AI/ML BASED MAPPING OF PLANETARY MORPHOLOGY

Exploring advanced techniques for analyzing planetary surface features using AI and ML.

INTRODUCTION

Identifying Diverse planetary objects for Various Applications

1

Project AIM

To develop an AI/ML-based system that accurately identifies and analyzes planetary objects in the universe.

2

Importance of Project

This project is significant for advancing space research, as it provides tools to explore planetary surfaces remotely, reducing the need for physical exploration and paving the way for automated planetary studies.

3

Impact of Project

The Project assist space agencies in planning exploration missions, facilitate real-time monitoring of planetary changes, and inspire further advancements in astronomical AI applications.

CHALLENGES

Identifying and addressing key issues in planetary morphology mapping

1. **Identifying key challenges**

   Understanding the complexities involved in mapping diverse planetary objects.

2. **High Resolution Data Requirements**

   Ensuring data quality and preprocessing accuracy for reliable detection results.

3. **Processing Speed**

   Handling large datasets efficiently to avoid slow processing times and ensure the system crashes.

4. **Ensuring robust results**

   Interpreting and visualizing results clearly for meaningful analysis.

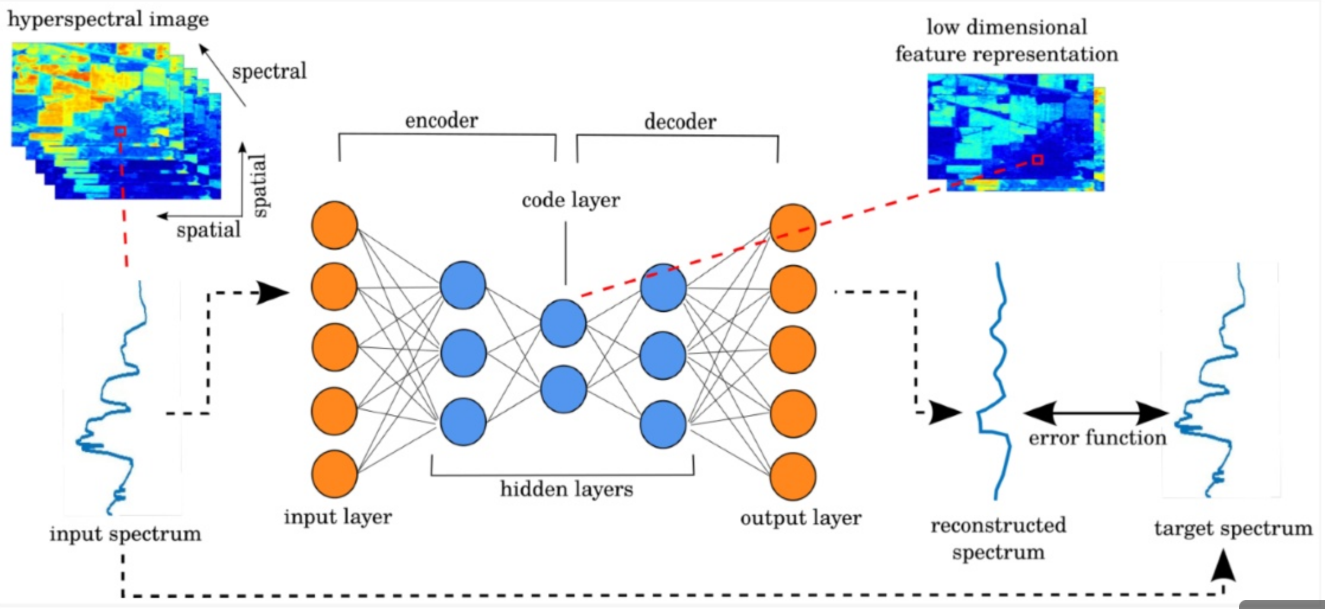
REQUIREMENTS

Essential tools and resources for effective mapping techniques

Data Requirements	Hardware Requirements	Software Requirements
High-resolution satellite imagery, multispectral data.	Processor: 6-core or higher (e.g., Intel i7/Ryzen 7 or better) RAM: 16 GB or more GPU:(NVIDIA Tesla V100 better for deep learning)	TensorFlow, Colab Jupyter Notebook, python, keras, matplotlib other tools

CNN MODEL ARCHITECTURE

Overview of AI/ML techniques (e.g., CNNs, U-Net) applied for mapping.



YOLO MODEL ARCHITECTURE

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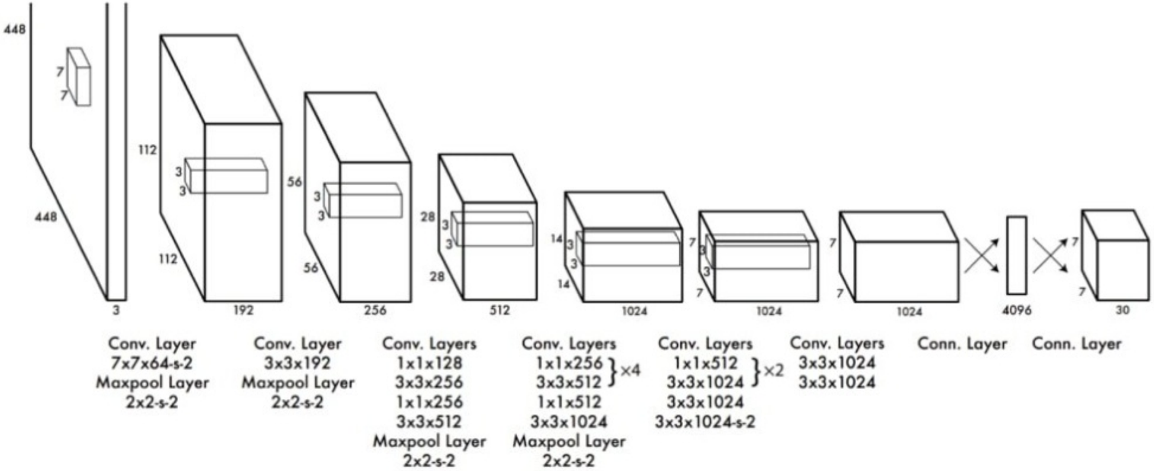


The Architecture. Our detection network has 24 convolutional layers followed by 2 fully connected layers. Alternating 1×1 convolutional layers reduce the features space from preceding layers. We pretrain the convolutional layers on the ImageNet classification task at half the resolution (224×224 input image) and then double the resolution for detection.

METHODOLOGY

1 2 3 4

Data Collection

Gathering relevant datasets from various sources to form the foundation for model training.

Data Preprocessing

Cleaning and transforming raw data into a suitable format for analysis, enhancing model performance.

Model Training

Applying algorithms to the preprocessed data to train the AI/ML model, learning from the patterns within the data.

Model Validation

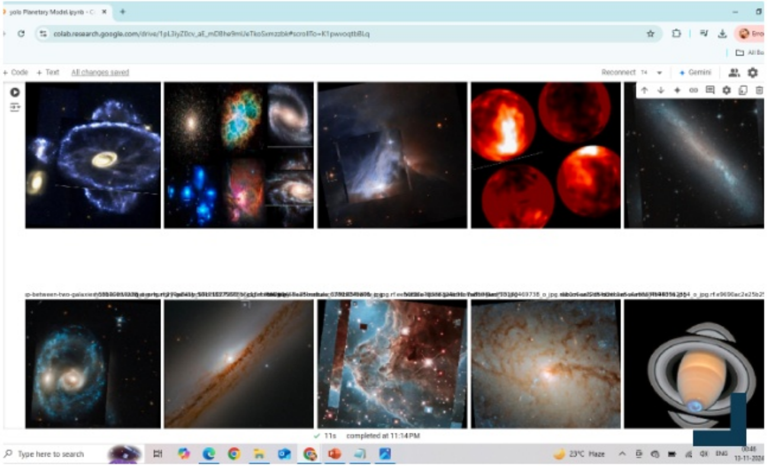
Evaluating the trained model using validation datasets to assess its performance and generalizability.

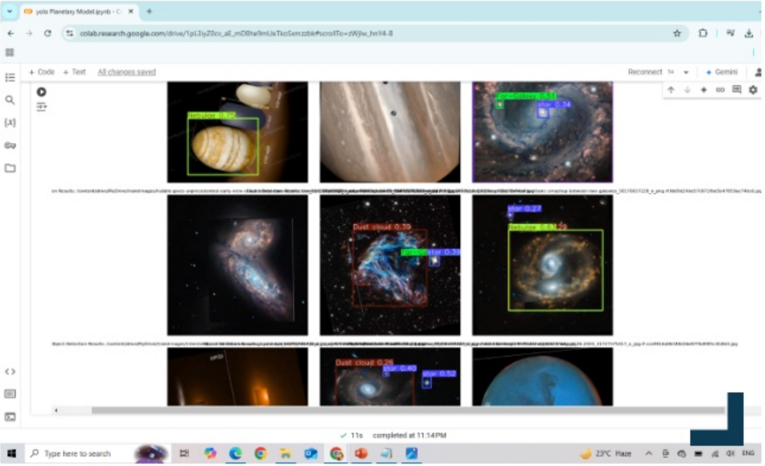
DIFFERENCE BETWEEN CNN AND YOLO

	CNN	YOLO
Basic Concept	Multi-stage detection with separate proposal.	Single-stage detection in one forward pass.
Speed	Slower, less suited for real-time use.	Very fast, ideal for real-time applications.
Detection Process	Region proposals followed by classification.	Directly predicts bounding boxes and classes per grid cell.
Emerging Use	Static image analysis, segmentation, and complex object detection.	Text to formula, data wrangling, synthetic data

RESULTS AND ANALYSIS

Effectiveness of AI/ML Models in Terrain Mapping





Output Images

Description of a primary heading

Input Images

Description of a primary heading

CONCLUSION AND FUTURE DIRECTIONS

Exploring the Potential of AI/ML in Planetary Morphology Mapping

Integration of AI/ML Techniques

Leveraging advanced AI/ML methods enhances the accuracy of planetary morphology mapping.

Real-time Data Processing

Implementing AI/ML allows for real-time processing of data from planetary missions, improving responsiveness.

Future Research Opportunities

Identifying further areas for research can lead to significant discoveries in planetary science.

Interdisciplinary Collaboration

Collaboration between different scientific disciplines will foster innovation in planetary mapping.

Improvement in Data Analysis

AI/ML can streamline data analysis processes, enabling quicker interpretations of geological features.