VOLUME 12 SPECIAL ISSUE 2, JUNE 2021

ISSN No. 0976-5697

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

COASTLINE AND RIVER BANKS EROSION PREDICTION USING IMAGE PROCESSING

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Abstract: In recent years the people are aware of the threat posed by river banks and coastal erosion. In several parts of the world, national and local governments are planning strategic management strategies in response. A thorough knowledge of coastal processes is an essential component of the planning process. Coastline erosion prediction is a process of estimating the future coastline and river banks. It is crucial to understand and predict large-scale, longer-term coastal changes, in order to manage the risk of 33 coastal settlements in India. The ecstatic sea level rise due to global warming is predicted to be about 18 to 59 cm by the 2100, which necessitates identification and protection of vulnerable sections of coasts. Research has been conducted for identification of coastal erosions and predicting changes in the coast line but none involves computerized technique for erosion prediction. Hence, we propose an innovative and practical method of predicting the changes in the coastline by using computer tools. The main aim of this project is to predict the coastline erosion efficiently by analyzing the images recorded through google earth. The absorbed images from google earth are feather processed and the transformed images are used for predicting the changes using SSIM tool.

Keywords: Image processing, SSIM(structural similarity), Grey scale imaging, image transformation.

I. INTRODUCTION

Field and aerial surveys are used to conduct coastline change analysis and prediction, which is essential for integrated coastal zone management. Direct field assessment, aerial photography analysis, and remote sensing analysis using satellite imagery can all be used to describe coastline mapping. Satellite imagery is now being used to analyse coastal change as a result of technological advancements. In several studies, satellite data was used to analyse coastal change and forecast erosion. For example, IRS satellite data were used to calculate the shoreline change rates, coastal erosion and a creation in southern coastal Tamil Nadu of India. GIS instruments were used to investigate the evolving pattern of accretion and erosion of the modern Yellow River sub aerial delta using multi temporal Landsat MSS and TM data from 1976 to 2000, totaling twenty scenes (6). Digital Orthophoto Quarter Quadrangles (DOQQs) and black and white aerial photographs were used to calculate shoreline change rate in Neuse River Estuary, USA. Coastal Erosion mainly occurs Natural environment changes like wind, waves and long shore currents move sand from shore and deposit it somewhere else. And also, the impact of the event like Tsunami or Storm Surge And use of coastlines throughout history for settling, sheltering, and economic and transportation purposes has caused artificial changes to them.

Since the effects of erosion can take months or even years to notice, it is known as a "Long Term Coastal Hazard. In the next three decades, It is estimated that coastal erosion will occur 3/2 times faster than the past three decades. Roughly

around 20% of the world's population lives within this area that is affected by coastal precipitation. This mean population density is about 3 times higher near coasts than on global average. Nearly 250 million Indians live within 50 km of the coast, and more than seven million coastal fishing and farming families depend solely on the coastal region.. At present, coastal erosion is very common, coastal lands are being swallowed by the seawater and coastal villages and houses are forced to move inland, which squeezes the living space of humans Millions living on India's coasts are threatened as India has lost 33% of its coastline to erosion in 26 years between 1990 and 2006, according to a report released in July 2018 by the National Centre for Coastal Research (NCCR) in Chennai. Due to erosion Puducherry has lost 57 percent of its coastline, Kerala 45 percent, and Tamil Nadu 41 percent, to heavy erosion. Since coastline detection is important for safe navigation, coastal resource management and for protection of environment.

The extraction of coastlines is a necessary part of coastal zone management. A coastline is the area where land meets the sea, but actually sometimes it is very difficult to determine a precise line that can be called coastline, due to the dynamic nature of the sea. Remote sensing plays an important role for coastline monitoring, through passive or active sensors. Optical images are simple to interpret and easily obtainable, moreover infrared radiation is significantly absorbed by water, while it is strongly rejected over inland area. These characteristics of water and land make optical images that contain visible and infrared bands widely used for coastline mapping [4].

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II. LITERATURE SURVEY

In 2016 the Coastline Detection paper [8] in this study, color infrared, grayscale, RGB, and fake infrared images were processed with the median filtering and segmentation software developed. The edge detection method was used in the analysis, and coastal lines were detected. The results show that segmentation with fake infrared images derived from RGB images to give the best results.

Paper [1] proposed approach based on fuzzy c-means (FCM) clustering and level set segmentation. It is made up of many image processing algorithms. The input SAR image is first clustered using the FCM algorithm. Second, the level set approach was used to remove the coastline using the FCM clustering results as initial contours.

A study was conducted in 2018 [4] to predict waves using the FFBP and NARX networks. The current study makes use of INCOIS wave data. The impact of network architecture on the model's success has been investigated. The NARX network outperforms the FFBP network for time series prediction.

In 2019 [3] study researched the change in coastline and sea area. Using over a 30-year period using Landsat TM and OLI remote sensing data. The total change in coastline length, sea area, and sea surface centroid were all calculated. Four shape indexes were used to quantify variations in coastline morphology: fractal dimension, compact ratio, circularity, and square degree. Equations were created to describe the fit of the shape index, coastline length, and marine area.

Our project presents an extension of the surveyed work. In this paper, we have taken input from the images provided by Google Earth. Accepting the input in terms of images makes it more user friendly.

III. PROPOSED SYSTEM

In our proposed model, we take minimum two images of that specific coast. The images must have been captured at different instances of time. The time gap between these two images must be atleast once month in-order to obtain better results.

Satellite images are collected from google earth and other source. These images are feather pre-processed for feature extraction.

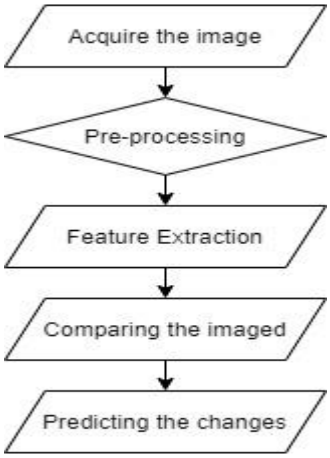

Figure 1: Flowchart

The proposed method has been modified to improve the performance of the pixel-enhancement phase. For the automatic coastline extraction, in this paper we have introduced a method for presenting edge detection and optimization procedures. The various steps involved in the process are as follow.

- Reduce the image's noise and improve the image's edges.
- Convert the smoothened image to grey-level image for obtaining the boundary points.
- Split the image into blocks in order to find threshold related to binary characteristics.
- Using the obtained threshold values, image is segmented.
- Then the segmented images are compared and changes are predicted.

A. *Image Processing*

Picture processing is the process of converting a physical image into a digital format. and apply some operations to it in order to obtain a better picture or extract some useful information.

B. *Contrast Enhancements*

By the brightness disparity between objects and their surroundings, contrast enhancements increase the perceptibility of objects in the scene. Contrast enhancements are usually done in two steps: a contrast stretch and a tonal enhancement, but they can be done together.

C. *Image Grey-level*

Most contrast enhancement methods make use of the grey-level, created by counting the number of times each grey-level value occurs in the image, then dividing by the total number of pixels in the image to create a distribution of the percentage of each grey level in the image Fig 1. The gray-level distribution of the grey levels in the image but contains no spatial information about the image. Figure 1demonstrates the properties of a grey-level for bright and dark scenes, as well as scenes of high and low contrast. Setting the camera's exposure to cover the entire dynamic range improves contrast, but it also risks saturating the detector with any radiance value greater than 255 counts, clipping these values into 255 counts and obliterating any scene details. Exposures are, therefore, usually set to collect lower contrast images that do not span the dynamic range because the images can be processed later to enhance the contrast albeit keeping a tight grip on the amount of clipping that happens.

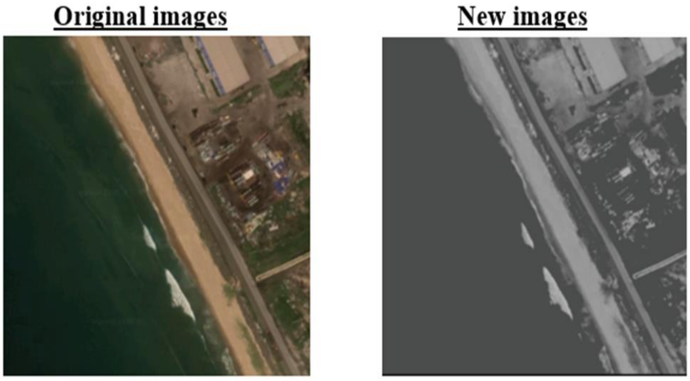

Figure 2: The grey-level for an image.

It is apparent from Figure 2 that all of the pixel values have been changed to the right, and therefore it can be validated from the image that the new image is darker, while the original image now appears brighter

D. *Image Transformation*

A function is a transformation. After performing some operations, this function maps one set to another set.

E. *Digital Image Processing system*

We've all heard of digital image processing, and we've created a machine that takes an image as input and outputs a processed image. It is seen in the diagram below.

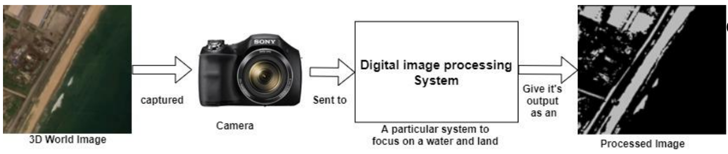

Figure 3: Image transformation.

The transformation function is a function used within a digital device to process an image and convert it to an output.

F. *Thresholding echniques*

Thresholding is an image segmentation technique in which the pixels of an image are changed to make the image easier to interpret. Thresholding is the process of converting a color or grayscale image into a binary image, which is simply black and white.

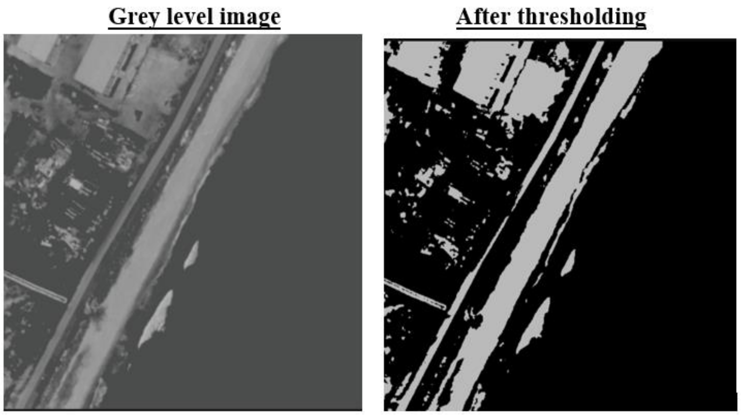

Figure 4: Grey-level to threshold image.

Thresholding is used to replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant value T, or a white pixel if the image intensity is greater than that constant value. In the example fig. 2 on the right, this results in the water becoming completely black, and the sand in the coastline becoming completely white.

G. *Image Comparison*

Comparing the processed image is done by using SSIM tool (Structural Similarity Index), which is provided by CV2 library. SSIM is a perceptual metric that measures the loss of image quality due to processing such as data compression or data transmission losses. This metric is essentially a complete reference that necessitates the use of two images from the same shot, i.e. two graphically equivalent images to the naked eye. The second image is usually compressed or of a lower quality, which is the index's objective. SSIM is most commonly used in the video industry, although it has a wide a diverse set of applications. The visual difference between two identical images is measured by SIM. It can't tell which of the two is better because it doesn't know which is the original and which has been subjected to additional processing like compression or filters.

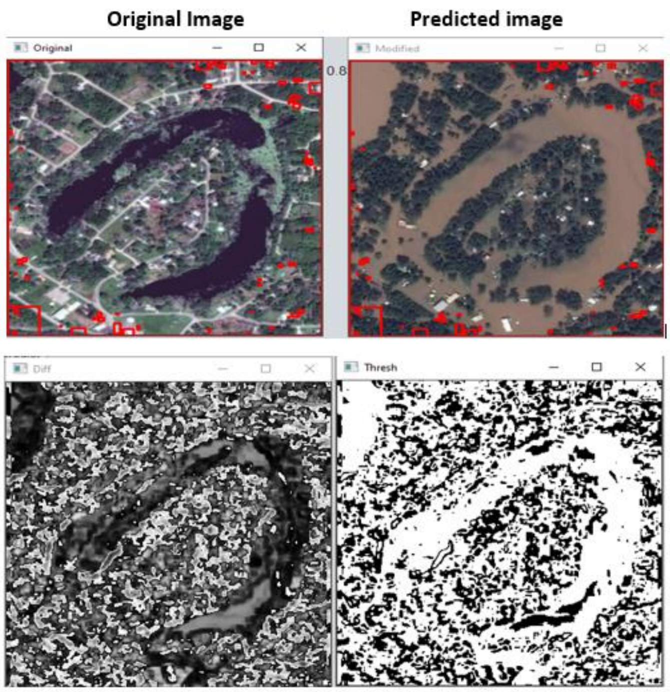

Figure.5: Prediction

One original image is shown in Figure 3, and the other image is the prediction made by the proposed model. The dark spots in the picture are a detailed examination of the changes caused by flooding or erosion, and these spots or areas on the maps are hazardous.

IV. CONCLUSIONS

In this paper, we propose a coastline and riverbank prediction method based on image processing techniques. The model proposed here can be used to accurately forecast the coastline and river banks using a broad dataset. The technique we're using is easy to implement; if we can figure out how to get the data into the system, we'll be able to get the model to work. However, since we currently have less images for the model, we are unable to produce exact values. If enough historical images are given, however, effective results can be obtained. We could reliably measure coastline erosion if we had a large enough number of photographs. Our next step is to put the model into practice by figuring out how to transfer the image features extracted. We also intend to create a social web platform based on the proposed model, where users can enter available data and then use software based on the proposed model to forecast erosion in coastlines or river banks from input images.

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