Satellite Imagery Analysis

[1]Dr. Laxmi B Rananavare, [2]Dhruthik U, [3]Charan L K, [4]E Nikhil Kumaraswamy, [5]Dhanush K

School of CSE, REVA University

[1]*laxmib.rananavare@reva.edu.in*, [2] *dhruthik28@gmail.com, charanshetty8435@gmail.com, nikhil.erigila09@gmail.com, dhanushnaidu2000@gmail.com*

Abstract.

In the EuroSAT dataset, deep learning methods are utilized to categorize land cover and land use. A detailed explanation and Python implementation of the 3D-CNN model for categorizing land cover in satellite pictures. For land cover classification in satellite images, SVM, K-Nearest Neighbour Classifier (K-NNC), Logistic Regression, and Tree-based Algorithms have traditionally been utilised. Deep learning and processing power developments have aided in the development of effective deep learning models for land cover classification. CNN (1D, 2D and 3D) are a popular architecture for extracting likely spectral and spatial information from satellite data that is vital for land cover classification. We will look at a simple explanation and implementation of 3D CNN for land cover categorization in satellite images.

Keywords 3D CNN, K-NNC, SVM, Satellite

1. INTRODUCTION

In recent years, the field of artificial intelligence and machine learning has advanced quickly. Machine learning techniques are used to enhance the outcomes of almost all study disciplines. Another key concern was the scarcity of labelled and clean data. However, in the majority of domains, public datasets are now available, which leads to innovation and entrepreneurship.

However, geographical data are required in some studies, and these datasets are not widely available. Because acquiring satellite imagery is expensive in and of itself, and only a few organizations make it available to the public. Even if they made it public, machine learning requires a large amount of labelled data to create models and generate relevant results.

However, government initiatives are currently making significant efforts to convert satellite photos into a free and open-source format that is widely utilized and yielding positive outcomes. To acquire additional insights from these satellite data, we must segment and interpret it for future research. Such a job is land cover and land use classification, which may provide insight into how land usage is occurring and changing through time. Satellite photos of various spectrums are captured and kept throughout time; when this sort of data is available and labelled, it may be utilized for future research. We are attempting to employ deep learning algorithms to deal with land cover categorization using the EuroSAT dataset in this project.

2. LITERATURE SURVEY

This research paper expresses the importance of satellite imagery in capturing the data in a short period of time over a large scale.

With the development of sensors and resolution of lenses, along with image enhancing techniques, it demonstrates that research based on satellite data saves time, money, and boosts the potential to recognize land using spectral analysis. [1]

This article relates artificial neural networks with biological neural networks. It acquires knowledge through learning and the information is stored in the inter-neuron connection strengths.

ANN receives information from external world in a pattern, after some processing it is fed into the activation function to get the desired output.

It has multiple layers of neurons which gather information from one another, resulting in a deep network.

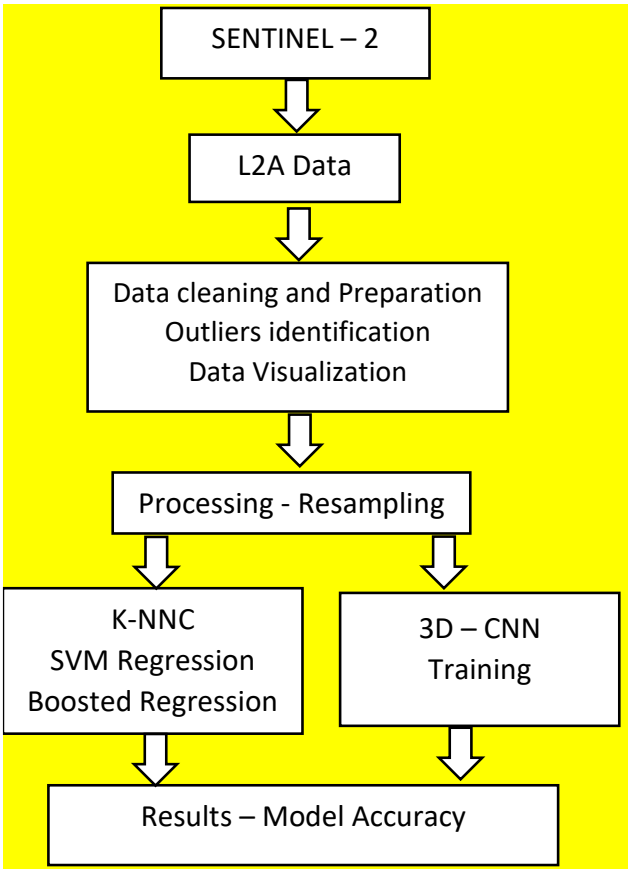
It is shown to have provided excellent results in object identification and can be used in sensing applications. [2]

In this paper the demand for methods for classification is identified, which in turn depends on the intelligent earth observation and the progress in this field. In the recent decades we have been using these images classification in applications such as natural hazard detection, image retrieval, vegetation mapping etc. The authors identified that we should rather focus on spatial patterns rather than analysis of single pixels. [3]

This paper focuses on an essential component in visual systems which is Image segmentation. It has a vast range of applications. Algorithms such as thresholding, k-means clustering, Markov random fields, etc. have been developed. But deep learning has provided models with more performance. Image segmentation can be looked as a classification problem which assigns a label to an image.

This paper discusses and gives an insight on most of the segmentations methods that has been developed. [4]

3. METHODOLOGY



Dataset - We used sentinal 2 satellite data. This is retrieved from sentinal hub website. It consists of multi spectral setellite images of 12 bands.

Visualization - Visualization gives us a better understanding of the data. The raw satellite images are difficult to comprehend. We use pythion libraries to visualize the data in a more familiar way

Data Cleaning - Satellite images are often captured with noise features, caused by clouds. Detection of clouds is performed for the data and once its detected we either find a better dataset or remove the cloud feature using some models.

4. MODEL IMPLEMENTATION

We are using the following models for our prediction and measuring the accuracy of the models –

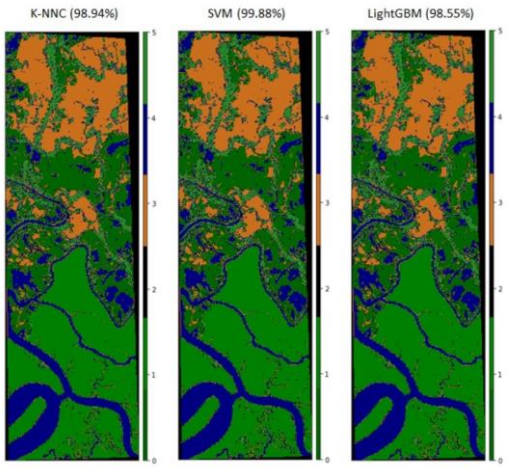
SVM - SVM is a prominent Supervised Learning algorithm that is used for Classification and Regression issues. It is based on strong prediction approaches established from statistical learning frameworks. SVR's primary concept is to locate the optimum fit line. The best fit line in SVR is the hyperplane with the greatest number of points.

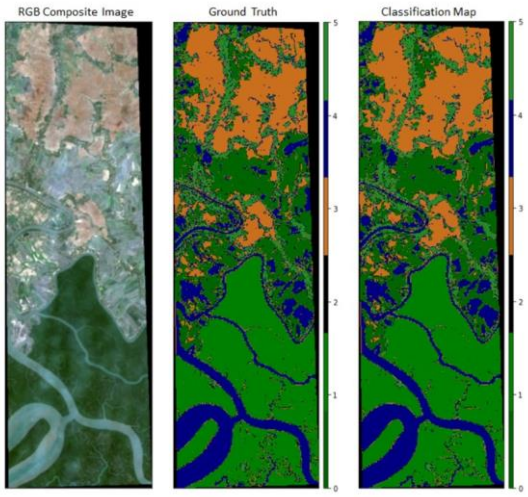
KNNC – K-Nearest Neighbour is a well-known Machine Learning technique, and its training phase consists solely of storing the feature vectors and class labels of the training samples. The K-Nearest Neighbor Classifier is a non-parametric technique, which means it makes no assumptions about the underlying data. It thinks the new data and available data are comparable and moves the new data into the category that matches the available categories.

Boosted - The Boosted Regression Tree is a machine learning model that uses past and present data to predict future performance. This model incorporates two algorithms: prediction accuracy-improving boosting methods and decision tree algorithms. In order to improve model accuracy in prediction, BRTs, such as Random Forest modes, would deploy a variety of decision trees on a regular basis.

3D CNN - The 3D CNN requires three-dimensional data as an input, so we must divide the satellite image into patches, each with its own class. The patch's class label has been defined as the class of the patch's centre pixel. Every patch has a size (W, W, B). Where W and B represent the size of the window and the number of bands, respectively.

5. RESULTS





	precision	recall	F1-score	Support
Class-1	0.95	0.91	0.93	16222
Class-2	0.99	0.99	0.99	23570
Class-3	1.00	1.00	1.00	6095
Class-4	0.95	0.97	0.96	16790
Class-5	0.96	0.97	0.97	13545
Class-6	0.84	0.89	0.87	9066
Accuracy			0.96	85288
Macro avg	0.95	0.95	0.95	85288
Weighted avg	0.96	0.96	0.96	85288

6. CONCLUSIONS

In this paper, we have addressed the issue of categorising land covered and used. The images obtained by satellites that operate remotely and are controlled by the government are being used as dataset for this purpose. This collected data that we used has been procured from Sentinel-2 satellite which is a part Earth Monitoring program.

We used CNN to set a standard for this dataset's spectral bands. For this new dataset, the outcome of the 13 unique spectral bands has been investigated. Based on this examination, the RGB band composition outperformed the SVIR and colour IR band combinations in classification accuracy, with the overall classification precision of 95.60%.

This research is the initial step in utilising the enormous quantity of available satellite data in machine learning, allowing for broad-scale monitoring of land surfaces of the Earth. The proposed dataset is ideal for a wide range of current time Earth observation applications. Detecting changes in land cover and use, and also updating geographical maps, are two possible applications.

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