Advancing Land Use and Land Cover Classification Through Deep Learning in Remote Sensing and Satellite Imagery

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ABSTRACT

Land use and land cover (LULC) changes, driven by agriculture, forestry, urban expansion, and deforestation, contribute significantly to global GHG emissions. Monitoring these changes is critical for urban planning, climate adaptation, and nature conservation. Recent developments in Earth Observation (EO) and deep learning, exemplified by architectures like CNN, have demonstrated significant potential in automating satellite imagery analysis. This project explores automating LULC mapping using satellite imagery and deep learning models, highlighting methods that enhance segmentation accuracy and scalability for environmental applications.

MOTIVATION

- Satellite-based land classification models accurately track urbanization, climate impacts and deforestation for informed decision-making.
- Timely mapping supports emergency response, urban planning, and environmental conservation with real-time geographical insights.

PROBLEM STATEMENT

- Rapid urbanization, deforestation, and agricultural expansion necessitate accurate, real-time land use monitoring for sustainability and disaster management.
- Current models are limited by poor classification accuracy, inadequate spectral coverage, and lack of scalability for large-scale analysis.

BLOCK DIAGRAM

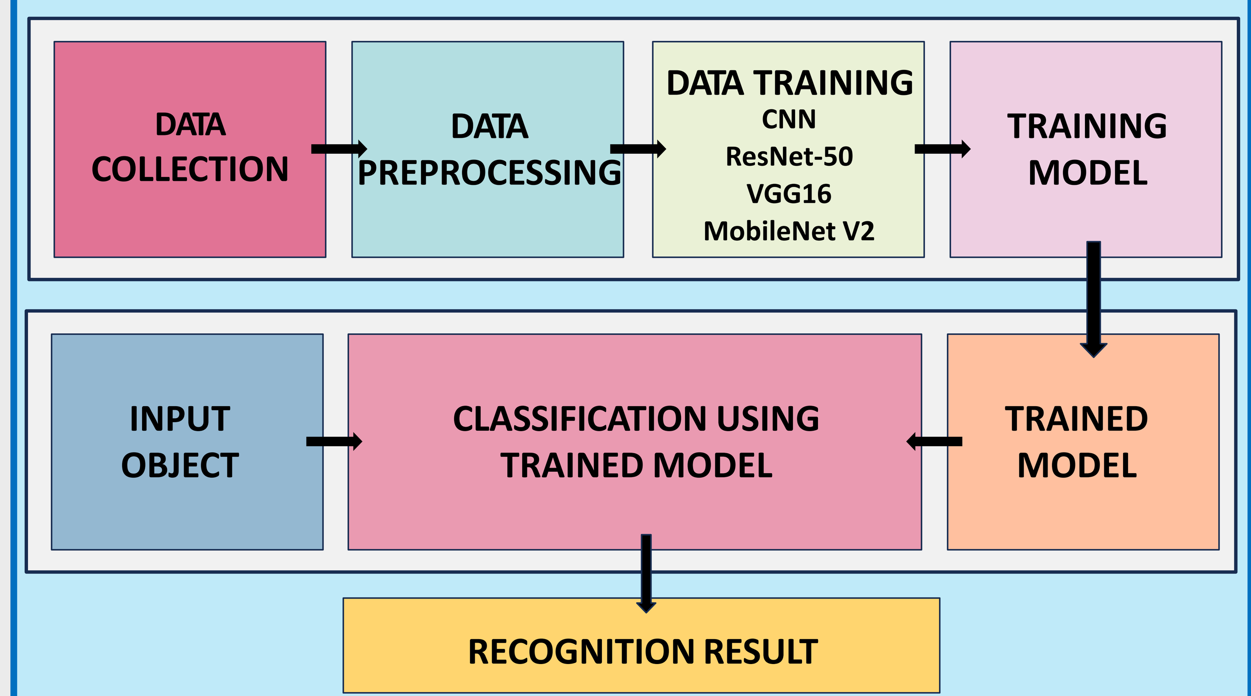

Fig. 1 : Block Diagram

DESIGN

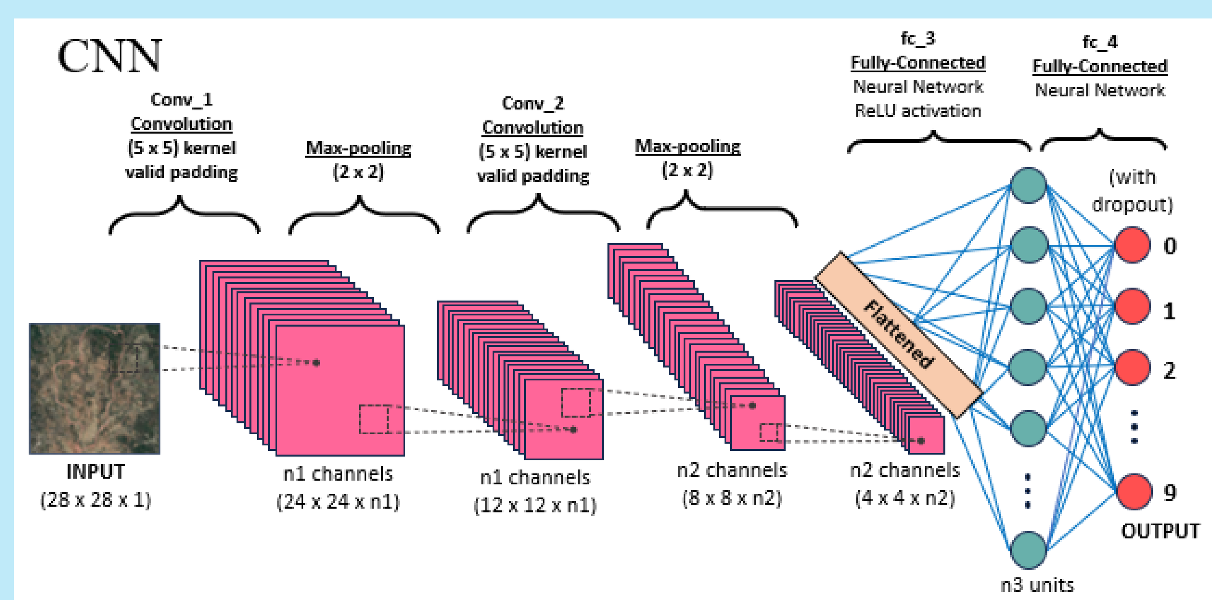

Fig. 2 : Convolutional Neural Network

REALISTIC CONSTRAINTS

- **Computational Resources:** High resource demands for training deep learning models can slow progress, especially for large datasets.
- **Model Generalization:** Ensuring the model generalizes well across diverse regions without overfitting is challenging.

ENGINEERING STANDARDS

- ISO 19115 (Geospatial Metadata)
- OGC Standards (Open Geospatial Consortium)
- ISO 9001 (Quality Management Systems)

RESULTS & INFERENCE

Fig. 3 : Input image of SRM

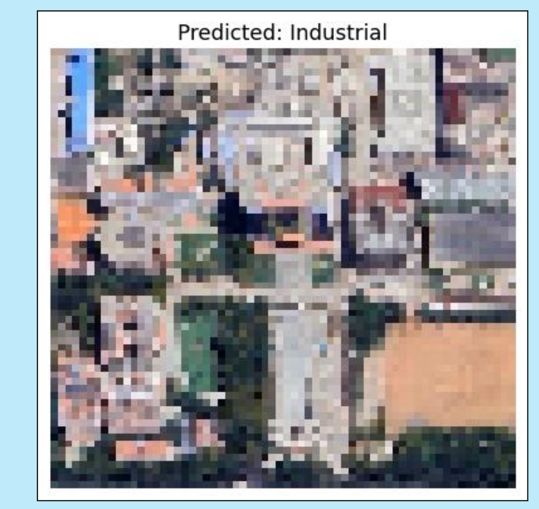

Fig. 4 : Output Prediction

Table I : Comparison Of Classification Algorithms

Model	Accuracy		Score		
	Train	Val	Precision	R-Square	F1
VGG 16	92.03	89.22	89.33	75.72	89.22
CNN	97.20	90.85	89.33	75.72	90.83
MobileNetV2	96.02	82.76	82.82	61.28	82.76

- **Chengalpattu Prediction**: The model accurately predicted and mapped ten LULC classes as shown in table II with color-coded tiles.

Table II : Colour Mapping for Class Prediction

Class/Land Cover	Colour
Annual Crop	Light Green
Forest	Forest Green
Herbaceous Vegetation	Yellow Green
Highway	Black
Industrial	Red
Pasture	Medium Sea Green
Permanent Crop	Chartreuse
Residential	Magenta
River	Purple
Sea/Lake	Blue

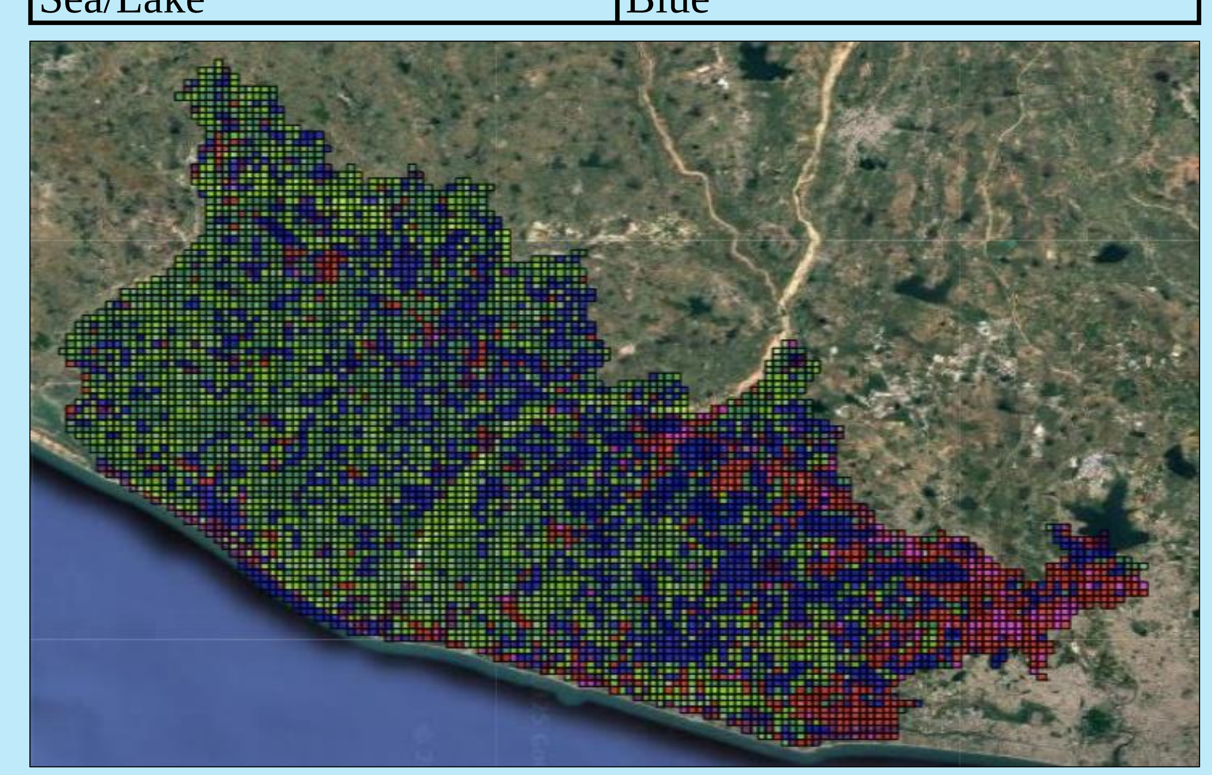

Fig. 5 : Predicted Classification of Chengalpattu.

CONCLUSION

- This project uses the EuroSAT dataset to increase the accuracy of land use classification using deep learning and multi-spectral data.
- Enables real-time monitoring for multiple applications including agriculture, urban planning, disaster relief, and deforestation prevention, while supporting GIS updates and climate analysis.

REFERENCES

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2. Adegun, A.A., Viriri, S., & Tapamo, J.R. (2023). "Review of Deep Learning Methods for Remote Sensing Satellite Images Classification: Experimental Survey and Comparative Analysis." Journal of Big Data, 10, 93. doi: 10.1186/s40537-023-00772-x.

CONFERENCE

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