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FEATURE EXTRACTION AND ACCURATE CLASSIFICATION OF REMOTE SENSING MULTI-SPECTRAL SATELLITE IMAGES USING MACHINE LEARNING

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ABSTRACT

Satellite imagery is powerful and essential for many applications including environmental monitoring, engineers, law enforcement, and disaster response. Traditional object classification and detection algorithms are unreliable and inaccurate to process. To solve this issue applications require the automatic classification and detection of objects to facilities the images. Image processing is performed to extract or to enhance images with high quality. This research proposed Machine Learning (ML) algorithms that emerge the remote sensing images classification with higher accuracy and detection of object to conveniences the images. Machine Learning is a part of Artificial Intelligence(AI) that learns from the data gathered from previous experiences and allow the computer program to change its behaviour accordingly. The multi-spectral satellite image categorization process involves the grouping of the color and image pixel values into consequential categories. The Hybrid algorithm of LeNet and Convolution Neural Network(CNN) is used to extract the feature from remote sensing image and classifying the satellite image accurately. The concept of neural network to recognize patterns much like human brains is employed. The proposed system uses a hybrid algorithm to achieve feature extraction and object detection through machine learning techniques. There are different types and large size images were presented in the dataset, there are collections of satellite images collected from the Kaggle database this is the world's largest community which is providing a data platform for learning data science. The hybrid techniques are used to extract the feature based on the three major categories texture, color, and structure. The best optimizer of LeNet is helpful to separate hyper spectral images based on their shape and texture. CNN can classify land cover types with higher accuracy especially in mining areas. CNN function analyse data and recognize pattern for accurate classification of images. Semantic segmentation of a remotely sensed image in the temporal, spatial, and spectral-domain is an essential pre-processing step where different classes of objects like water bodies, industrial, crops, pasture, roads are localizing by a boundary. The investigational results demonstrate that the proposed algorithm of Hybrid LeNet and Convolution Neural Network (CNN) gives high accuracy feature extraction and object detection using machine learning methods.

Keywords: Classification, Convolution Neural Network CNN), Feature extraction, Hybrid LeNet, Machine Learning, Remote sensing.

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INTRODUCTION

Satellite images play a significant role in providing qualitative and quantitative geographical information this reduces the complexity of investigation times and field works. The satellite images are collected at regular intervals by receiving images from data centers and growing exponentially on time. A satellite image is not a complex manner but the analysts have to make many choices and decisions in remote sensing satellite image classification.

This technique involves the explanation of sensing images and studying the urban area to determine various land uses spatial data mining and studying various vegetation types such as foresters and agriculture. Deep Learning has gained extraordinary growth in various fields, for example, natural language processing, farming computer vision, and the medical area. Contrasted with conventional, deep learning has the capacity of robust learning and improve utilization of sensing image datasets for feature extraction.

In the practicability view, deep learning turns out to be an increasingly central stream for many researchers to do their research works. This paper focuses on optimizing different parameters using CNN of deep learning for classifying many satellite images. First LeNet is used to extracting the feature and then the CNN classifier is used for object classification. The proposed system using ahybrid LeNet-CNN algorithm for achieving object detection, feature extraction, and classification through deep learning techniques.

RELATED WORKS

Athira M.V *et al*., (2020), Over the past year the object detection has been dealing out extreme development. The onset of deep learning has boosted high performance and accuracy for improving several systems. This survey developed several works in the field of image detection and classification using machine learning, deep learning, and object detection-based night vision applications. The paper classified the object detection by using image classification performance are used to separate the infected regions with better high accuracy.

Muthu Krishnammal *et al*., (2019), authors have been carried out to investigate intensive research of abnormalities there in the structure of the brain the detection of tumors types based on the image of brian is statistically extracted from the medical images of features. By using MRI images for detecting tumors is traditional but the accurate location and quantity size of the tumor is a clinical challenge for the further treatment process. The proposed system includes three stages for tumor detection that are feature extraction, segmentation of images, and tumor segmentation. The deep learning techniques are used for feature extraction through wavelet transform with multiresolution techniques.

Neware and khan *et al*., (2018), Geospatial data deals with the high resolution of remote sensing data and it works on various fields like water resource, forests, land cover, geosciences, soil, disaster management, and environment. Some image processing techniques are applied to get the required information from the satellite images. The essential part of image processing is the classification andsegmentation of remote sensing images into their land cover area. This survey used supervised method, unsupervised method, and object-oriented classification to discover the land-covered area by using classification techniques through satellite images.

METHODS

A) DATASET COLLECTION

Recently explain about several datasets of imagery along with the activities of classification and detection technique through the learning process. Deep Learning applied for remote sensing imagery to deal with land cover image detection and segmentation. There are collections of satellite images were collected from the Kaggle database this is the world's largest community which is providing a data platform for learning data science. Satellite image classification is a conventional technique to extort information and detecting the object by pixel range from a huge volume of sensing images.

There are different type of images with a different pixels of images were taken as input images of datasets. The research took the remote sensing

images from different categories and these images had an extensive variety of dimensions (for example 300x280, 345x500, 500x414, etc.) and quality. From the dataset, few images have a perfect quality but some presented with an unvarying background where others have clustered background.

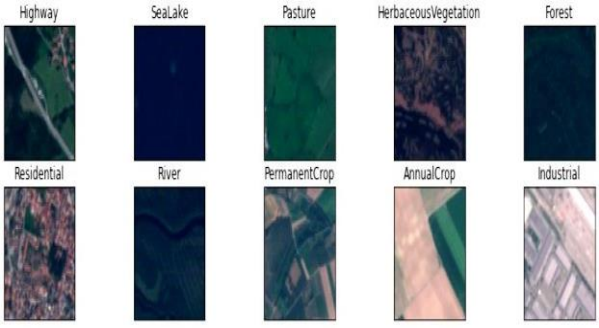

Figure 1: Satellite Images dataset with 8x8 pixel range

B) DATA PREPROCESSING

The data pre-processing stage is an important phase to make the sharing input images with the same characteristics. The first stage was the training phase the images are processing through starting method based on features vector extraction based on deep learning techniques. The dataset used in our model different color for each image preprocessing is converting all images into 256*256 uint8 three bands for the red, green, and blue channel. In the data pre-processing stage the all input satellite images are resizing the image size with the same dimensional region.

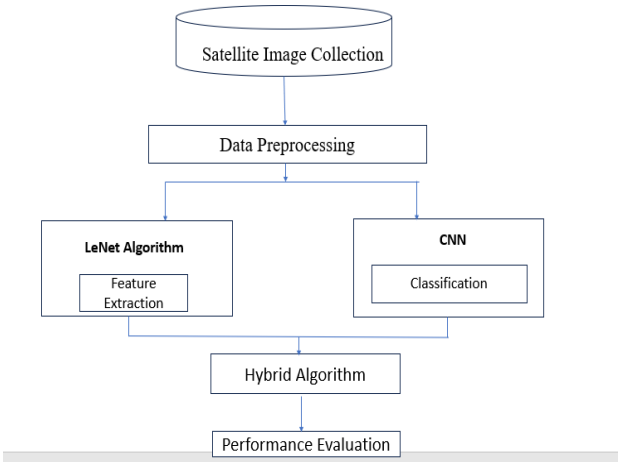

Figure 2: Proposed block diagram

So the testing phase can classify the images into color normalization by reducing invisible or irrelevant bands from the SAT dataset. Converting images into grayscale then the entire dataset images are ready for the further process of feature extraction that belongs to each satellite image into training and testing set.

C) LeNet USED FOR FEATURE EXTRACTION

The effectiveness of remote sensing image classification is based on the influence of features extracted from the input satellite dataset of training images. The feature extracted from the images provides a high-level process using LeNet algorithms. The feature extraction is divided into three groups using the LeNet algorithm: structure, texture, and color which are described in the approaches.

i) Structure-Based Feature Extracted

Self-Similarity(SSIM): The structure of SSIM evaluated on a set of points at a phase in both X and Y directions of 8 pixels. The satellite images of each descriptor are acquired by computing the correlation map of 9 × 9 pixels area in a window with the radius of 4 pixels, the feature extracting from the image of four angular and radial bins that yield 12 dimensions of descriptor vectors.

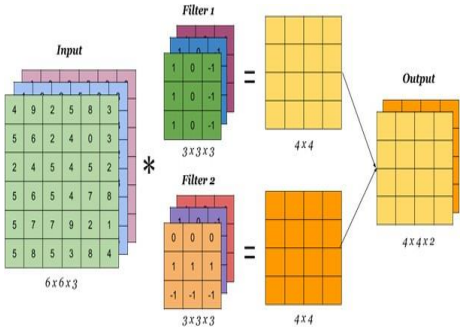

Figure 3: Feature extraction based on LeNet

Geometric Blur (GB): It is performed spatially that varying Gauss kernels and convolution ofthe image this is one of the features which are extracted from the satellite images. GB describes extracting the three channels each have 68-dimensional vectors.

ii) Texture Based Feature Extracted

Local Binary Patterns (LBP): This is defined as invariant to process rotation and grayscale this computed using eight sampling points on a radius of a circle with 1 pixel this is also extracted from a regular patch size of 16 × 16 pixels. Schmid Filter Bank (SF): The set of invariant filters rotationally consist of 13 dimensions of each pixel vector to the response of each image dimensionality reduction.

iii) Color Based Feature Extracted

Color Histogram: The color space is the major feature to extract the images more accuratelyit is defined as a red–green–blue (RGB) channel to compute the histogram into each RGB channel with 40bins. Then the three color channel defined concatenated independent histograms and defined 120- dimensional Colorhist. The feature extraction is defined on the regular grid to provide 20 × 20 pixels with an overlap phase of 10 pixels.

Color Pool and Hue: It defined the color mean concatenated this feature used to split the images into 4 × 4 non-overlapping rectangular regions. In each region of the image, the pixel value is obtained by fining the mean color of R, G, and B channels and concatenating them with each channel.

The texture features the first process is filtering and image using above mentioned extraction than to compute the mean range of each pixel on the regular grid size of 20 × 20 pixels. All the mentioned features are finally quantized into the feature extraction process by using LeNet techniques and the histograms are counted based on the pixel value then used for the classification methods.

D) IMAGE CLASSIFICATION USING CNN

The satellite images are used to extract the feature and based on the features the CNN algorithm of a deep learning process for classification. CNN layers that produced an act to respond or activation an extracted feature and classify the object from the satellite images for example Highway, River, Forest, and Industrial Lake Etc.

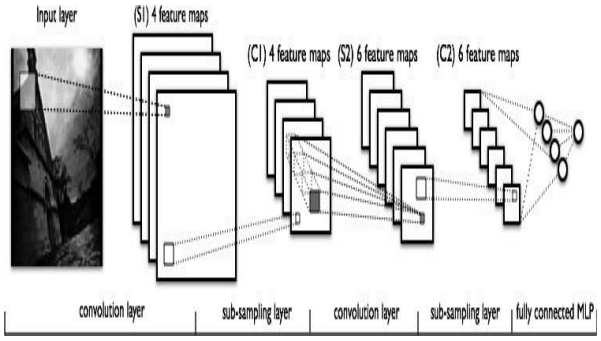

Figure 4: CNN Architecture for Layer processing

Learning for detecting blob and edge features is the first layer of the CNN progression and these original features are processed by a deeper layer. In the full connection layer if the first features are combined with more high-level features then it is used for classification or recognition tasks. Generally, a CNN mostly consists of three key parts first convolution layers, second pooling layers, and finally fully connected layers. In convolution neural layers the input maps are involved to form the output feature maps with learnable kernels and are activation function put through subsequently. Position (h, w) of the kernel that is associated to the m^{th} feature map in the $(m -1)^{th}$ layer correspondingly and (b_m, j) is the bias of the j^{th} feature map in the m^{th} layer. Such convolution layers establish weight sharing mechanism within similar feature maps this helps to decrease the number ofparameters. The CNN is used to classify the image through processing different types of layers position (h, w) of the kernel that is associated to the m^{th} feature map in the $(m -1)^{th}$ layer correspondingly and (b_m, j) is the bias of the j^{th} feature map in the m^{th} layer. Such convolution layers establish weight sharing mechanism within similar feature maps this helps to decrease the number ofparameters. The CNN is used to classify the image through processing different types of layers.

There are two advanced techniques used to classify the image accurately by using deep learning techniques. There is a versatile collection of image dataset is classified based on the extracted features of a classification system. The Hybrid method of LeNet-CNN is used to extract the features and segment the images more efficiently with the help of pixel classification.

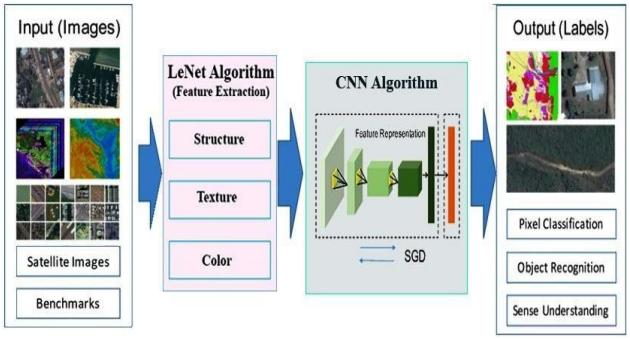

Figure 5: Architecture of overall research methodology

CONCLUSION

This study examined the Convolutional neural network with a natural remote sensing image dataset which has around 1000 training images relevant to the category. We achieved the best classification accuracy with the best parameter of the proposed architecture. An extensive comparative study has been given on various methods available in deep learning. The training and testing stages of the satellite image classification used deep learning techniques for achieving high accuracy there are different types of techniques used to extract the feature using the LeNet algorithm and based on the extracted features the images are classified using the CNN algorithm on Layer network. The Hybrid LeNet-CNN algorithm can detect and classify the satellite images by using deep learning techniques. Finally, this paper provides quantitative metrics evaluating such as precision, recall, and F1 score the classification of satellite Image with high accuracy

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