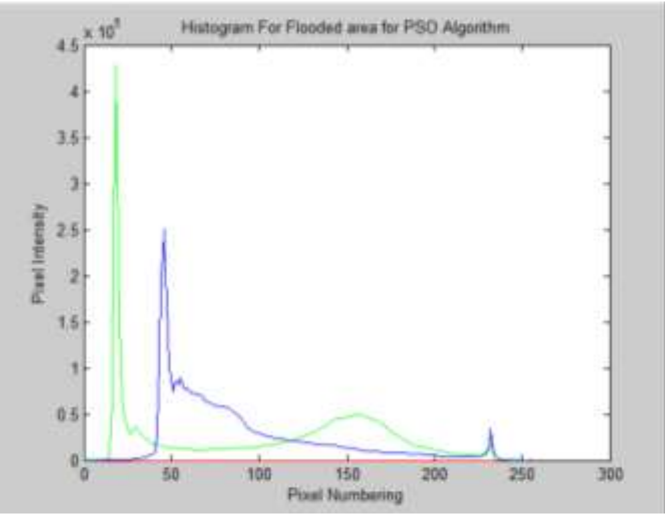

Fig- 3.4 Histogram calculation of input image

The histogram is calculated for the input image of pixel numbering and pixel intensity. It shows which pixel has occurred how many times.

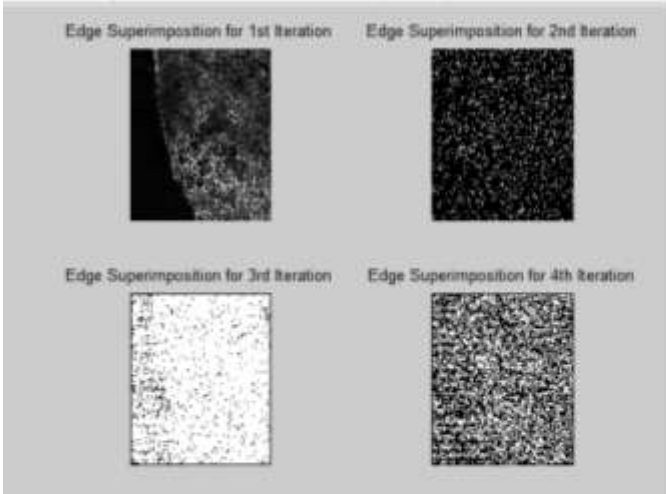

Fig - 3.5 Edge Detection in four iterations

The edge detection algorithm is applied on input image along with knowledge of convolution and histogram which gives optimized results in the iterations of edges.

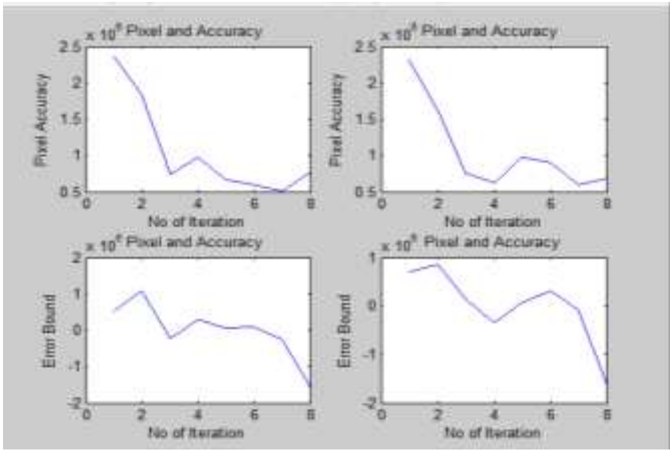

Fig – 3.6 Pixel accuracy and error bound graphs

The graphs of pixel accuracy and error bound are calculated w.r.to number of iterations taken in the edge detection. The error is between range of -1 to 1 for four iterations and pixel accuracy is maximum for two iterations and lowers after that.

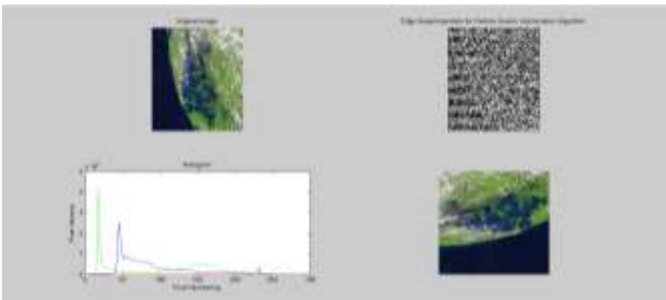

Fig – 3.7 Input to particle swarm optimization algorithm

The input image, edge detection result which obtained using convolution, histogram and bitmap format image created out of input image is given as input to particle swarm optimization.

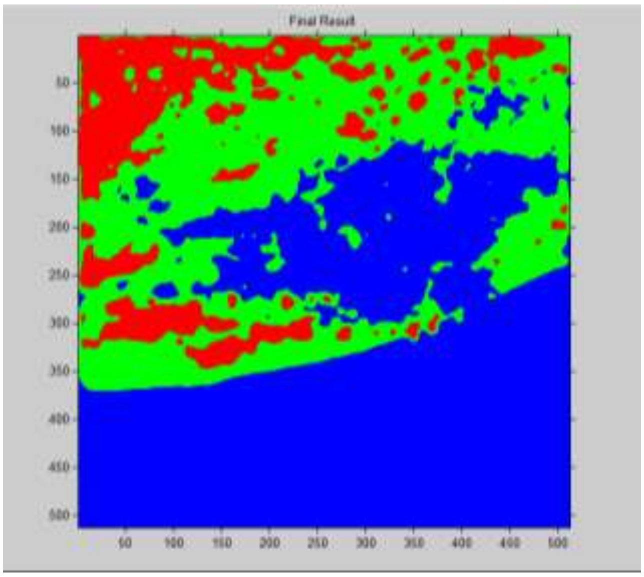

Fig – 3.8 Output Image

The output image is the output of particle swarm optimization algorithm which shows flooded area with blue color, land area with green color and red area is error which is covered by clouds in red color.

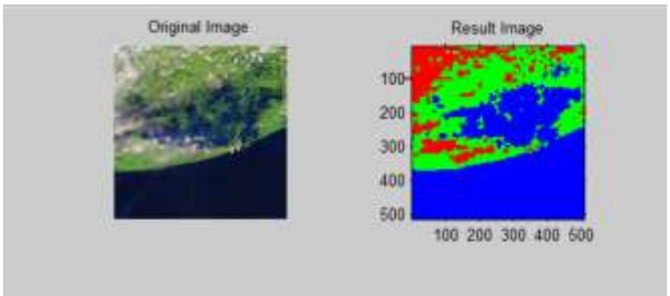

Fig – 3.9 Comparison of input and output

The comparison of input and output image is shown in this figure 3.9. The exact similarity in flooded area from input image and blue colored area from output image can be seen and boundaries are detected between water and land clearly.

4. CONCLUSION

The results obtained from proposed method will be a great measure for predicting and analyzing impact of floods. It will help rescue teams to address high alert areas first so, minimum or no loss of life will be achieved. In future, the method can be modified to be used for coastline detection, urbanization, deforestation and earthquakes.

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