

Introduction to Machine Learning and Remote Sensing Satellites

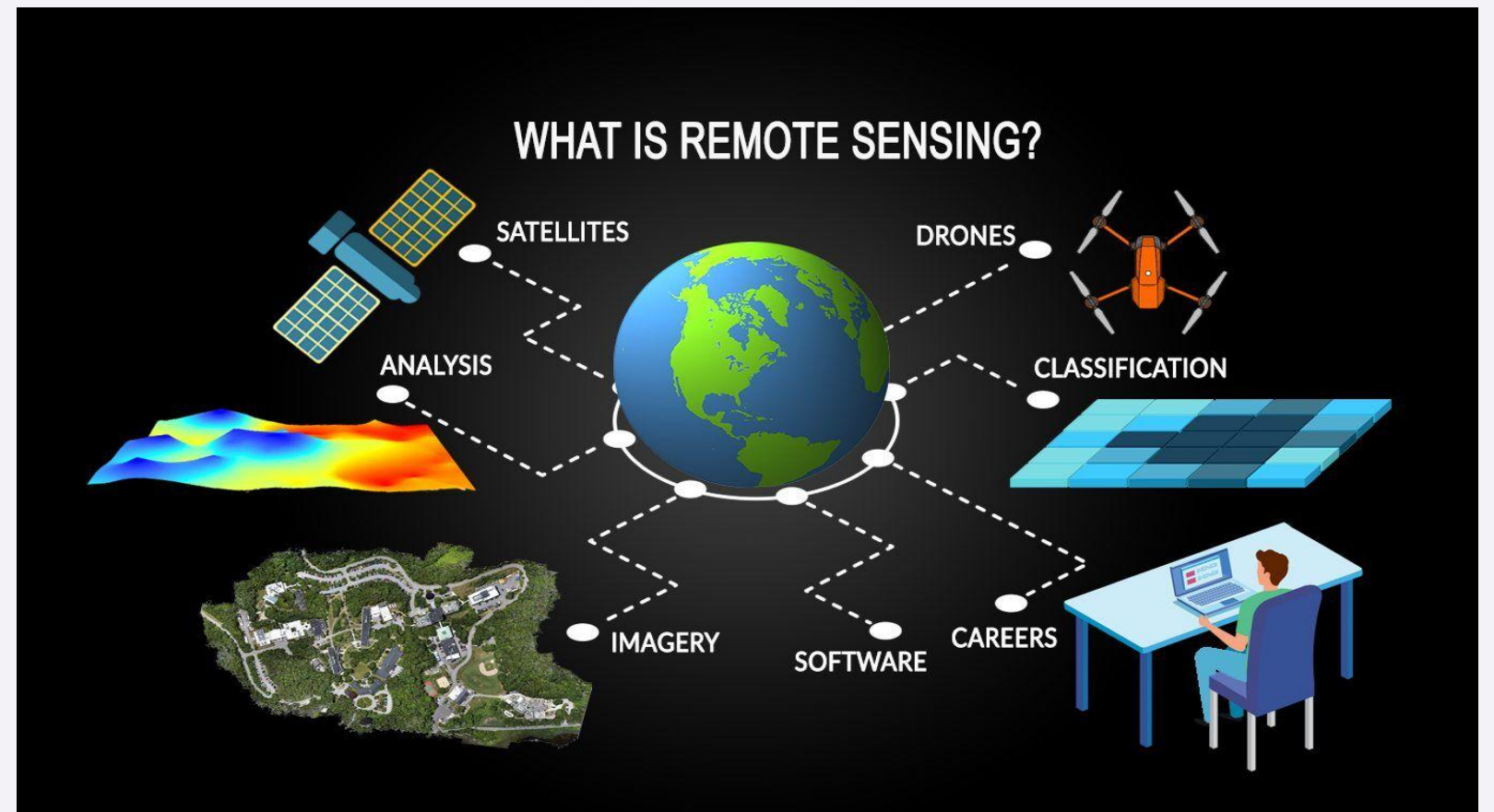
BY: MARKAND (21BEC065)
PANKTI (21BEC044)



Satellite Imagery Analysis

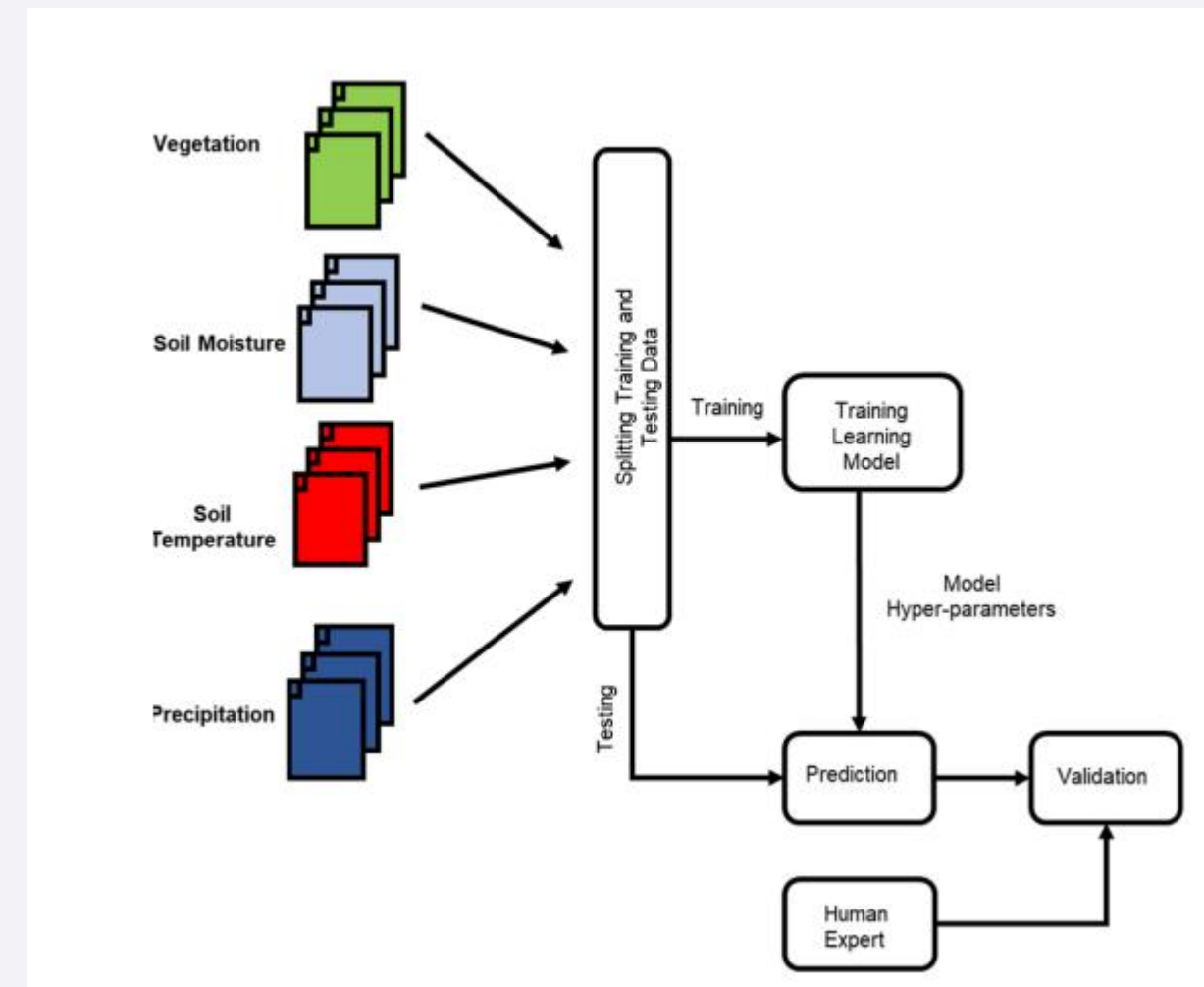
Machine learning algorithms can analyze high-resolution satellite imagery to detect and classify various urban and natural features. This enables detailed mapping of land use, monitoring of infrastructure, and identification of changes over time.

Applications of machine learning in remote sensing satellites, focusing on four key areas: **precipitation prediction, vegetation classification, mineral exploration, and oil spill detection.**



PRECIPITATION PREDICTION AND VEGETATION CLASSIFICATION:

Precipitation prediction plays a vital role in weather forecasting, water resource management, and disaster mitigation. The only way to measure Precipitation (P) over any topographically complex domain is via remote sensing from space. By accurately forecasting rainfall patterns, decision-makers can effectively plan for water supply, agricultural activities, vegetation water content, soil moisture, and surface temperature prepare for potential flooding events.

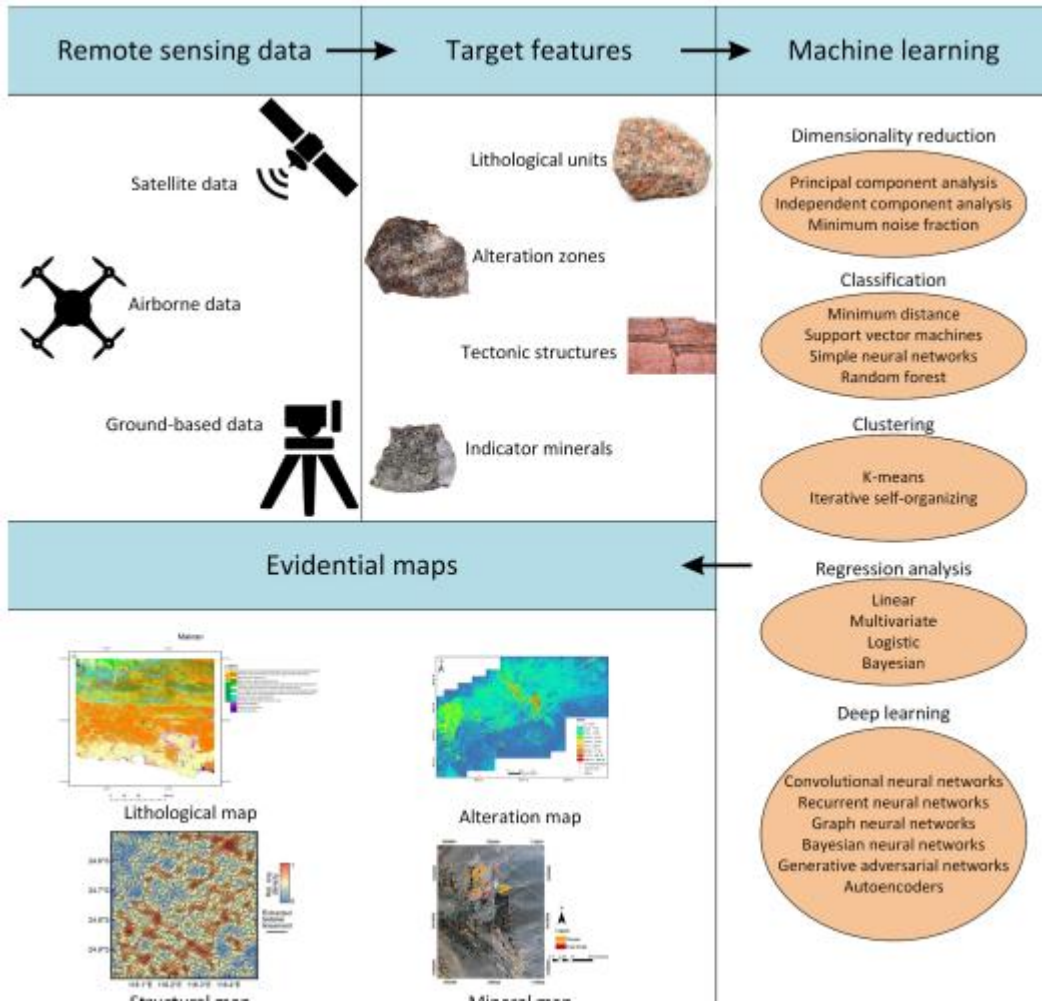


MINERAL EXPLORATION:

Methodology:

Mineral exploration is a critical process in identifying and assessing potential sources of valuable minerals, essential for various industries such as construction, electronics, and energy production. Machine learning offers advanced methods for analyzing remote sensing data to improve the efficiency and accuracy of mineral exploration efforts.

Mapping geological features is a fundamental step in mineral exploration. The combined use of machine learning methods and remote sensing data can be considered an easy and inexpensive approach for mapping lithological units, alteration zones, structures, and indicator minerals associated with mineral deposits. In several fields, rapid advancements in acquiring high-resolution remote sensing data have led to the explosion of big data that offers a new opportunity for data-driven discovery.



OIL SPILL DETECTION:

Oil spill detection is a critical process for protecting marine environments from the adverse effects of oil contamination. Machine learning techniques applied to remote sensing data, particularly infrared (IR) images, offer a promising approach to detecting oil spills with greater accuracy and efficiency.

Once the training is done, the trained CNN can be deployed while using an interference device. Interference devices are low cost, low power computers, and are highly optimized for parallel GPU computations, ideal for CNNs. These devices make it possible to segment the images in real-time.

Methodology:

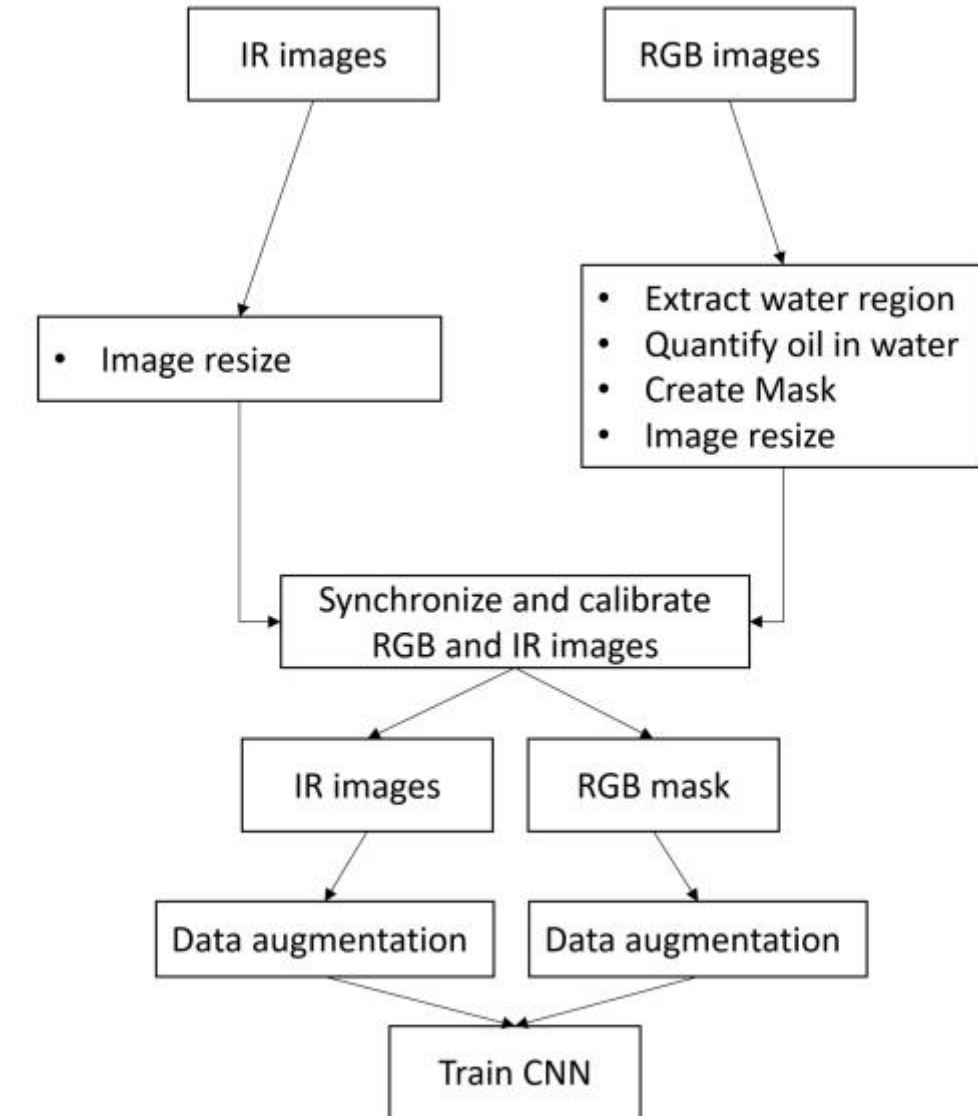


Figure: Flow chart of the training process

Original Image



Figure: Raw RGB image

Water Mask + Dilate + Extract Area

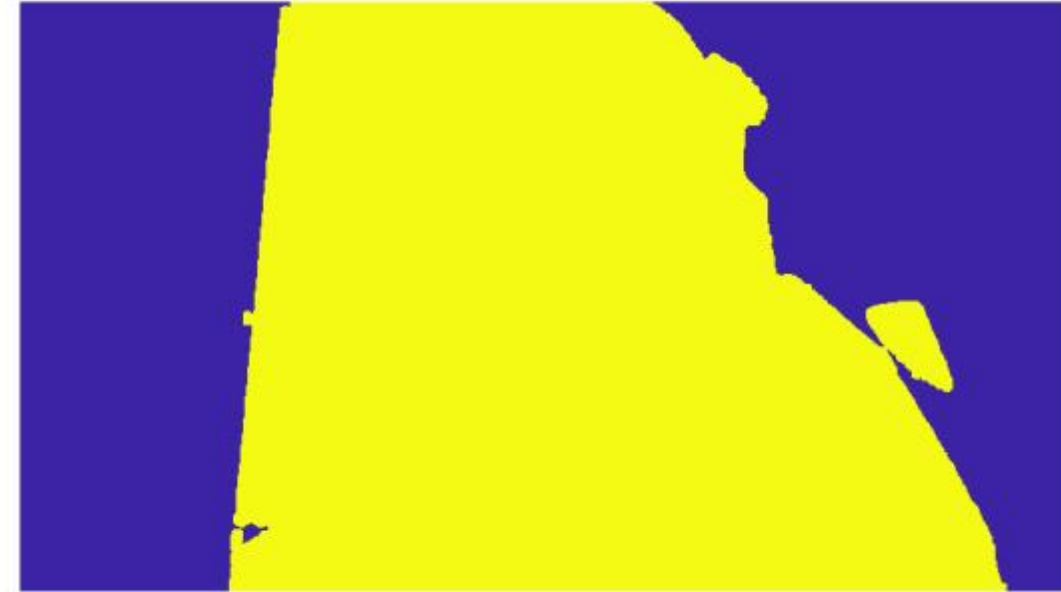


Figure: RGB image with the entire water/oil region extracted

Oil Mask Binary

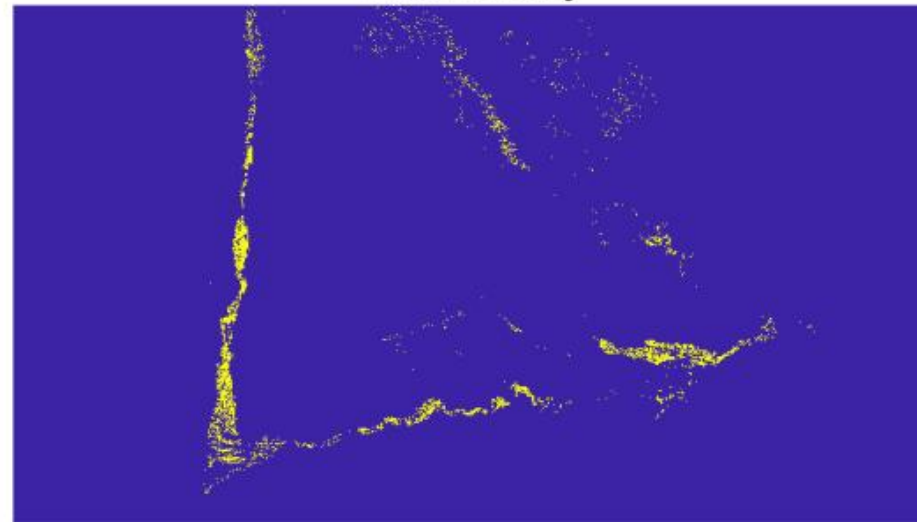


Figure: Oil extracted from above image

Environmental Monitoring and Climate Change Studies

1

Satellite Data Collection

Remote sensing satellites capture a wealth of data on environmental conditions, from greenhouse gas levels to deforestation patterns, enabling comprehensive monitoring of our planet.

2

AI-Powered Analysis

Machine learning algorithms can rapidly process satellite imagery and sensor data, identifying trends, anomalies, and insights that inform climate change models and environmental policies.

3

Global Collaboration

Satellite data and AI tools enable global cooperation on environmental issues, as researchers and policymakers share knowledge and coordinate responses to shared challenges.



Conclusion and Future Outlook

Satellite technology combined with machine learning has revolutionized remote sensing applications.

ML algorithms have enabled efficient analysis of vast and complex remote sensing data. Applications such as precipitation prediction, vegetation classification, mineral exploration, and oil spill detection have greatly benefited from ML.

The integration of ML with remote sensing enhances the capabilities of satellites for various purposes.

Continued advancements in machine learning and remote sensing promise further innovation and improvement in environmental monitoring, resource management, and disaster mitigation.

This comprehensive overview highlights the transformative impact of machine learning on remote sensing and underscores its importance in addressing critical challenges facing our planet.

