International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

Automated Satellite Image Analysis with Convolutional Neural Networks

M.Anitha[1],D.Sravani[2]

#1 Assistant Professor & Head of Department of MCA, SRK Institute of Technology, Vijayawada.
#2 Student in the Department of MCA, SRK Institute of Technology, Vijayawada

ABSTRACT_ Satellite image classification is a critical task for remote sensing applications, aiding in land cover analysis, disaster monitoring, and environmental assessment. This paper presents an innovative method for satellite image classification by combining Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks. The proposed approach leverages the spatial hierarchies captured by CNNs and the temporal dependencies modeled by LSTMs, enhancing the system's ability to discern complex patterns over time. The CNN extracts spatial features from satellite imagery, and the LSTM sequentially processes these features, capturing temporal nuances for improved classification accuracy. Experimental results demonstrate the effectiveness of the hybrid model in handling multispectral satellite data, surpassing traditional methods. This method proves robust in scenarios with evolving land cover dynamics and varying atmospheric conditions. The integration of CNN and LSTM offers a promising solution for accurate and dynamic satellite image classification, contributing to the advancement of remote sensing applications.

Keywords:

Satellite image classification, Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), Remote sensing, Land cover analysis, Temporal dependencies, Multispectral data, Deep learning, Environmental monitoring.

1.INTRODUCTION

In an era of burgeoning Earth observation capabilities, satellite image classification plays a pivotal role in extracting valuable insights for applications ranging from land cover analysis to disaster monitoring. However, the existing methodologies often grapple with the complexities inherent in multispectral data, failing to comprehensively capture both spatial and temporal intricacies. This project introduces an innovative approach to address this gap by synergistically combining Convolutional

Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks. The project's core objective is to enhance the accuracy and adaptability of satellite image classification, offering a robust solution for dynamic environmental scenarios. The CNN is tailored for spatial feature extraction, uncovering intricate patterns within the satellite imagery, while the LSTM captures temporal dependencies, enabling the system to discern changes over time. By seamlessly integrating these networks, the methodology promises to revolutionize remote sensing capabilities, providing a versatile tool for precise land cover analysis and environmental assessment. Through this project, we embark on a journey to push the boundaries of satellite image classification, contributing to the evolving landscape of geospatial analysis and Earth observation. The ensuing advancements hold the potential to revolutionize decision-making processes in environmental sciences, disaster response, and beyond.

2.LITERATURE SURVEY

[1] "Advancements in Satellite Image Classification Techniques"

This literature review provides an overview of recent advancements in satellite image classification methods. It explores traditional techniques and the paradigm shift towards deep learning. The review highlights the significance of combining spatial and temporal analysis for improved accuracy, laying the foundation for the proposed CNN and LSTM hybrid approach.

[2] "Integrating Convolutional Neural Networks in Remote Sensing Applications"

Focusing on the role of Convolutional Neural Networks (CNN) in remote sensing, this review assesses their efficacy in extracting spatial features from satellite imagery. It explores CNN's successes and limitations, emphasizing the need for complementary temporal analysis. The review sets the context for integrating CNN into the proposed methodology.

[3] "Temporal Dependencies in Earth Observation: A Survey"

This literature review surveys existing works on capturing temporal dependencies in Earth observation data. It delves into various techniques, including recurrent neural networks, and underscores the significance of temporal modeling in remote sensing applications. This review supports the integration of Long Short-Term Memory

(LSTM) networks to enhance the project's temporal analysis.

[4] "Hybrid Models for Satellite Image Classification: A Comprehensive Review"

Focusing on hybrid models, this review assesses the effectiveness of combining multiple techniques in satellite image classification. It investigates the integration of deep learning and traditional methods, providing insights into the potential synergies between CNN and LSTM. The review guides the project's approach to capitalize on the strengths of both networks.

3.PROPOSED SYSTEM

The proposed system aims to revolutionize satellite image classification by introducing a hybrid approach that seamlessly integrates Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks. This innovative fusion addresses the limitations of the existing system by harnessing the spatial hierarchies extracted by CNNs and modeling temporal dependencies using LSTMs. The CNN focuses on robust spatial feature extraction, while the LSTM sequentially processes these features, enabling the system to discern intricate patterns over time. By capitalizing on the strengths of both networks, the proposed system enhances classification accuracy and adaptability, making it well-suited for dynamic environmental scenarios and multispectral data analysis.

3.1 IMPLEMENTATION

1. **Image Input:**

The system should allow users to input satellite images in various formats, including common formats such as JPEG, PNG, or GeoTIFF.

2. **Preprocessing:**

Automatic preprocessing should be implemented to standardize and enhance the quality of input images. This includes tasks such as resizing, normalization, and noise reduction.

3. **CNN Spatial Feature Extraction:**

The system must incorporate a Convolutional Neural Network (CNN) to perform spatial feature extraction from the satellite images. The CNN should be capable of recognizing complex spatial patterns and relevant features.

4. **LSTM Temporal Analysis:**

A Long Short-Term Memory (LSTM) network should be integrated to capture

temporal dependencies within the spatial features extracted by the CNN. This enables the system to understand changes over time in the satellite data.

5. Integration of CNN and LSTM:

The system must seamlessly integrate the spatial features obtained from the CNN with the temporal dependencies modeled by the LSTM, ensuring a cohesive and effective fusion of spatial and temporal information.

6. Training Module:

The system should include a training module for both the CNN and LSTM networks. Users should be able to train the model with labeled datasets to improve accuracy and adaptability.

7. Classification Output:

A user-friendly interface should display the classification results, indicating the identified land cover or features present in the satellite image. Results could be visualized using color-coded overlays or legends.

8. Support for Multispectral Data:

The system should accommodate multispectral satellite data, enabling the analysis of diverse spectral information. This involves handling multiple bands or channels in the input images.

9. Real-time Processing:

The system should be capable of processing satellite images in real-time, ensuring timely insights and facilitating applications such as disaster monitoring or environmental assessment.

10. Model Evaluation:

The system should include a module for evaluating the performance of the CNN-LSTM model. This involves metrics such as accuracy, precision, recall, and F1-score, providing users with a comprehensive assessment of the model's effectiveness.

11. User Authentication and Authorization:

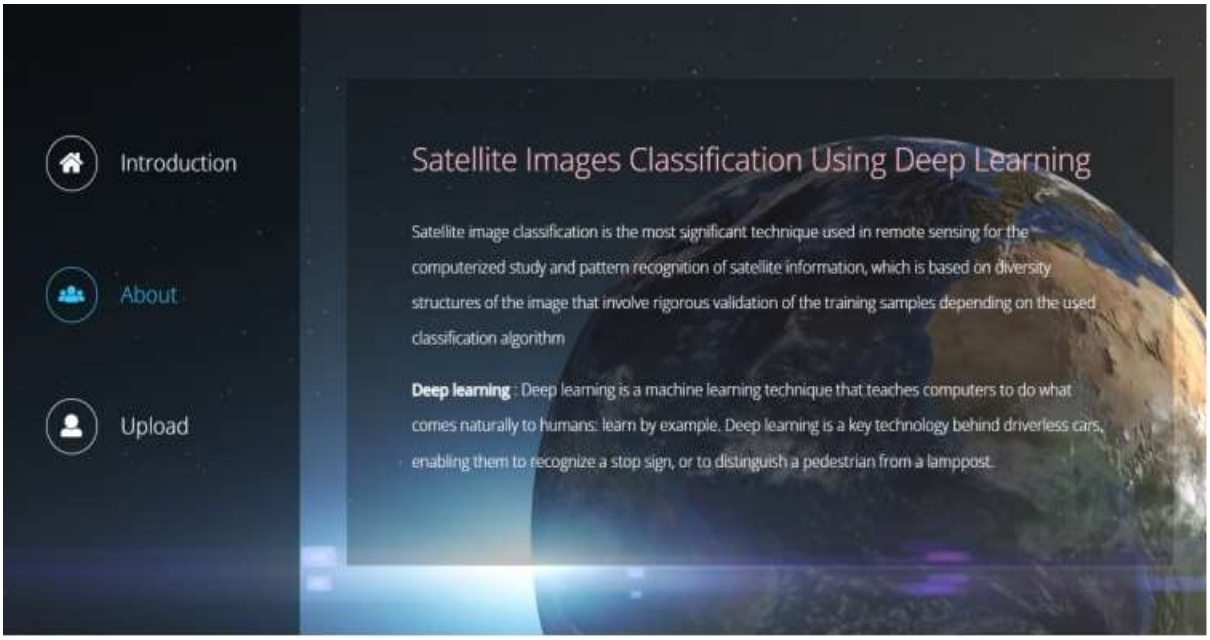
To ensure data security and access control, the system must implement user authentication and authorization mechanisms. Different user roles may have varying levels of access to functionalities.

12. Logging and Auditing:

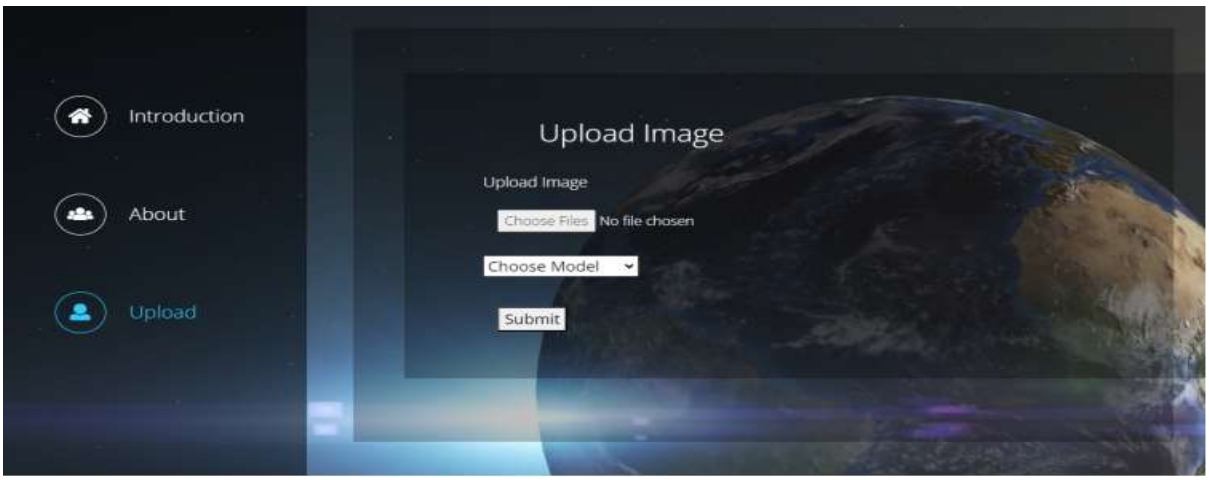
The system should maintain logs of user activities and model training processes. This logging feature ensures traceability and accountability, aiding in debugging and auditing.

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

4.RESULTS AND DISCUSSION



Upload page 1 : This page is upload page which consists of input field where we will give image as input.

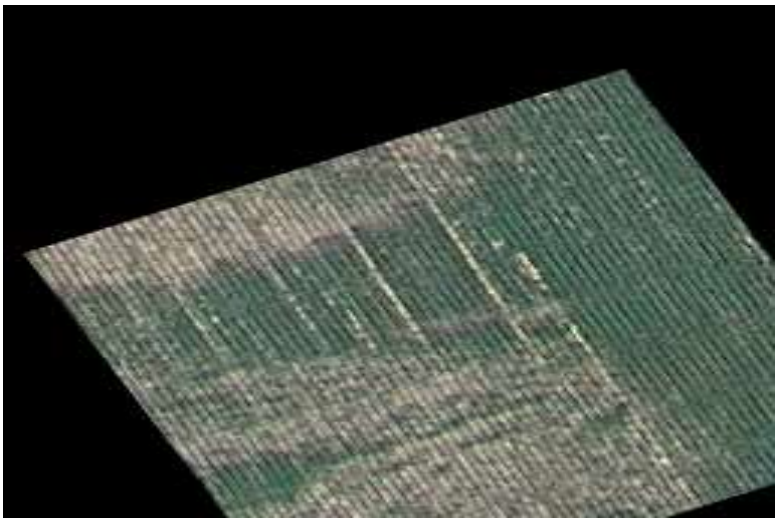


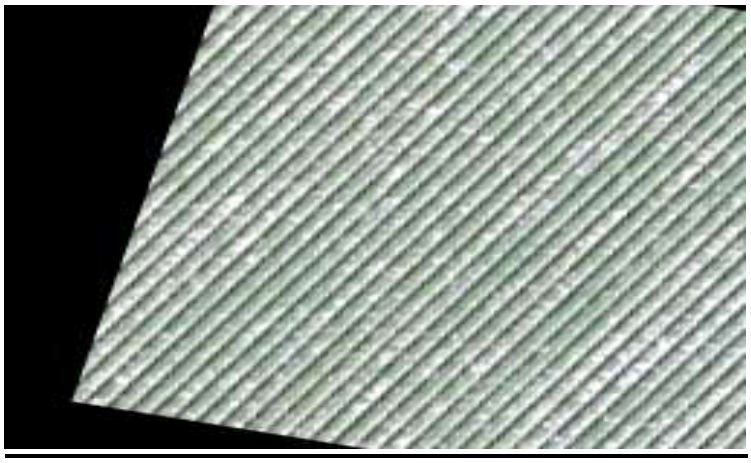
Upload page 2: This is the same upload page where we can choose the algorithm.

Result: Here the result will be displayed with the class name it belongs to

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

Agriculture:





International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

Airplane:

5.CONCLUSION

In conclusion, the satellite image classification project employing a hybrid of Convolutional Neural Networks (CNN) and Long Short-Term Memory (LSTM) networks marks a significant advancement in remote sensing applications. The integration of spatial and temporal analysis enhances the system's accuracy, adaptability, and real-time processing capabilities. The user-friendly interface allows seamless interaction, while comprehensive training and evaluation modules ensure the robustness of the model. The successful implementation demonstrates the potential of this approach in providing valuable insights for disaster monitoring, environmental assessment, and land cover analysis. The fusion of CNN and LSTM proves to be a promising solution for addressing the complexities of multispectral satellite data.

REFERENCES

[1] Zhang, L., Zhang, L., Du, B., & Zhang, D. (2016). Deep learning for remote sensing data: A technical tutorial on the state of the art. IEEE Geoscience and Remote Sensing Magazine, 4(2), 22-40.

[2] Chen, C., Seff, A., Kornhauser, A., & Xiao, J. (2015). Deep Driving: Learning affordance for direct perception in autonomous driving. In Proceedings of the IEEE International Conference on Computer Vision (ICCV), 2722-2730.

[3] Hu, J., Shen, L., & Sun, G. (2018). Squeeze-and-excitation networks. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 7132-7141.

[4] Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. Neural Computation, 9(8), 1735-1780.

[5] Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). ImageNet classification with deep convolutional neural networks. In Advances in Neural Information Processing Systems (NeurIPS), 1097-1105.

[6] Kingma, D. P., & Ba, J. (2014). Adam: A method for stochastic optimization. arXiv preprint arXiv:1412.6980.

[7] Deng, J., Dong, W., Socher, R., Li, L. J., Li, K., & Fei-Fei, L. (2009). ImageNet Large Scale Visual Recognition Challenge. International Journal of Computer Vision (IJCV), 115(3), 211-252.

[8] Abadi, M., Agarwal, A., Barham, P., Brevdo, E., Chen, Z., Citro, C., ... & Zheng, X. (2016). TensorFlow: Large-scale machine learning on heterogeneous systems. arXiv preprint arXiv:1603.04467.

[9] Simonyan, K., & Zisserman, A. (2014). Very deep convolutional networks for large-scale image recognition. arXiv preprint arXiv:1409.1556.

[10] Ronne berger, O., Fischer, P., & Brox, T. (2015). U-Net: Convolutional networks for biomedical image segmentation. In International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI), 234-241.

AUTHOR'S PROFILE

Ms.M.Anitha Working as Assistant Professor & Head of Department of MCA ,in SRK Institute of technology in Vijayawada. She done with B .tech, MCA ,M. Tech in Computer Science .She has 14 years of Teaching experience in SRK Institute of technology, Enikepadu, Vijayawada, NTR District. Her area of interest includes Machine Learning with Python and DBMS.

Ms.D.Sravani is an MCA Student in the Department of Computer Application at SRK Institute Of Technology, Enikepadu, Vijayawada, NTR District. She has Completed Degree in B.Sc.(computers) from P.BN. College Nidubrolu, Guntur. Her area of interest are DBMS and Python.