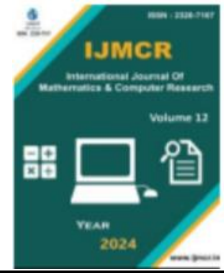
International Journal of Mathematics and Computer Research

ISSN: 2320-7167

Volume 12 Issue 04 April 2024, Page no. – 4150-4154

Index Copernicus ICV: 57.55, Impact Factor: 8.316

DOI: 10.47191/ijmcr/v12i4.06



Analyzing Retrieval Method Using Classification and Clustering Process of Remote Sensor Satellite Images

Dr. Shunmuga Kumari D.[1], Dr. Shalinigayathri D.[2]

[1]Assistant Professor, Department of Information Technology, V.V. Vanniaperumal College for Women, Virudhunagar, Tamilnadu, India.

[2]Assistant Professor, Department of Computer Science,Agurchand Manmull Jain College,Meenambakkam, Chennai, Tamilnadu, India.

ARTICLE INFO

Published Online:
29 April 2024

Corresponding Author:
Dr. Shunmuga Kumari D.

ABSTRACT

Today, remote sensors and satellite images are utilized across enormous regions. As visual tools, they are very important in cities, agriculture, disaster relief, and tracking systems. Pattern recognition, classification, and clustering are examples of machine learning techniques that can be used to acquire and retrieve the images. This is because they can accurately categorize and classify the images into clusters, which will help search engines discover the image that was given as a question. In our study, we look at Naïve Bayes, SVM Linear and Non-Linear, and Random Forest as classification methods, and Agglomerative Hierarchy and BIRCH as clustering methods. In this study, the fast recovery method and high accuracy rate of image retrieval by classifiers from machine learning were compared with clustering techniques from transfer learning. Using the UC Merced dataset, this research demonstrates that the accuracy classifier as SVM linear is 64.6%, SVM non-linear is 77.7%, random forest is 66.8%, and naïve bayes is 60.3%, and clustering of Agglomerative is 96.5% and BIRCH is 92.8%. The work that was mentioned is one of a kind because the clustering methods work better than the classification methods when they are used. It's unsupervised learning whose scores are above 90% for all classes.

KEYWORDS: Image retrieval, Satellite Images, SVM, Decision Tree, Random Forest, Clustering, Transfer Learning.

I. INTRODUCTION

Now it's hard to classify remote sensing satellite images [1] and guess which one will be the best by using search methods. It's better to use field monitoring than remote sensing to keep an eye on things that have an impact on people and the environment, like the health of the plants that grow on the land and in the water. Someone can quickly scan and map large areas of the Earth while receiving data on places that would be too expensive or hard to study on one's own if it used both remote sensing and traditional field mapping together. In the last few years, remote sensing has become increasingly widespread. Because it can be used in lots of places. More people can get data from far away thanks to the Internet. As prices go down and spatial, spectral, radiometric, and temporal details get better, even more people will be able to buy it.

Problems with GPS Remote Sensors[2] an image can be put into several groups, such as sea, city, forest, farm, and field. It's very hard to process pictures from a fake satellite. When you look for images, you use feature extraction and matching measures. Always remember that satellite pictures aren't always the best and are harder to understand than other kinds. A nearby measure doesn't work in a Machine Learning Model. It's hard to see when clouds are in the sky. The shots from space need to be checked again by people on the ground, which takes a long time. Areas Where Remote Sensing Is Most Useful. Satellites have been very important in the progress of many technologies, such as world mapping, the global positioning system (GPS), city planning, and many others. Many new things were made possible by the creation of satellites, such as remote sensing. The weather Trees and forests Biodiversity, farming, and a change in the surface. Applications of Remote Sensor images for the society are Rural Road analysis, developing an initial map for use as a guide, Estimating the Snowfall, Astrophotography: a collection of Earth images, putting out forest fires, figuring out what kind of land is being used and where, Assessing Wood Supply.

Deep learning [3] is the main type of computing used in artificial intelligence. Artificial neural networks are used to carry out structured machine learning methods in this method, which is also called "deep learning." The machines can learn on their own with the help of these programs, which let them set their own limits and decide how to make decisions. These "deep networks," which are like neural networks in the brain, are made up of many stacked "layers," or steps, where messages are processed, changed, and changed again. In contrast to Machine Learning, which requires manual criterion creation and training, Deep Learning can do both automatically. The goal of Transfer Learning [4] with convolutional neural networks is to improve performance on a new task by using what the networks already know how to do well on similar tasks. It has made big improvements to diagnostic image analysis by getting around the problem of not having enough data and saving time and system resources.

II. RELATED WORK

Giveki, D., Shakarami, A., Tarrah, H., & Soltanshahi, M. A. (2022). [5] This study comes up with new ways to sort and find images. The suggested way works quickly and doesn't use much memory. AlexNet uses a CNN to look at pictures. We used four models that were learned on graphics cards to sort photographs into groups. In image search, it is common to figure out and show how close the collection and question picture are. We improved the approach's settings by using datasets. Experiments show that the suggested method works better than the current situation. [5]

Al-Jubouri, H. A., & Mahmmod, S. M. [6] A lot of the work that CBIR does for picture recognition depends on feature descriptions to bridge the language gap and pull out visual characteristics. We used known precision measures to compare different methods to ones that had been tried before. [6]

Chen, D., et al. [7] Footprint images are vital to solving serial crimes as crime scene evidence. Comparing and retrieving footprints the old-fashioned way takes plenty of time and effort. Using deep learning, convolutional neural networks have enhanced picture recognition and retrieval. Meanwhile, we created a footprint acquisition method using edge computing. Our technique is helpful and feasible, according to our footprint dataset experiments. [7]

Barhoumi, W., & Khelifa, A. [8] Pathology-confirmed image of a skin tumor. Getting a CBDLR test can save lives and money. The answer suggested in this study is CBDLR. A closeness measure recommender picks the best distance value for each picture question. This study uses deep-learned traits to divide skin tumors into seven groups. It says that this method could help with performance and making choices. [8]

Jiang, D., & Kim, J. [9] This study shows a new way to use CBIR that is based on combining picture features. The features of a deep network are focused on objects and places. Deep feature association and complexity go down when DCT is used. When using the Corel and Oxford building datasets, combining short features works better than using just one type. The suggested approach of combining deep traits might make things a little better. This research also looks at picture memory factors, like using PCA instead of DCT. DCT can cut down on size without affecting efficiency. [9]

III. METHODOLOGY

In this study, 256x256-pixel Landcover areas were used to see how well different classification algorithms worked with different ways of training data. Our goal was to see how well the different algorithms worked with ten categories of images for execution and prove good retrieval methods.

A. Image Data Set

A dataset was put together from data sources in several major cities across the country, as well as a huge number of images from the US Geological Survey's images collections, which are divided into 10 classes.

Table 1. Urban Area Imagery Collection

Name of the Category	***No. of Images***	***Pixel Size***
Agriculture	100	256x256
Aircraft	100	256x256
Baseball Diamond	100	256x256
Buildings	100	256x256
Chaparral	100	256x256
Harbor	100	256x256
Intersection	100	256x256
Parking Lot	100	256x256
Storage Tanks	100	256x256
Beach	100	256x256
Transportation	100	256x256

Table 1. shows the Urban Area Imagery Collection from UC-Merced Land use which has ten classes of each one 100 images with 256*256-pixel size.

Fig. 2. Some examples of land use imagery from satellites

Fig.2. the photographs, which show different cities across the country, were carefully chosen from huge collections of pictures. In Land, the cover area is split into different groups:

farm, airplanes, baseball field, beach, buildings, transportation, chaparral, harbor, intersection, parking lot, and storage tanks. A total of 100 photographs were taken in each group

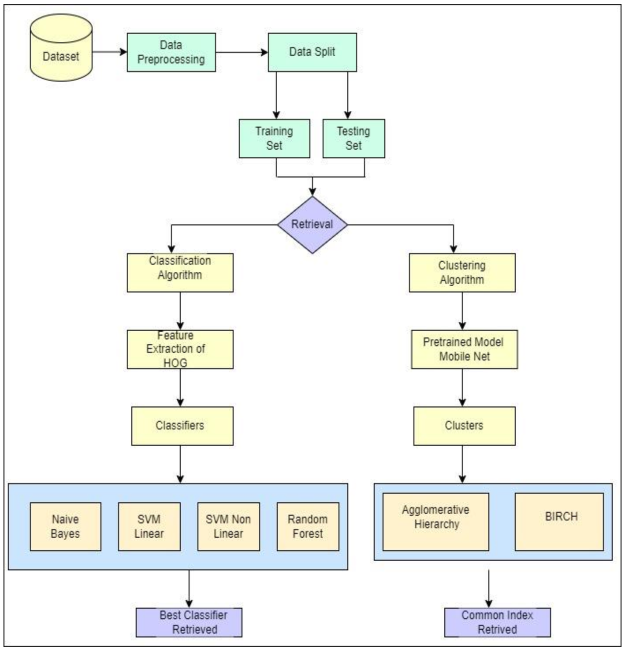


Fig.2. Image Retrieval Flow Diagram

Fig.2. Image Retrieval Flow Diagram shows the image retrieval based on classification and clustering using machine learning and pretrained model of Transfer Learning.

B. General Flow Image Retrieval by Steps:

The process of image retrieval is illustrated by the following steps:

Step 1: Loading a 1K dataset of satellite images with 10 classes of land use area.

Step 2: The pixel value of each image is 256 x 256 as actual data, which is converted to 128 x 128-pixel resolution in a preprocessing session.

Step 3. The dataset is divided into two splits, one as training samples and the other as testing samples, with a ratio of 80:20.

Step 4: Analyzing the best image retrieval by classification and clustering of both ends.

Step 5. From classification, feature extraction approaches for histogram-oriented gradients have been used.

Step 6: Different classifier approaches are applied to an image dataset.

Step 7. From clustering, convert the images into a pre-trained model for a deep learning network.

Step 8: Resize the image feature for unique identification.

Step 9: Check and generate the cluster number from the clustering index for each class.

Step 10. Finding accuracy from both methods for predicting good accuracy for image retrieval

The training samples of each 10 class have 800 images whereas testing samples of each class have 200 images. Training samples are trained as a model for giving an accuracy of good results. Deriving the best classifier and clusters for which leads to giving good prediction results in Image Retrieval [10].

IV. CLASSIFICATION TECHNIQUES OF REMOTE SENSOR SATELLITE IMAGES

A. Naïve-Bayes

Naive Bayes is an algorithm that quickly sorts image information from remote sensors into groups and does calculations. It checks the number of features for training samples in a straight line. It can put things into two or more groups and make accurate guesses based on the traits of those groups. It sorts a group of traits into a class based on conditional chance. The set that is used to learn is called the "training set," and the set that is used to test what has been learned is called the "test set."

B. SVM Linear

A hyperplane that works well for training data is made by attempting to put data into groups that are not the same in three dimensions. To find the most important minor hyperplane and make a good selection of hyperplane that makes mistakes less likely. Being close to the hyperplane makes the support vectors, which are very important to the prediction, stand out. Each class point has two lines that are very close to each other. The space between them is called an edge. For this method to work, the data must be simple; it can only handle classes that are separated in a straight line.

C.SVM Non-Linear

Sorting complicated data that can't be split up in a straight line across a space with many dimensions is easy with kernel functions. A new layer that lets data be put into groups is added when non-linear spaces are turned into linear spaces. The plane looks three-dimensional and parallel to the x-axis when you use two dimensions, x and y, and add a third dimension, z=x2+y2. In two dimensions, z=1 is used to find the circle's radius around the points that don't follow a straight line.

D. Random Forest

Another type of directed learning is random forest, which is mostly used to put things into groups. It's easier to use and gives you more options. A decision tree is made from random pieces of data. It then gets figures from each tree and votes on which choice is best. It also makes it clear how useful the tool is. A forest is a group of decision trees that work together to sort data. It is based on the divide and conquer method of a decision tree on a dataset that was split up randomly. Each decision tree has its own traits based on an attribute selection signal such as gain, gain ratio, or Gini index.

V. CLUSTERING TECHNIQUES OF REMOTE SENSOR SATELLITE IMAGES

The Pretrained Model of MobileNet is a CNN design that is faster and smaller. It uses Depth-wise Separable convolution. Because they are small, these shorter versions work well with mobile and embedded devices. MobileNet uses depth-separable convolutions, which also lower the value than what standard convolutions would do. A depth-separable convolution is made up of two phases. MobileNets can handle images that are larger than 32 by 32 and images that are bigger work better. MobileNet has fewer factors than other deep neural networks, but it is better at classifying things. MobileNet uses DenseNets' dense blocks to reduce the number of network factors and improve the accuracy of classification.

Image clustering involves preparing the images, extracting features, grouping them by how similar they are, and using a measure of goodness to find the optimal number of groups. To group data sets, it should know how to use the agglomerative and BIRCH methods.

A. Agglomerative Hierarchy clustering algorithm

The process of grouping things that are similar together in a way that makes sense. Each piece of information has been placed in its own group. Afterwards, groups are linked. During the process, groups that are alike are always brought together into a single massive root cluster. It is possible to find small groups with agglomerative grouping. When the job is done, a dendrogram shows the groups. In this type of clustering, instances are combined to make the right number of clusters. Moreover, the tree may be split into any desired number of clusters by selecting the appropriate node at which to make the incision.

B. BIRCH algorithm

This method, called BIRCH (The Balance Iterative Reducing and Clustering using Hierarchies), works better than k-means on very big data sets. A tree plan is used to find the middle points of the clusters. Instead of putting data points together, it puts short statements together. Summaries try to tell it as much as they can about the spread. Other ways of grouping things use BIRCH because it works with their reports. BIRCH can never deal with words. To get categorical numbers, it's necessary to change the data.

VI. RESULTS AND DISCUSSION

All assessments were done on a Windows 10 computer with an Intel(R) Core (TM) i5 1.8 GHz processor, 1 TB HDD, and 8 GB RAM. Here, Spyder tool is used for our experiment in Machine learning Python Environment.

Table 2. Accuracy Of Classifiers

Accuracy of Classifiers			
Naïve Bayes	SVM Linear	Random Forest	SVM Non-Linear
60.3	64.6	66.8	77.7

Table 2. shows the accuracy for each classifier gives a good result when comparing existing methods. In there the classifier of SVM 64.6%, SVM-Non-Linear 77.7% gives high accuracy of 1K image dataset, whereas Random Forest is 66.8% and Naïve Bayes 60.3% places their accuracy. Different classifiers are assessed and compared for the test dataset by measuring their metrics of precision, recall, and f1 score values. The SVM Non-Linear classifier as actual value and predicted values are high when compared with other classes. The Naïve Bayes and Random Forest Classier gives the results equally same value while comparing the next two classifiers between actual and predicted values.

Table 3. Cluster Indexing With Its Accuracy

Cluster Name	*Cluster Number*	*MobileNet + Birch*	*MobileNet +Aggl*
Agriculture	5	95.75	98.75
Airplane	3	94.25	96.25
Baseball	4	90.75	98.75
Beach	9	98.25	100
Building	8	70.75	78.75
Chapal	7	98.23	100
Harbor	0	95.34	100
Intersection	2	96.75	98.75
Parking	6	97.45	100
Storage tanks	1	90.75	93.75

Table 3. shows the agglomerative, BIRCH cluster index for each category of the data set, for clustering each category is assigned with cluster index like storage tank is assigned with index number with one, harbor is cluster number two, similarly for all. It also demonstrates the cluster name by its cluster number with percentage calculation.

The validation parameter for Cluster metrics is calculated by,

$$\frac{\text{Total number of correctly retrival image of the class}}{\text{Total number of images in the class}}$$

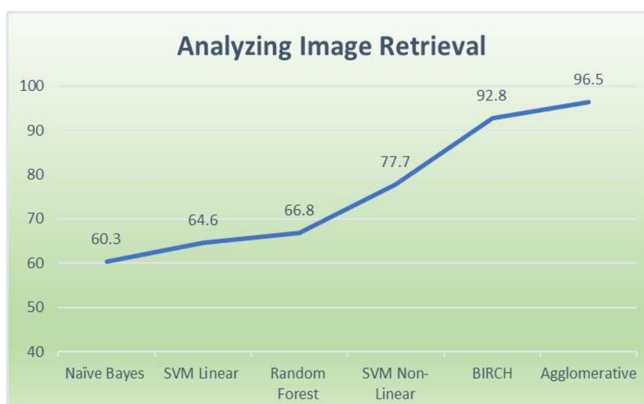


Fig. 3. Analyzing Image Retrieval

Fig.3. shows Analyzing of Image Retrieval with classifier and clusters with pretrained model. From the horizontal axis with different classifier and two clusters’ techniques. The chart clearly states that comparison from classifier to clusters performance values from 60.3 to 96.5, while its shows good improvement of accuracy while using the clusters for given dataset.

VII. CONCLUSION

The main purpose of this study is to look at how well the models work and how accurate they are, as well as to compare the results and come up with the best ideas for future research. With the cluster methods Agglomerative and Birch, the results would be better, but the classifiers Random Forest and SVM-Non-Linear show lower scores. The best scores, though, were above 90 percent. Therefore, the process of analysis makes the smart choice to use clusters for remote sensor image retrieval. These models may be utilized for either direct prediction on novel tasks or included in the training of a new model. Reduced training time and improved accuracy in generalization are the results of incorporating pre-trained models into a new model. Finally, we can use transfer learning to apply our retrieval method to a query image, which requires less training time and provides greater accuracy. This will help the model do better and be more accurate by using its better features.

REFERENCES

1. Zhang, X., Cui, J., Wang, W., & Lin, C. (2017). A study for texture feature extraction of high-resolution satellite images based on a direction measure and gray level co-occurrence matrix fusion algorithm. Sensors, 17(7), 1474.
2. Wu, Z. Z., Zou, C., Wang, Y., Tan, M., & Weise, T. (2021). Rotation-aware representation learning for remote sensing image retrieval. Information Sciences, 572, 404-423.
3.] Qi, Q., Huo, Q., Wang, J., Sun, H., Cao, Y., & Liao, J. (2019). Personalized sketch-based image retrieval by convolutional neural network and deep transfer learning. Ieee Access, 7, 16537-16549.
4. Alzu’bi, A., Amira, A., & Ramzan, N. (2019). Learning transfer using deep convolutional features for remote sensing image retrieval. IAENG International Journal of Computer Science, 46(4), 1-8. http://www.iaeng.org/IJCS/issues_v46/issue_4/index.html
5. Giveki, D., Shakarami, A., Tarrah, H., & Soltanshahi, M. A. (2022). A new method for image classification and image retrieval using convolutional neural networks. Concurrency and Computation: Practice and Experience, 34(1), e6533.
6. Al-Jubouri, H. A., & Mahmmod, S. M. (2021). A comparative analysis of automatic deep neural networks for image retrieval. TELKOMNIKA (Telecommunication Computing Electronics and Control), 19(3), 858-871.
7. Chen, D., Chen, Y., Ma, J., Cheng, C., Xi, X., Zhu, R., & Cui, Z. (2021). An ensemble deep neural network for footprint image retrieval based on transfer learning. Journal of Sensors, 2021.
8. Barhoumi, W., & Khelifa, A. (2021). Skin lesion image retrieval using transfer learning-based approach for query-driven distance recommendation. Computers in Biology and Medicine, 137, 104825.
9. Jiang, D., & Kim, J. (2021). Image Retrieval Method Based on Image Feature Fusion and Discrete Cosine Transform. Applied Sciences, 11(12), 5701.
10. Bhandi, V., & Devi, K. S. (2019, March). Image retrieval by fusion of features from pre-trained deep convolution neural networks. In *2019 1st International Conference on Advanced Technologies in Intelligent Control, Environment, Computing & Communication Engineering (ICATIECE)* (pp. 35-40). IEEE.