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Land Classification Using Satellite Imagery

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Abstract: Using information from remote sensing, the process of identifying different land cover types—such as plants, water bodies, and soil—is known as land cover classification. This is useful for anticipating future interactions between human activity and the environment as well as for discovering significant facts about the surface of the Earth. These expected interactions lead to the formation of sustainable land use practices and the preservation of natural resources.

This study focuses on classifying land cover using both supervised and unsupervised methods. The supervised method for classification uses random forest classifiers, while the supervised approach for land cover detection uses CNN. The values of the evaluation parameters are calculated and compared for the input and output photographs.

Keywords: Land classification, machine learning, convolutional neural network, feature extraction, satellite imagery, environmental management.

I. INTRODUCTION

The term "land cover" describes the natural and man-made characteristics that blanket the surface of the Earth. It consists of various land use forms, vegetation, and bodies of water. Understanding how this land cover is classified is a crucial first step towards comprehending Earth's biophysical system. Classified land cover is useful for estimating the distribution and availability of natural resources as well as for monitoring the health of ecosystems. A method for analysing the effects of climate change on ecosystems and determining an area's susceptibility to natural catastrophes like floods, landslides, and forest fires is the land cover classifier.[1]

Classifying land cover using satellite multiband imagery with 12 bands is the aim of this study. Land, water, and vegetation are the three primary categories into which satellite data is divided. This would help the country's future development initiatives become safer and more effective.

II. LITERATURE SURVEY

A. Existing Work

Title: Deep Learning for Land-Cover Classification in Satellite Imagery: A Review,Authors: Liangpei Zhang, Qiangqiang Yuan, Xiao Xiang Zhu, Christiane Schmullius,Published: IEEE Geoscience and Remote Sensing Magazine, 2016,Summary: This paper provides a comprehensive review of deep learning techniques, including CNNs and RNNs, for land cover classification in satellite imagery. It discusses various architectures, methodologies, and applications in the field.

Title: Multiscale Recurrent Neural Networks for Hierarchical Conditional Random Fields-based Scene Labeling, Authors: Shuai Zheng, Sadeep Jayasumana, Bernardino Romera-Paredes, Vibhav Vineet, Zhizhong Su, Dalong Du, Chang Huang, Philip H. S. Torr,Published: CVPR, 2015, Summary: This paper presents a framework that combines CNNs with multiscale RNNs for hierarchical scene labeling, which can be adapted for land cover classification in satellite imagery.

Title: Deep Recurrent Neural Networks for Hyperspectral Image Classification,Authors: Zhihui Wang, Dingwen Zhang, Fei Yan, Hengchao Li, Yubao Sun,Published: IEEE Transactions on Geoscience and Remote Sensing, 2017,Summary: This paper explores the use of deep recurrent neural networks, specifically Long Short-Term Memory (LSTM) networks, for hyperspectral image classification, which can also be applied to land cover classification in satellite imagery.

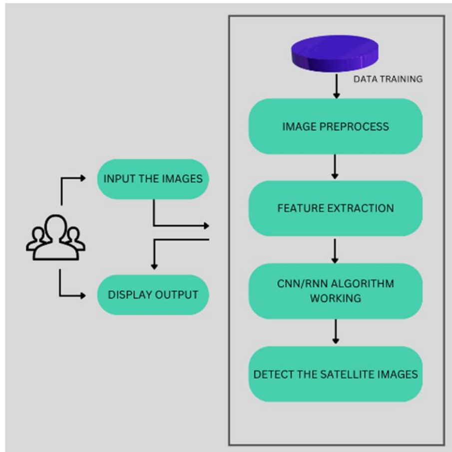
Title: DeepSat - A Learning framework for Satellite Imagery,Authors: Keiller Nogueira, Gustavo Batista, Adriano Veloso
Published: Pattern Recognition Letters, 2017,Summary: This paper introduces DeepSat, a deep learning framework that combines CNNs and RNNs for the classification of satellite imagery. It presents experiments on various datasets, including land cover classification tasks.

III. PROBLEM STATEMENT

In the pursuit of optimizing agricultural practices and resource allocation, there exists a critical need to accurately differentiate between cultivable and non-cultivable lands. This project aims to address this pressing challenge through the utilization of advanced models applied to satellite imagery analysis.

IV. PROPOSED WORK

A. Arhcitechture of the Model



B. Satellite image Acquisition

The initial phase includes obtaining satellite imagery statistics from legitimate resources which includes Sentinel and Landsat. This records encompasses multispectral imagery capturing various wavelengths of light, crucial for discerning special land cover types.

C. Data Preprocessing

Following acquisition, the satellite imagery undergoes preprocessing to make sure quality and consistency. tasks include correcting geometric distortions, eliminating atmospheric outcomes, and resampling to a standardized decision.

D. Feature Extraction

Feature extraction is pivotal for discerning relevant information from satellite imagery. techniques consisting of spectral analysis, texture evaluation, and flora indices computation are employed to extract discriminative features like plant life density, water bodies, and urban regions.

E. Model architecture layout

The middle of the technique includes designing a hybrid CNN-RNN model tailor-made for land cover type. CNNs are utilized for spatial feature extraction from satellite imagery, at the same time as RNNs seize temporal dependencies over sequential pictures, permitting dynamic land cover analysis.

F. Training the model

The model is skilled the use of categorised satellite imagery data, with ground truth annotations for unique land cover training. Supervised mastering strategies are carried out to optimize version parameters and improve category accuracy.

G. Model evaluation

The trained model's overall performance is evaluated the use of popular metrics including typical accuracy, precision, recall, and F1 score. additionally, visual inspection of classification maps and confusion matrices aids in assessing classification performance and identifying regions for development.

H. Integration and application

Upon successful assessment, the skilled model is incorporated into GIS structures or remote sensing software for practical software. it could be used for duties which include land cover mapping, environmental tracking, urban planning, and natural aid management. normal updates and refinement ensure the version's persevered relevance and effectiveness in actual-global situations.

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V. RESULTS

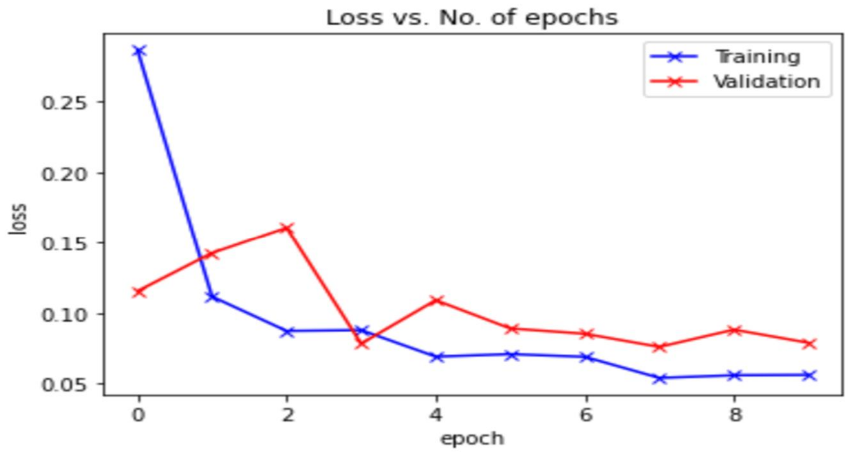

Figure 1. Loss vs Epochs for Training and Validation

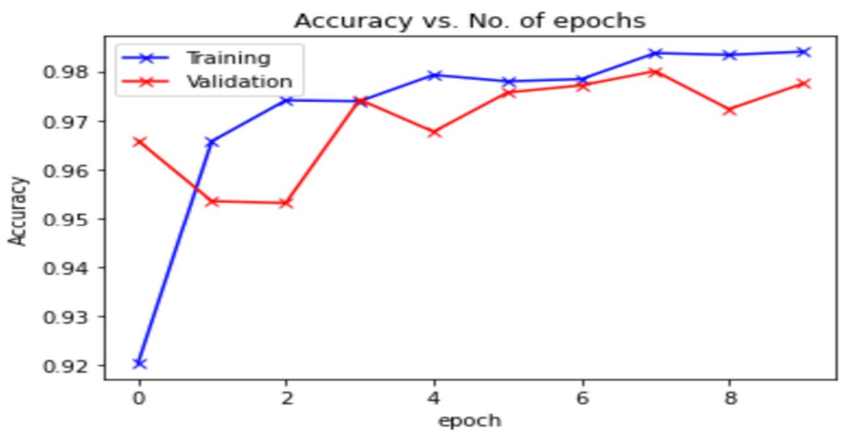

Figure 2. Accuracy vs Epochs for Training and Validation

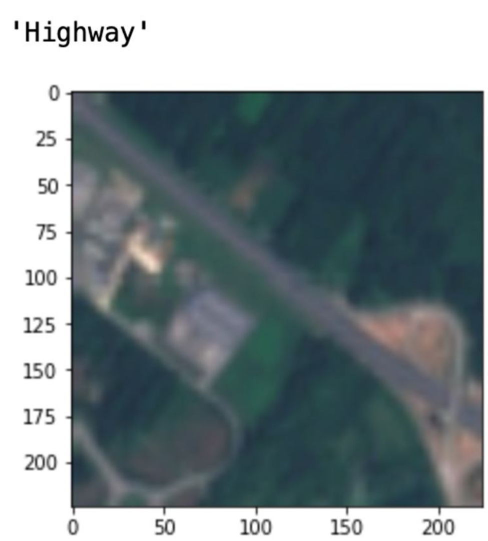

Figure 3. Example of Output

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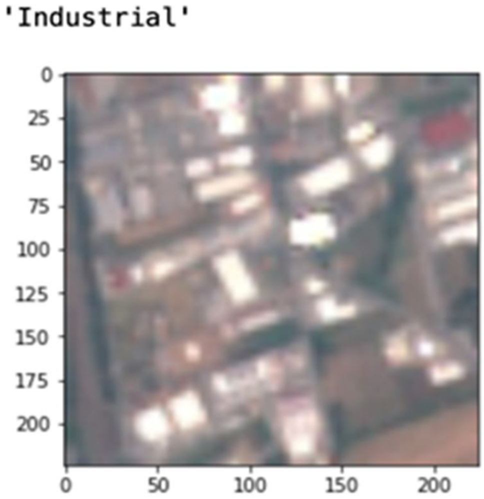

Figure 4. Example of Output

VI. CONCLUSION

The CNN architecture proposed in this paper can be used to extract scene information from satellite photos. The majority of alternative models that have been put forth in the literature start with a basic CNN model and include elements unique to satellite imagery. The AI community does not typically have access to such domain knowledge. The model has fewer parameters but is still developed along the lines of VGG. Additionally, our model outperformed all other architectures with an accuracy of 99.84 and 99.47 on the SAT4 and SAT6 satellite image datasets, respectively, thanks to the approaches of batch normalisation and dropout. Compared to other methods, the training and testing phase only takes thirty epochs, which is a very little amount of time. A further benefit is that a large number of photos can be batch processed without the requirement for preprocessing. This model will be used to process the state's data and determine its land resources.

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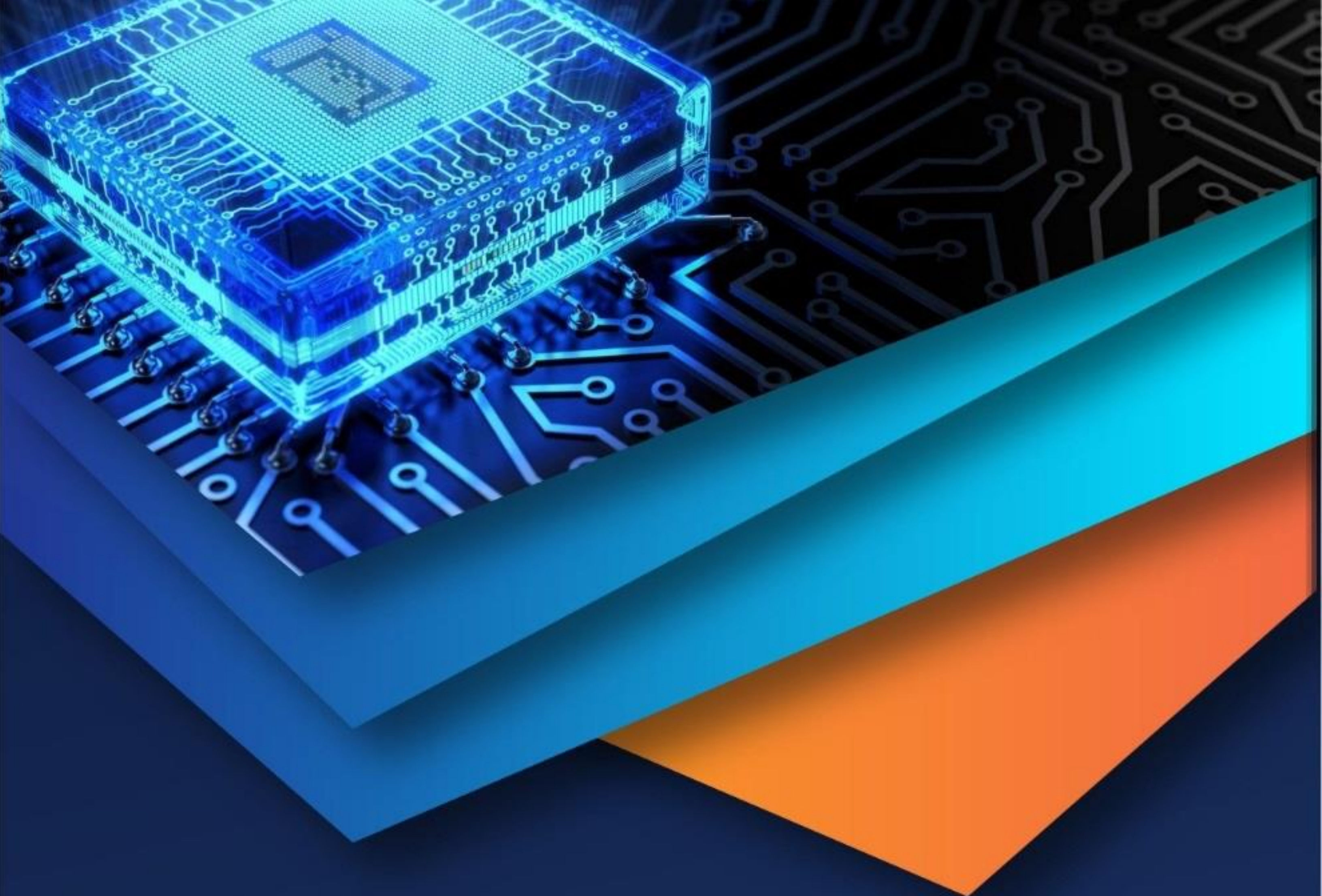

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