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A REVIEW ON

TEXTURE, SHAPE AND COLOR BASED CLASSIFICATION OF SATELLITE IMAGES USING GLCM & GABOR FILTER, FUZZY C MEANS AND SVM

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Abstract - *In early days satellite pictures were to a great degree exorbitant and they were constrained for open source applications exactly in the meantime, as a couple of business satellites have been moved they give around the world, correct, high-assurance images to individuals, affiliations, and governments. Thusly, satellite pictures have ended up being more reasonable and the regions of use have extended greatly. In order to make use of satellite images in various applications, we need an efficient approach. In this paper, we introduce a preliminary review of researches currently performed in satellite images classification using Image Segmentation, feature extraction, and classification techniques. Based on that we proposed a novel approach for Classification of Desert, mountain, residential area, river and forest Images with the help of satellite images. The proposed structure uses Fuzzy C Means for Image segmentation & Clustering, Gabor Filter, GLCM and color histogram for Feature extraction and SVM for training and Image Classification. In feature extraction, the features are separated in view of color, shape, and texture.*

Key Words: FCM, Gabor Filter, GLCM, Color Histogram, SVM.

1. INTRODUCTION

The satellite data has been effectively utilized since the 1970's. The primary applications have been for weather prediction, to screen worldwide ecological conditions and topographical and land applications.

Satellite pictures give detail information about earth's surface. The advantages of satellite imagery include covering huge zones; visit returns to any part of the globe, paying little mind to its remoteness; the capacity to gather information unhindered by neighborhood air movement.

Beforehand, satellite pictures were exceptionally costly and they were utilized for military applications just, for example, threat monitoring and assessment. As a few business satellites have been launched, such as IKONOS, QUICK BIRD, and IRS and so on. They give worldwide, precise, high-resolution pictures to people, associations, and governments.

Satellite Pictures with high-resolution information with ground pixel sizes of under 5m give detail data about the Earth's surface and small objects, for example, structures, lanes, and trees can be shown in extraordinary points of interest. High-resolution pictures are utilized for applications, for example, transportation organizes mapping, calamity readiness, urban arranging, exactness cultivating, and broadcast communications. Then again, low-resolution satellite pictures, with ground determination more prominent than 10m, are utilized for applications like environmental assessment, local mapping, forestry management, across the board catastrophe evaluation, and urban observing.

Satellite pictures give an ideal perspective of the coveted area. They can likewise be utilized to decide rise (of mountains, slopes, and even structures) and geological highlights, which make it simpler to get a feeling of what the land resembles. Satellite pictures are likewise utilized as a part of horticultural fields where agriculturists can monitor the strength of their crops. Researchers can look and concentrate ecological changes that could influence the globe later on. City organizers can study, screen, and plan the advancement of new lodging groups with accuracy. In transportation, satellite information could be utilized for the traffic study, and help in the arranging of new roadways. If there arise an occurrence of catastrophes, for example, earthquakes or flames, government offices could utilize satellite information to design departure routes.

To extract the region of interest from the satellite images we require the processing and analysis of the images. The primary objective of this research is to provide an efficient satellite image classification with the use of high-resolution satellite images to distinguish: Desert, mountain, residential, river and forest Images. To accomplish this objective, we reviewed and analyzed various image segmentation, classification and feature extraction algorithms.

2. RELATED WORK

Jin-Tsong Hwang, Kuan-Tsung Chang, Hun-Chin Chiang [01], have proposed a method for remote sensing image classification using Gabor filter for texture feature extraction and SVM and decision tree for image classification which shows the best classification results. The Gabor texture

features are combined with original bands of the image, PCA, and NDVI were adopted as the characteristic vector of training samples for SVM, and Decision Tree classification. For most of the cases, the SVM method gave the highest correct classification rate within these three methodologies. Decision tree and SVM have their superiority respectively.

P. Ganesan, K. Palanivel [02], has discussed three fuzzy based clustering approaches for performing segmentation of satellite images. Also, the performance of these approaches was tested on the basis of the parameters such as execution time and PSNR. Many approaches have been developed for the segmentation of satellite images, but fuzzy based approaches are quite famous and widely used because of their good performance in the huge class of images. In this paper, the fuzzy-based clustering approaches Fuzzy-C-Means (FCM) Clustering, Possibilistic C Means (PCM) and Possibilistic Fuzzy C Means (PFCM) are compared and the performance of these algorithms was tested with the number of satellite images.

Omar S. Soliman 1, Amira S. Mahmoud 2, Safaa M. Hassan [03], have introduced a satellite image classification using SVM and PSO algorithm, employed as a non-linear classifier with different non-linear kernel type including polynomial RBF and sigmoid function. The obtained result on the comparison of the performance of SVM and PSO using RBF as well as polynomial kernel function has highest average overall accuracy.

Fardin Mirzapour, Hassan Ghassemian [04], have tried to use the two popular methods i.e., GLCM and Gabor filters for texture feature extraction from single band satellite images in order to benefit advantage of both. Gabor feature are powerful in finding class boundaries while GLCM features are preferable in areas within classes.

Panpan Yang; Zhiting Hou; Xiaolong Liu; Zhengtao Shi [05], have integrated the fingerprint recognition algorithm with GLCM texture extraction method that utilized Gabor filter to enhance texture feature of the segmented image. The result of classification of the enhanced image that uses GLCM for feature extraction showed accuracy increment on comparing with the result of classification of images that were not enhanced.

Mr. S.V.S.Prasad, Dr. T. Satya savithri, Dr.Iyyanki V. Murali Krishna [06], have proposed a method for classifying the multispectral satellite images using cluster repulsion based kernel FCM for object segmentation and one-many Support Vector Machine (SVM) classifier. The accuracy of the proposed work is contrasted with FCM based classification with the neural network. The outcomes demonstrated that the proposed strategy has accomplished better outcomes.

Rupinder Kaur, Dolly Sharma, Amit Verma [07], has implemented the edge detection using Mar Hildreth Edge Detection Algorithm; Fuzzy c means Clustering using for segmentation of the satellite image, to extract the features used Principle component analysis, to optimize the extracted feature using Bacteria Foraging Algorithm and classification SVM (Support Vector Machine) to execute the satellite picture classification. In minimum time and evaluate the better accuracy based on Support vector machine (SVM) algorithm.

S.Manthira Moorthi, Indranil Misra, Rajdeep Kaur, Nikunj P Darji, R. Ramakrishnan [08], have presented that the SVM algorithm shows better performance than the maximum likelihood estimation method for the classification of satellite images. In comparison with maximum likelihood SVM shows overall accuracy above 92%. The objective of this work is to use SVM technique for classifying multispectral satellite image dataset and compare the overall accuracy with the conventional image classification method.

Anita Dixit, Dr. Nagaratna Hedge, Dr. B. Eswar Reddy [09], have proposed texture based satellite image classification algorithm by extracting first order texture and GLCM feature and feature vector are formed by extracting same feature from LWT and then SVM is employed as classifier to determine the soil, vegetation and water bodies.

3. IMPORTANT ALGORITHMS

we will perform our satellite image classification through FCM for image segmentation, Gabor filter, GLCM and color histogram for feature extraction i.e., texture, shape and color and classification through SVM.

3.1 IMAGE SEGMENTATION

Image segmentation is the process of partitioning the digital image into multiple segment or clusters that is a set of the pixel. It divides an image into discrete regions such that pixel has high similarity in each region and high contrast between regions so that they may represent meaningful areas. From different segmentation techniques, one of the most efficient methods is clustering method. One of the widely used clustering algorithms in image segmentation is Fuzzy c-means (FCM). FCM is a technique for clustering which enables one piece of information to have a place with at least two clusters. This technique (created by Dunn in 1973 and enhanced by Bezdek in 1981) is regularly utilized for clustering.

Fuzzy c-means (FCM) is an information clustering technique in which a dataset is gathered into n clusters with each data point in the dataset having a place with each cluster to a certain degree. For instance, a certain data point that falsehoods close to the center of a cluster will have a high level of having a place or enrollment with that cluster and another data point that lies far from the center of a cluster will have a low level of having a place or participation with that cluster.

This calculation works by allotting membership to each information direct corresponding to each cluster center based on the distance between the cluster center and the information point.

Fuzzy clustering has been proposed as a more pertinent estimation in the performance of Image Processing.

3.2 FEATURE EXTRACTION

Feature extraction is a sort of dimensionality reduction that efficiently represents region of an image as a compact feature vector or the process in which certain features of interest within an image are detected and represented for further processing.

A. GABOR FILTER

A Gabor filter is a linear filter whose impulse response is characterized by a harmonic function multiplied by a Gaussian function. In view of the multiplication convolution property (Convolution theorem), the Fourier transform of a Gabor filter impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function.

The Gabor Filter is Image Texture feature-based approach, commonly used technique in image processing for edge detection based on multichannel filtering. Few parameters are considered before applying Gabor filter such as Gabor filter bank and extraction of the feature.

The Gabor filter bank with different scales and orientations is constructed. Bringing about an alleged Gabor space, the filters are convolved with the signal.

In both frequency and spatial domain, these filters have shown optimal localization properties and subsequently are appropriate for texture classification. Gabor filters have been utilized as a part of numerous applications, for example, texture division, the object recognition, fractal measurement administration, document evaluation, edge detection, retina identification, image coding and image portrayal.

B. GRAY-LEVEL CO-OCCURRENCE MATRIX (GLCM)

GLCM is most widely used in remote sensing image classification. In an image, specific texture identification is achieved by modeling texture as a 2-D gray level variation. This 2-D array is called as GLCM. It is a statistical image analysis technique that is used to estimate image properties that consider the spatial relationship of pixels. Define structural as well as spatial properties of an image.

GLCM is a spatial dependence matrix of relative frequencies in which two neighboring pixels i and j have certain grey level and few parameters are considered before implementing it i.e., displacement vector d and orientation or angle θ and can be represented by GLCM element $G(I,j,d,\theta)$. The various feature can be extracted from GLCM.

When an image is transformed into co-occurrence matrix, neighboring pixels can be taken in any of the eight defined directions. Generally, 0^0, 45^0, 90^0, 135^0 are used. However, their reverse (negative) direction can also be taken into account. GLCM usually depends upon directionality.

GLCM matrices are widely known for texture feature and they could be used for shape measures too.

The quantity of gray levels in the picture decides the span of the GLCM.

The gray-level co-occurrence matrix can uncover certain properties about the spatial dissemination of the gray levels in the texture picture. For instance, if the vast majority of the sections in the GLCM are concentrated along the corner to corner, the texture is coarse concerning the predefined balanced. You can likewise get a few statistical measures from the GLCM.

C. COLOR HISTOGRAM

A color histogram of an image represents the distribution of the composition of colors in an image. For representing the color feature use of color histogram is the most common way.

This technique is extremely viable and easy to execute.

The color histogram for an image is developed by counting a number of pixels of each color and quantizing the colors inside the image. Then taking the summation and calculating the mean and standard deviation from the color histogram. Finally, store it in a one Dimensional array. This value is calculated for every image in the database.

Color histogram only concentrates on the proportion of the number of different types of colors, paying little attention to the spatial area of the colors. The values of a color histogram are from statistics. They demonstrate the statistical distribution of colors and the essential tone of an image.

3.3 IMAGE CLASSIFICATION

Image classification refers to the labeling of a pixels or group of pixel. It is basically defined as assigning land cover classes to pixels. It is the task of extracting information classes from the satellite image. The resulting classes from image classification can be used to create thematic maps.

SUPPORT VECTOR MACHINE (SVM)

One of the widely used classification technique is Support Vector Machine (SVM). It is supervised classification machine learning algorithm or learning strategies utilized for classification, regression and anomalies detection. Works in 2 stage: training and testing stage. It trains itself by learning features which are given as input to its learning algorithm.

SVMs presented by Boser, Guyon, and Vapnik in COLT-92 in the 1960s.

Great performance: fruitful applications in numerous fields (bioinformatics, content, image recognition . . .)

An expansive and differing group work on them: from machine learning, optimization, statistics, neural systems, functional analysis, and so on

SVM used for multi-object classification. SVM is based on statistical learning classification framework where the fundamental thought is to discover a hyperplane which isolates the d-dimensional information splendidly into its two classes.

The input satellite image can be classified into five categories using SVM. The classifications are Desert, mountain, residential area, river and forest Images. Different loops of SVM activity are done for SVM operation for coordinating input images.

4. CONCLUSIONS

This paper introduces the preliminary review of research currently performed in segmentation, feature extraction, and classification of images. Based on that we proposed the hybrid approach of using Fuzzy C Means for Segmentation and clustering of image, GLCM & Gabor Filter for feature extraction such as texture, color and shape and SVM (Support Vector Machine) for satellite image classification for Desert, mountain, residential, river and forest Images.

FCM technique used for segmentation and clustering which identifies the normal grouping of data from a large volume of the dataset to generate a representation of framework behavior.

GLCM, Gabor filter and color histogram shows vital invariance properties that make them to a great degree appropriate for feature extraction.

A classification system in perspective of SVM has been proposed. One essential favored point of view of the SVM based course of action is that there are few model parameters to pick for the understudy and the classifier. The SVM-based course of action system will exhibit better broad accuracy.

REFERENCES

[1] Jin-Tsong Hwang, Kuan-Tsung Chang, Hun-Chin Chiang, "Satellite image classification based on Gabor texture features and SVM", Geoinformatics, 2011 19th International Conference, 12 August 2011,ISSN: 2161-024X, DOI: 10.1109/GeoInformatics.2011.5980774,

[2] P. Ganesan, K. Palanivel, B. S. Sathish, V. Kalist, KhamarBashaShaik, "Performance of fuzzy based clustering algorithms for the segmentation of satellite images - A comparative study", Computing, Communication and Information Systems (NCCCIS), 2015 IEEE Seventh National Conference, 12 October 2015, ISBN: 978-1-4799-8990-4, DOI: 10.1109/NCCCIS.2015.7295906,

[3] Omar S. Soliman 1, Amira S. Mahmoud 2, Safaa M. Hassan, "Remote Sensing Satellite Images Classification using Support Vector Machine and Particle Swarm Optimization", 2012 Third International Conference on Innovations in Bio-Inspired Computing and Applications, 25 October 2012, DOI 10.1109/IBICA.2012.61, ISBN: 978-1-4673-2838-8

[4] Fardin Mirzapour, Hassan Ghassemian, "Using GLCM and Gabor filters for classification of PAN images", Electrical Engineering (ICEE), 2013 21st Iranian Conference, 14-16 May 2013, ISSN: 2164-7054, DOI:10.1109/IranianCEE.2013.6599565

[5] Panpan Yang; Zhiting Hou; Xiaolong Liu; Zhengtao Shi, "Texture feature extraction of mountain economic forest using high spatial resolution remote sensing images", Geoscience and Remote Sensing Symposium (IGARSS), 2016 IEEE International, 03 November 2016, ISSN: 2153-7003, DOI: 10.1109/IGARSS.2016.7729816,

[6] Mr. S.V.S.Prasad, Dr. T. Satyasavithri, Dr.Iyyanki V. Murali Krishna, "Object Classification of Satellite Images Using Cluster Repulsion Based Kernel Fcm and Svm Classifier", IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p- ISSN: 2278-8735. Volume 7, Issue 3 (Sep. - Oct. 2013), PP 25-35

[7] Rupinder Kaur, Dolly Sharma, AmitVerma, "Enhance satellite image classification based on fuzzy clustering and Marr-Hildreth algorithm", Signal Processing, Computing and Control (ISPCC), 2017 4th International Conference, 25 January 2018, DOI: 10.1109/ISPCC.2017.8269663, ISBN: 978-1-5090-5838-9

[8] S.Manthira Moorthi, Indranil Misra, "Kernel based learning approach for satellite image classification using support vector machine", Recent Advances in Intelligent Computational Systems (RAICS), 2011 IEEE, DOI: 10.1109/RAICS.2011.6069282, ISBN: 978-1-4244-9478-1, 03 November 2011

[9] Anita Dixit, Dr. Nagaratna Hedge, Dr. B. Eswar Reddy, "Texture Feature Based Satellite Image Classification Scheme Using SVM", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 13 (2017) pp. 3996-4003