SMART INDIA HACKATHON 2024

- **Problem Statement ID – 1732**
- **Problem Statement Title- Enhancement of Permanently Shadowed Regions (PSR) of Lunar Craters Captured by OHRC of Chandrayaan-2**
- **Theme- Space Technology**
- **PS Category- Software**
- **Team ID- MITADTSW343**
- **Team Name- Hunters of Artemis**

Hunters of Artemis

Lunar Shade: Enhanced PSR Mapping using 3D map of Moon Craters

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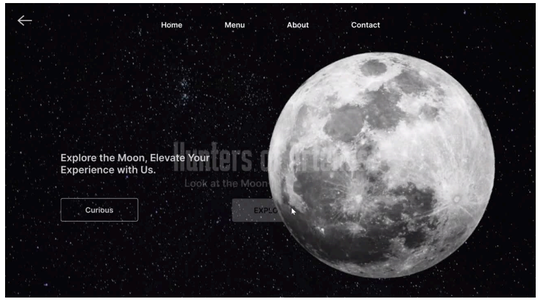
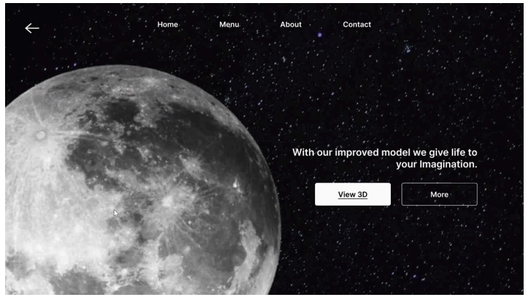
Web Application UI



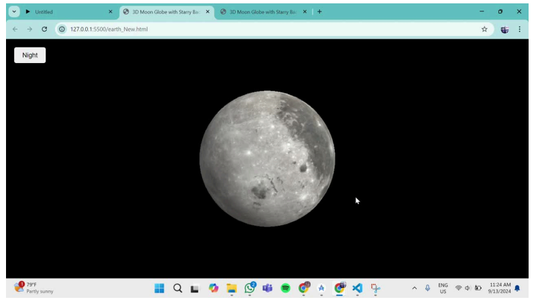
Landing Page

Introduces and guides users through key content.



Tutorial

Guides users on **viewing 3D** enhanced moon models and comparing versions.



Lunar Features

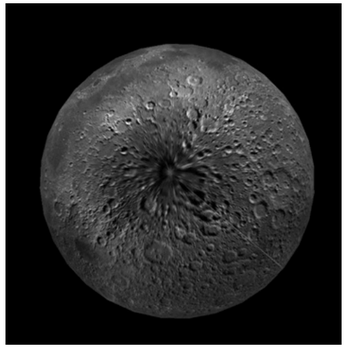
Discusses craters, showcases images, and highlights **nearby craters.**

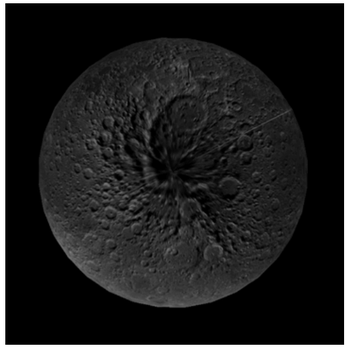
Crater Overview

Presents enhanced and unenhanced crater images with **detailed information and location.**

LINK TO VIDEO

3D Enhanced Model Images



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TECHNICAL APPROACH

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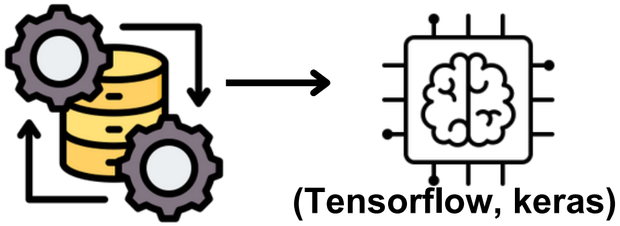
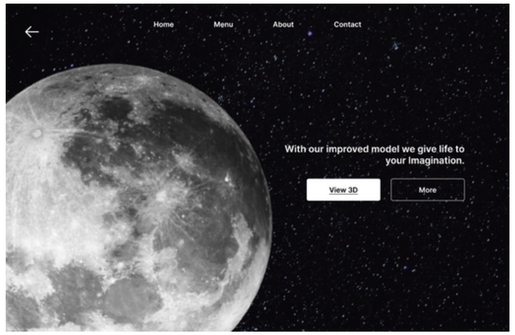
(Unstitched Dataset)
128 X 128px

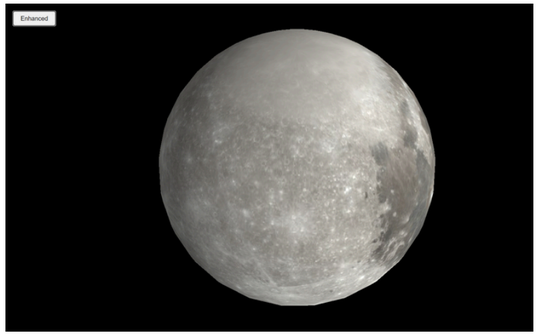


(Tensorflow, keras)

Uses a toggle switch for API calls to send lunar images. The UNET-like CNN enhances dark images using night (X: input) and day (Y: output) data.

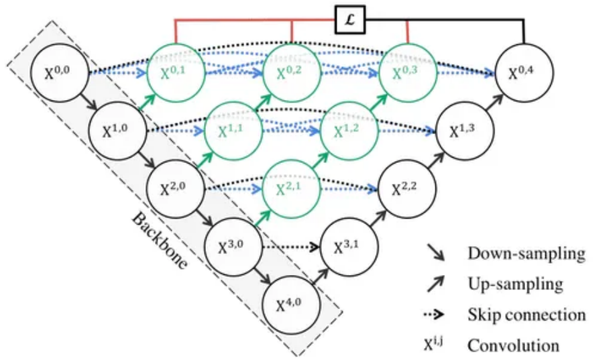


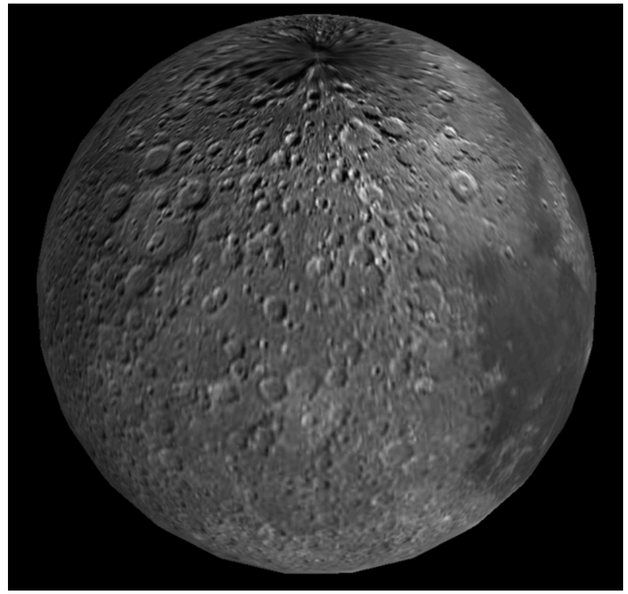
Interface-
React for frontend
Python **fast-API** for backend
Model exported in **".keras"**
(update for **.H5**)



3D model of moon-
WebGL Renderer used for transforming 2D map into 3D map.

Our deep learning model is trained on-night(X: input) and day(Y: Output) images the **UNET-like CNN** based model learns to enhance the dark images





(Enhanced Image)

Enhanced image generated with 82% training accuracy and 89% validation accuracy; model can be fine-tuned on updated lunar surface images.

Status: Prototype ready; model can be **continuously updated and trained** on new lunar surface datasets (TensorFlow, Keras).

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FEASIBILITY AND VIABILITY

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Feasibility

1. **Current Technology**
   - Image processing, deep learning (CNN), Python, OpenCV, Scikit-learn.
2. **Hardware Requirements**
   - High-end GPUs, large datasets, complex calculations, specialized computing resources, partnerships with space agencies, cloud providers.
3. **Adaptability to Lunar Conditions:**
   - Low-light environments
   - Unique surface textures
4. **Long-Term Benefits:**
   - **Potential discovery of resources** (water, ice) in Permanently Shadowed Regions (PSRs).
   - **Economic and scientific advantages** justify investment in AI-driven solutions for future missions.

Challenges

1. **Dataset Limitations:**
   - NASA datasets may be outdated.
   - Users (landing site selectors) may need more current data.
2. **Technical Demands:**
   - High-end hardware is necessary for effective model training.

Overcoming Challenges

1. **Dataset**: Extensive lunar region images unstitched from high-resolution image of lunar surface [NASA].
2. Update datasets through collaborations and new data sources.
3. Utilize partnerships for hardware access and technical support.

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IMPACT AND BENEFITS

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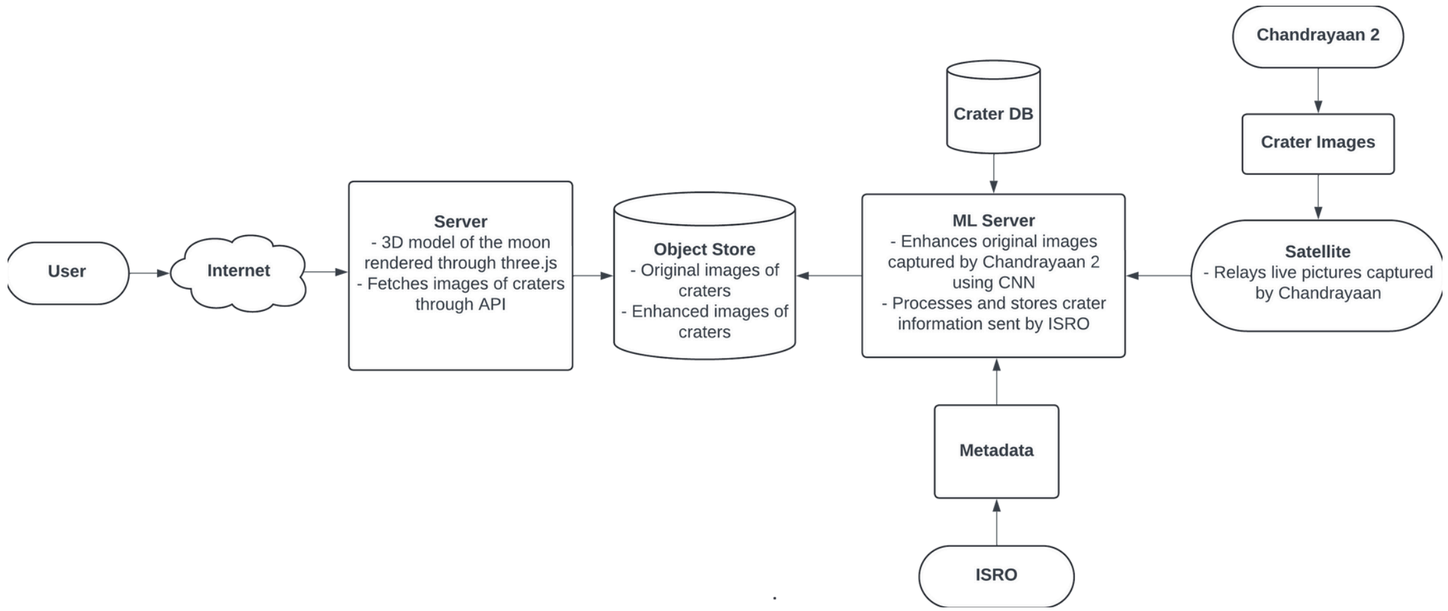
DL's Impact on PSR Enhancement

- **Potential Impact on Target Audience:**
- **Lunar Landing Site Selection:** Accurate PSR data enhances decision-making for safe, resource-rich landing zones.
- **Geomorphological Analysis:** Improved study of lunar craters and terrain in low-light regions.
- **Lunar Resource Mapping:** Identifies water-ice deposits in PSRs, supporting in-situ resource utilization (ISRU).
- **Scientific Community:** Offers new insights into lunar PSR regions, advancing planetary science research.



ML-Driven Benefits

1. **Cost-Effective Exploration:**
   - Deep learning analyzes PSR data for targeted missions, reducing unnecessary exploration and lowering costs.
2. **Automated Hazard Detection:**
   - Identifies hazards (boulders, crevices) for safe landing site planning.
3. **Resource Detection:**
   - Deep learning models detect valuable materials (e.g., water ice) in PSRs.
4. **Flexible Adaptation:**
   - Methods can be adapted for future missions on other celestial bodies, like Mars.
5. **Transfer Learning:**
   - Leverage existing models trained on Mars surface data to enhance analysis of PSRs, improving efficiency and accuracy.

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RESEARCH AND REFERENCES

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