INDIA INTERNATIONAL SCIENCE FESTIVAL 2023

SCIENCE AND TECHNOLOGY PUBLIC OUTREACH IN AMRIT KAAL

SPACE HACKATHON

H2S HACK2SKILL

Team Name: Team Neuronaventador

Name of College/University: Karunya Institute of Technology And Sciences (Deemed to be University)

Problem Statement: Feature Extraction from RS HR data using AIML

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PROBLEM STATEMENT

Explain your understanding on Problem Statement:

Our project aims to extract distinct features like Farm Pond, Check Dam, etc., from high-resolution satellite data, leveraging AI/ML techniques. The objective is a multi-label classification model capable of confidently identifying multiple features in a scene and providing accurate bounding boxes/masks. Utilizing Bhuvan data , and open source resources we manually label it to train the model, ensuring precise feature recognition.

Brief Idea Of The Project:

- Our project aims to develop a robust system using AI and machine learning to accurately identify landscape features in high-resolution satellite imagery.
- We focus on creating labeled datasets, training a classification model, and implementing automated identification for efficient analysis.
- The system includes a user-friendly interface allowing easy upload of TIFF files.
- The website processes uploaded images and returns fully labeled images, enhancing user accessibility and expediting feature identification.

Novelties:

- Extracting vegetation indices as an indicator for ecosystem health.
- Dynamic dashboard for insights discovery.
- Automated Reporting: Implement automated reporting functionalities that generate regular reports summarizing ecosystem health trends,
- During floods and emergencies, real-time satellite AI identifies critical infrastructure like dams and treatment plants, enabling swift and targeted disaster response.

Detailed Proposal:

Impact: Revolutionize agriculture, infrastructure, urban planning.

Challenges: Balancing accuracy and real-time efficiency, potentially requiring further optimization for specific aerial imagery tasks.

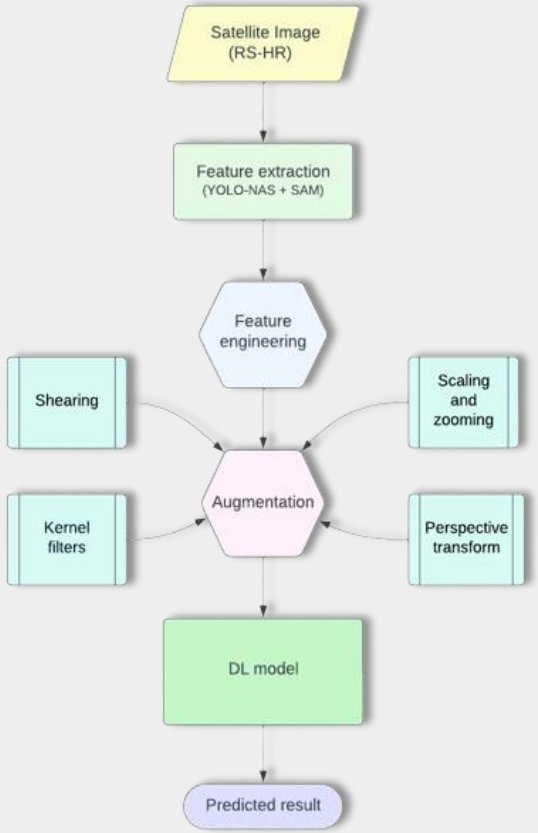
Approach: Leveraging YOLO-NAS's neural architecture search to automatically design an efficient and accurate object detection model.

Data: High-resolution Sentinel-2, EuroSAT, Google Earth, Bhuvan Portal imagery, prepped for quality.

Model: YOLO-NAS architecture fine-tuned specifically for the target objects and tasks in aerial imagery.

Output: Precise bounding boxes and labels with color coding for clear visualization and analysis.

Improvement: Continuous analysis & refinement for optimal accuracy.



Solution Approach:

- ❑ **Dataset Annotation:** Detect & localize farm ponds, check dams, etc. from satellite imagery.
- ❑ **Feature engineering:** Convert TIFs to images, manually label features, split into training/validation/test sets. While training the model, leverage GDAL for geospatial data processing and QGIS for interactive visualization and feature labeling.
- ❑ **Train the model:** Utilize YOLO-NAS for multi-label classification with high-resolution imagery**.**
- ❑ **Evaluate & compare:** Measure performance with IoU, MAP, F1 scores, and consider class weightages**.**
- ❑ **Optimize & improve:** Increase labeled data, fine-tune hyperparameters, explore model ensembles**.**
- ❑ **Deploy & present:** Develop a web portal for user interaction, visualize predictions, and integrate with existing tools.

Advantages of YOLO-NAS MODEL In this work:

- ❑ Improved **accuracy** and **efficiency**.
- ❑ Customization for **diverse features.**
- ❑ **Scalability** and generalization.

Tools and Devices used:

- **Software**: PyTorch, Torch Vision, Super Gradients, GDAL, Docker, Neptune.
- **Hardware:** NVIDIA GeForce RTX 3050 GPU processor.
- **Project workspace:** VSCode, Anaconda, Jupyter Notebooks.
- **Version Control:** Github, CI/CD.
- **AnnotationTool:**Roboflow,labelbox.

Technologies Used:

- **Remote Sensing Technologies** Satellite Imagery and GIS Tools QGIS,GDAL.
- **ML & AI Technologies:** YOLO-NAS Model.
- **User Interface Technologies:** Flask, React Js, Tailwind CSS

References:

- Multi-Scale Object Detection in Aerial Images https://arxiv.org/abs/2102.12219
- Sentinel-2 Image Classification for Land Cover and Land Use Mapping https://arxiv.org/abs/1508.00092

Preliminary Results on Trained Model

Classes Trained

Farm Land
Forest
River

Results

mAP	Precision	Recall	F1-score
98.1%	96.6%	94.4%	95.1%