

Digital Image Processing in Remote Sensing

Ajinkya, Prof. P.P. Jorvekar

Computer Department, NBN Sinhgad School of Engineering

Abstract

Image Processing is a method or technique in which the image is taken as an input and it is processed further to get the result which is also an image with data extracted from the input image. We can also take more than one image at a time as an input and can get the output which may be a single image or group of images. In the modern era image processing plays a vital role in almost all fields that come in our imagination. There are certain algorithms which get used in Image processing technology. Remote means something which is not exactly in contact or in physical contact, something which is far away and sensing means extraction of data of the target object. Basically, Remote Sensing is a procedure of measurement or accomplishment of information of some property or phenomena by a recording device without any physical contact with the object under study. The primary motive of this paper is to present an overview of image processing in remote sensing.

Keywords: Image processing, Remote sensing, Thematic map, Sensors, Image Acquisition, Image Segmentation

I. INTRODUCTION

Image processing as a technique in which various operations have to be performed on images for different purposes such as image quality enhancement or data extraction. Image processing is a type of signal processing in which images are passed as an input and its output may be image or characteristics associated with that image. Digital image processing helps in modification of the visual quality of an image.

Image processing types:

a. Analog Image Processing

Analog image process is used for the hard copies. Image analysts use basic principles of interpretation while using these visual methods. Whereas digital image processing methods aid in digital images manipulation by the use of computers. There are three specific stages that all types of data have to pass through while using digital techniques are pre-processing, enhancement, and display, data extraction. Digital image processing makes the image more interpretable.

b. Digital Image Processing

Digital Image Processing plays a crucial part in remote sensing. There are various steps involved in digital image processing. The starting step in digital image processing is the scanning of the image which we want to process. This step involves the use of a scanner or camera as an image detection device. After that the manipulation of the scanned image gets done in some means and the third step contains output of processed image.

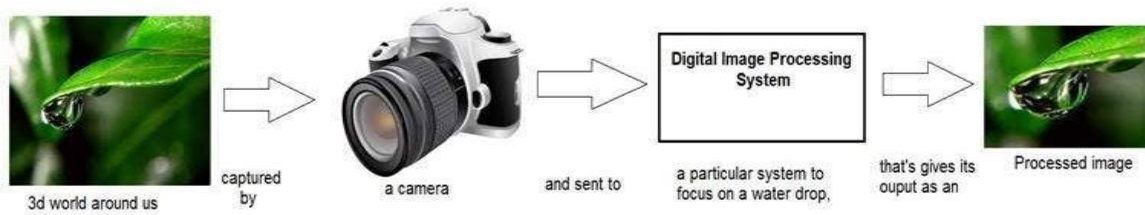


Figure 1: How Digital Image Processing Works.

REMOTE SENSING

Remote sensing is an art and science of identifying, measuring and observing any object without getting direct contact with the target object. Remote Sensing means getting or extracting data from the input image. There is a basic assumption has to be made in remote sensing is that the target land or surface of earth possess some different characteristics while interacting with the radiation [2]. Satellites have various sensors and cameras with them for scanning the Earth's surface and drilling it down [4][5]. There are various examples of remote sensing such as sonography, X-rays in medical fields, Signature recognition, iris recognition in authorization of users. There are some techniques which are almost common in various applications of remote sensing Image segmentation, Image Fusion. There are various sensors used in remote sensing like light sensors, ultrasonic sensors, temperature sensors and so on.

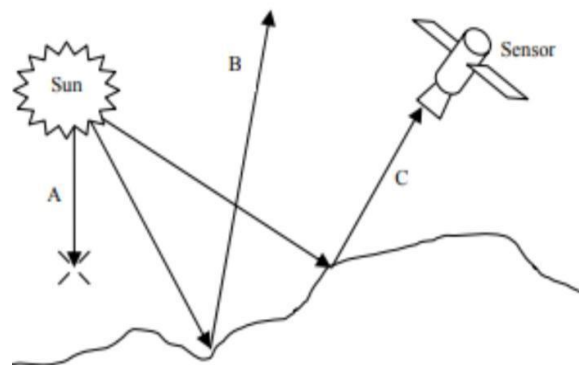


Figure 2: Sensor detects the quantity of energy reflected and emitted by earth surface [1].

The sun is the most superior source of energy and also radiation which offers a suitable energy source in remote sensing. The sun's energy is reflected as it is for visible wavelengths otherwise it gets absorbed and then re-emitted as it is for thermal infrared wavelengths. Sensors attached with satellites or spacecraft scan the earth's surface and detect energy reflected by the target and transfer the scanned data to the computer or devices connected with it wirelessly. Further Image processing techniques applied on these scanned Earth's surface.

Remote sensing is done with the help aircrafts or satellites .It uses various instruments that detect targets to detect the spectral, spatial and radiometric relations of the target object. Almost all modes of sensing are based on sampling of photons corresponding frequency in the electromagnetic spectrum. Remote sensing procedures require an interaction between incident radiation and the targets. However, the remote sensing also includes the sensing of energy emitted by the targets and the use of non-emitted sensors.

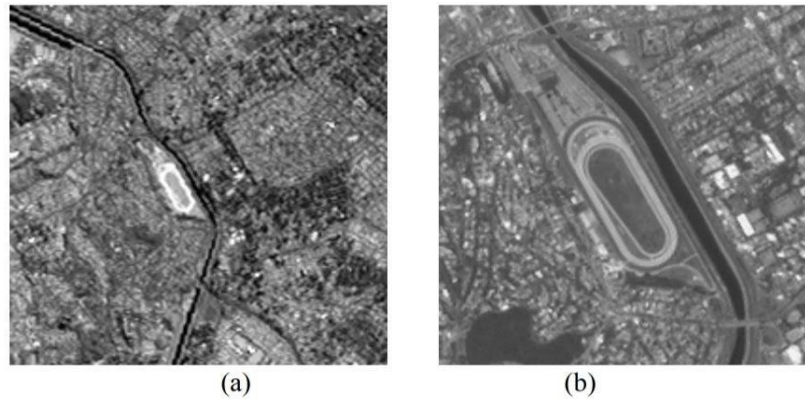


Figure 3:Image captured by different sensors

IMAGE PROCESSING TECHNIQUE

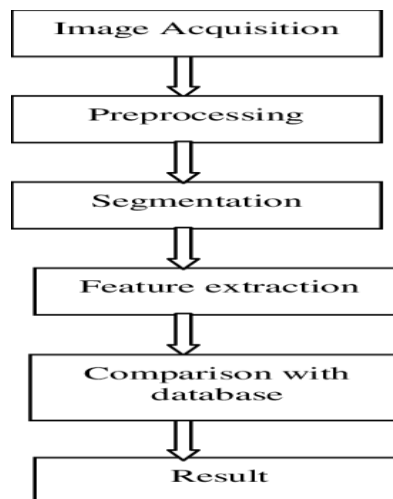


Figure 4: Block Diagram for Image Processing Technique

There are methodological ways for each application of remote sensing.

a. Image Acquisition

It takes the input image from the user. The images get generated by combining the illumination source and the reflection or absorption of energy from the target by the elements of the scene being imaged.

The basic aim of image acquisition is the translation of an optical image into an array of numerical data which could easily be manipulated by computer [7].

b. Image Preprocessing

The image that is taken as an input from the user is preprocessed. It's one of the most significant steps in image processing. By selecting the best image processing technique the quality of the image can be improved to the great extent. It's aim is to improve the image data to avoid noise distortion[8]. There

are a number of preprocessing operations: Contrast Enhancement, Brightness Enhancement, Sharpness Enhancement, Hue, Saturation, etc can be changed as per requirement.

c. Image Segmentation

It is a method that divides an image into its subcomponents region or object. The aim of segmentation is to represent each pixel of the image into something that is more meaningful and easier to analyze. We use a set of rules to analyze the content of an image. It divides the scanned image or target into small portions[3]. Basically, the result of segmentation is influenced by the subject because different users can select different parameters of segmentation[6]. Edge detection is a fundamental problem in image segmentation[7]. We use segmentation only when we want the computers to make the decisions. It's not required in case images have to be shown to human beings. Examples of Image Segmentation includes Automated Blood Cell Counting, Fingerprint matching in forensic.

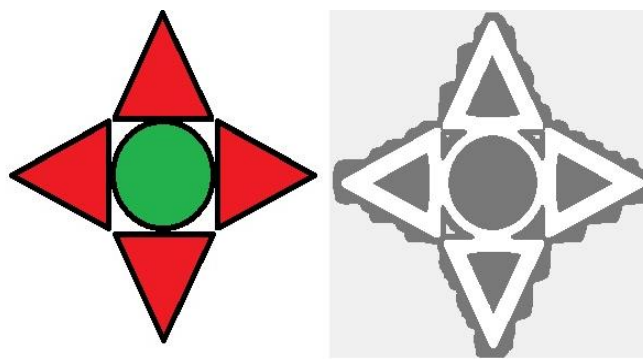


Figure 5: Image segmentation

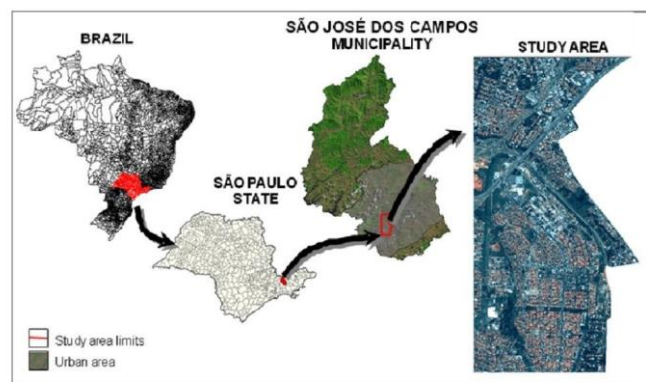
d. Feature Extraction

It's a projection of higher dimensional feature space to a lower dimensional feature space. A number of algorithms are there. Whatever be the image that was segmented it makes them more appealing.

e. Comparison with the Database

Using different photo matching algorithms the output of the segmented images are compared with the original images. In remote sensing the target after processing is matched to the thematic map in order to detect the accuracy of processed images and data.

Figure 6: Thematic map obtained from a Landsat-5 TM image



Conclusion

This paper concludes the review of this survey paper. It contains the different steps of image processing which are the most important steps in remote sensing. It contains some general procedure involved to solve a remote sensing application using image processing techniques. In this paper different steps of image processing have been covered along with types. Image acquisition, preprocessing, segmentation, feature extraction all these terms have been covered. The main focus of this paper is on principal of image processing techniques with the hope that the information provided in the paper would enable an interpreter to conduct research on remote sensing applications.

REFERENCES

- [1] Schowengerdt, R. A Remote Sensing Models and Methods for Image Processing, London, Academic Press, p.521.
- [2] Mather, P.M. Computer Processing of Remotely-Sensed Images: An Introduction. New York, Wiley, 2004, p.442. 3 ed.
- [3] Gonzalez, R.C., Woods, R.E. Digital Image Processing. Prentice Hall, 2007, p.976.
- [4] Jensen, J.R. Remote Sensing of the Environment: An Earth Resource Perspective. Upper Saddle River, Prentice Hall, p.608. 2 ed.
- [5] Lillesand, T.M., Kiefer, R. W., Chipman, J.W. Remote Sensing and Image Interpretation. New York, Wiley, 2007, p.768.
- [6] G. Espindola, G. Camara, I. Reis, L. Bins, A.M.V. Monteiro. Parameter Selection for Region-Growing Image Segmentation Algorithms using Spatial Autocorrelation. International Journal of Remote Sensing, vol 27 (14/20):3035-3040.
- [7] https://www.researchgate.net/publication/318500799_Image_Acquisition_and_Techniques_to_Perform_Image_Acquisition
- [8] Digital Image Processing Real Time Applications, S.Padmappriya, K.Sumalatha, ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726