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SATELLITE LAND COVER CLASSIFICATION USING NEURAL NETWORK

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***Abstract*— This project develops a robust land cover classification system using CNNs for Sentinel-2 imagery, crucial for detecting land use changes and enhancing mapping. Leveraging Copernicus data ensures accessibility and integration into broader Earth observation initiatives, benefiting various fields.**

***Keywords*— Sentinel-2 imagery, Convolutional Neural Networks (CNNs), Copernicus program, remote sensing, land use changes, environmental studies, urban planning.**

INTRODUCTION

Image classification involves assigning a single label to an entire image, determining the class it belongs to. With public access to satellite image data like Sentinel-2 through programs like Copernicus, there's a wealth of data available for various purposes. Copernicus offers datasets like EuroSAT, comprising 27,000 images, pivotal for geographical mapping in agriculture, disaster recovery, climate change, urban development, and environmental monitoring.

However, to harness this data effectively, it needs processing into structured classes. One crucial classification task is Land Use and Land Cover Classification, which categorizes land types or land usage automatically. Utilizing convolutional neural networks (CNNs) ensures high accuracy in this process, as demonstrated in literature.

In summary, image classification facilitates understanding and utilization of vast satellite data for diverse applications. Leveraging CNNs, particularly in Land Use and Land Cover Classification, promises accurate and efficient analysis crucial for various domains..

LITERATURE SURVEY

Scholarly literature extensively explores image classification, notably in satellite land use and cover classification, with a significant emphasis on adopting Deep Learning, particularly through neural networks. Deep Learning has proven formidable in enhancing accuracy and efficiency in satellite-based applications, marking a notable breakthrough in this field. Various studies delve into the workings of neural networks, particularly Convolutional Neural Networks (CNNs), showcasing their architecture and capabilities in feature extraction and accurate predictions.

Deep Learning's extensive applications in various domains, highlighted by Dhawale et al., underscore its potential for accurate forecasting and improved planning. In the context of satellite imagery, automation is crucial for disaster response and environmental monitoring, where deep learning plays a pivotal role in achieving accurate object detection and classification.

Sentinel-2 satellite images, part of the Copernicus program, offer a valuable resource for land use and cover classification, as discussed by Helber et al., emphasizing the significance of datasets like EuroSAT derived from these images.

Moreover, the utilization of CNNs for assessing data classification accuracy in satellite imagery, as explored by Chauhan et al., reflects the ongoing trend of leveraging advanced technologies for precise results across various fields.

Overall, scholarly research continues to advance image classification methodologies, particularly in satellite-based applications, with Deep Learning playing a pivotal role in enhancing capabilities and precision, ultimately contributing to a deeper understanding of our surroundings..

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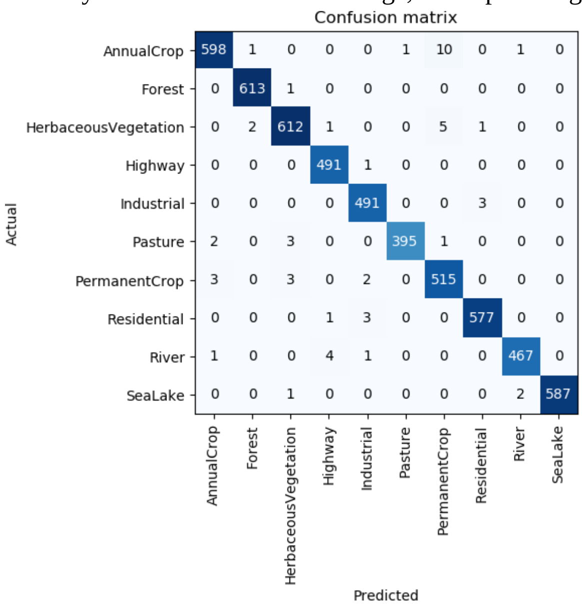
RESEARCH METHODOLOGY

- In our methodology, we commence with dataset collection, followed by rigorous data preparation and Exploratory Data Analysis to ensure dataset quality. Subsequently, we generate image patches, which are sequentially analyzed by a kernel or filter, systematically examining each segment.
- The next phase involves image fusion, where essential information from multiple images is amalgamated into

a single, more informative image. This fused image is designed to be more accurate and comprehensive than any individual source image, encapsulating all



necessary information.

- The fused image serves as input into a Convolutional Neural Network (CNN) model, a potent deep learning architecture. The CNN processes the information and generates output labels, ultimately determining the final class of our image.
- Through the utilization of deep learning techniques, we accurately ascertain the class to which our satellite image belongs. This holistic approach, depicted in Figure[1].underscores the integration of data preparation, image patch creation, image fusion, and CNN-based classification in achieving precise and meaningful results in satellite image analysis.

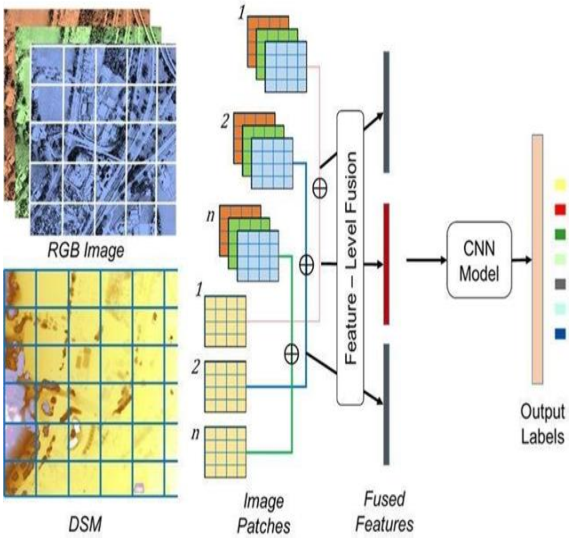


Figure.1.

RESULT AND DISCUSSION

1.Confusion matrix for our model

The confusion matrix for our model can be seen as shown in Figure[2].The plotis between actual and predicted class.

Figure.2

2.Classification of images

The assignment of 10 classes to the EuroSAT dataset is a significant milestone in land use and cover classification. The delineation of diverse features such as Annual Crop, Forest, Forest, Highway, and more provides a comprehensive understanding of the dataset. Visual representations demonstrate effective classification across these classes. Particularly noteworthy is the ability to identify industrial and residential areas, offering promising implications for urban planning and environmental monitoring. This success underscores the robustness of the classification methodology, enabling valuable insights and applications in land use assessment and related domains.

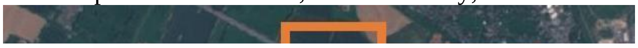
Figure.3.

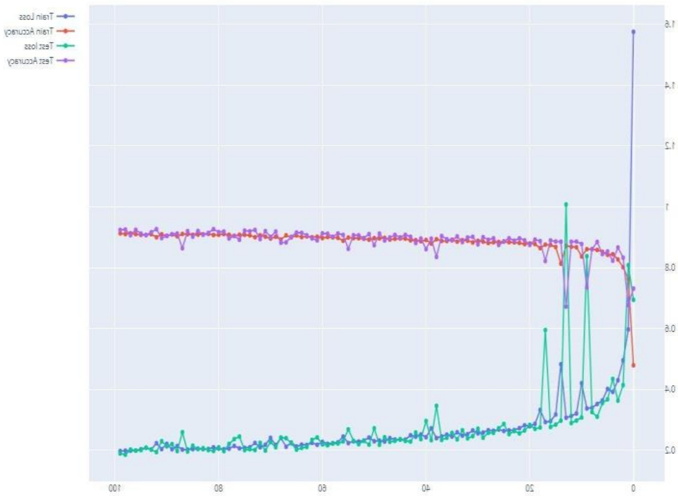
3.The loss and error rate for each epoch is shown in Fig [4] and total accuracyalong with loss is shown in Fig [5]. We get total accuracy of 92% or 0.92.

epoch	train_loss	valid_loss	error_rate	time
0	0.089976	0.058546	0.018889	08:35
1	0.076192	0.052770	0.018148	08:35
2	0.065030	0.049059	0.017037	08:35

Figure.4.

4. The plot b/w train loss, train accuracy, test loss and test





accuracy is shownin Fig [5].

Figure.5.

5.We can easily identify residential and industrial areas for future use as shownin Fig [6].

Figure.6.

FUTURE SCOPE AND CONCLUSION

This model addresses land use and cover classification using a novel dataset derived from Sentinel-2 satellite images, provided by Copernicus. With 27,000 labeled images across 13 spectral bands, we employed deep CNNs to assess band performance. The RGB band combination demonstrated superior accuracy at 92.18%, highlighting its efficacy. Leveraging free Sentinel-2 data opens avenues for large-scale Earth surface monitoring. Our dataset facilitates diverse applications like change detection and map enhancement. This research showcases machine learning's potential in extracting insights from extensive satellite datasets, advancing our understanding of dynamic landscapes.

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