



MoonTrek Augmented Reality

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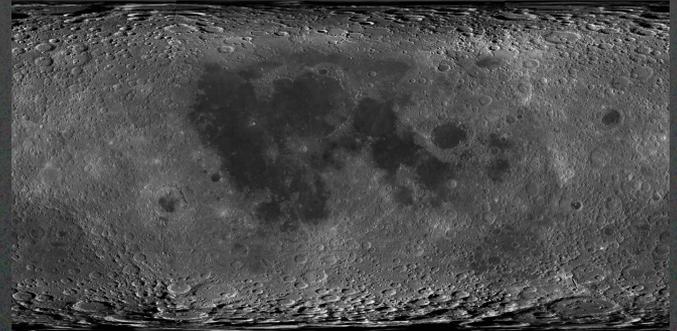
01

PURPOSE

Project Objective and Prior Contribution

Project Background

- NASA MoonTrek Website
 - Showcases different aspects of the moon
 - Hundreds of lunar data products
 - Analysis Tools for experimentation
- Collaboration with JPL
 - Project Sponsors



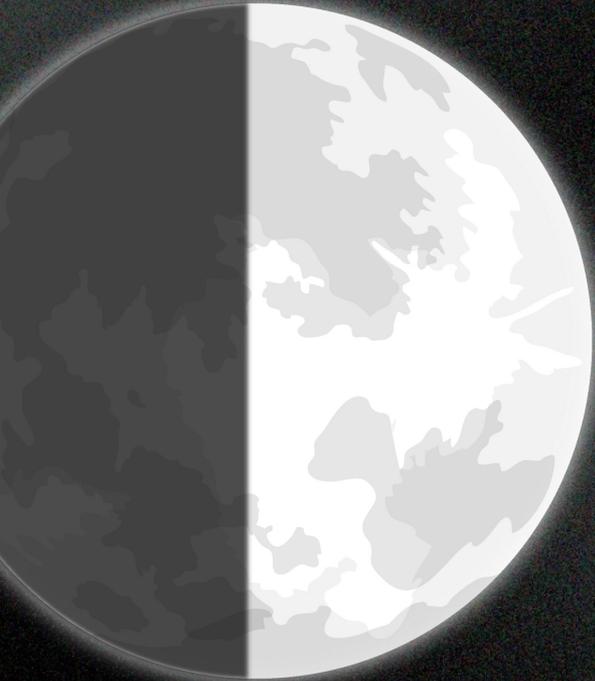
MoonTrek Showcase



Objective

- Augmented Reality port
 - Bridges user image to MoonTrek
 - Accessible lunar data
- Generate 3D Model from user's image
 - Develop new features
 - Enhance current ones





PAST WORK



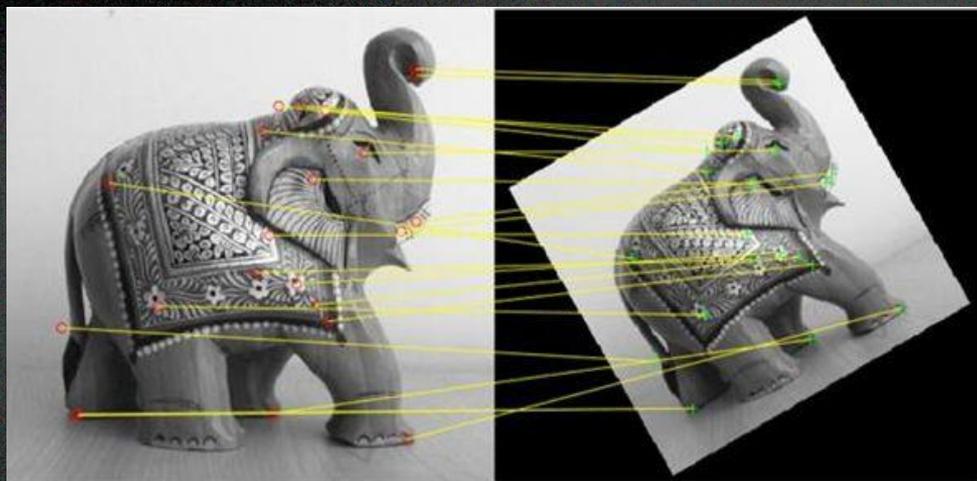
Three Body Solution



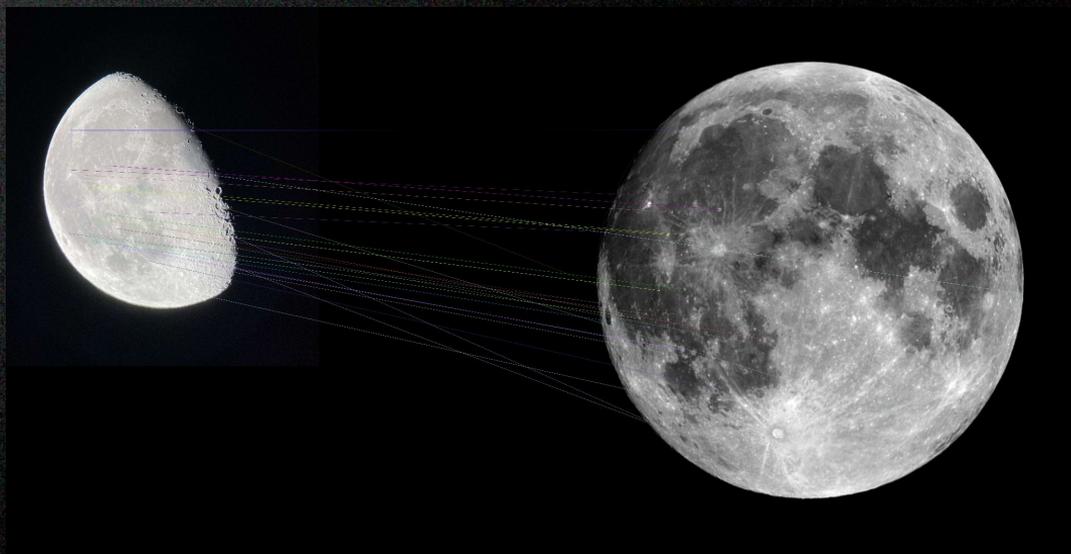


IMAGE REGISTRATION

- One Coordinate System
- Key Features
- Transformation Matrix
- Align Images



Non-Context Aware Image Registration



Registration Matches



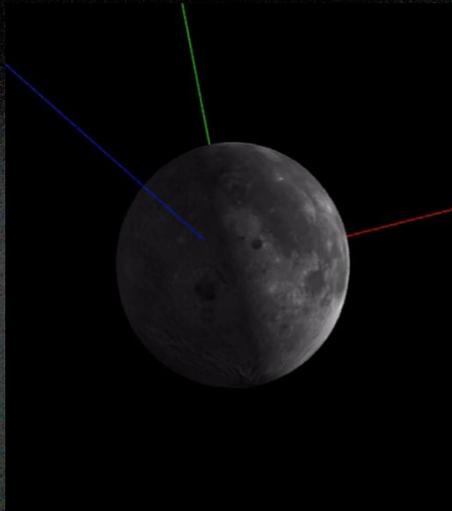
Transformed User Image



Overlay with Non-Context Aware Image Registration



3D Model



```
{
  "status": "Successfully retrieved positions",
  "person": {
    "x": -2.4796454580425302,
    "y": 3.5625951328989993,
    "z": 4.663517400397262
  },
  "sun": {
    "x": 46548.461307995194,
    "y": -54103.29850389757,
    "z": 129134.68200261264
  },
  "moon": {
    "x": -264.5967431225511,
    "y": 184.462926513140664,
    "z": -219.98498034882583,
    "libration": {
      "lon": 4.863,
      "lat": -6.3647
    }
  },
  "points": {
    "nearest": {
      "x": 1.7241294218539243,
      "y": -0.175338066418318452,
      "z": -0.12436114334194903
    },
    "copernicus": {
      "x": 1.6088481631125429,
      "y": 0.29834272145238166,
      "z": 0.5881181284918254
    },
    "tycho": {
      "x": 1.2402844450627017,
      "y": -1.19155885124719,
      "z": 0.24603289868849157
    },
    "crisium": {
      "x": 0.8533235388148849,
      "y": 0.5080160146500774,
      "z": -1.4257996867827363
    }
  }
}
```

JPL API





Generated Context-Aware Reference Image

User Image



Reference Image

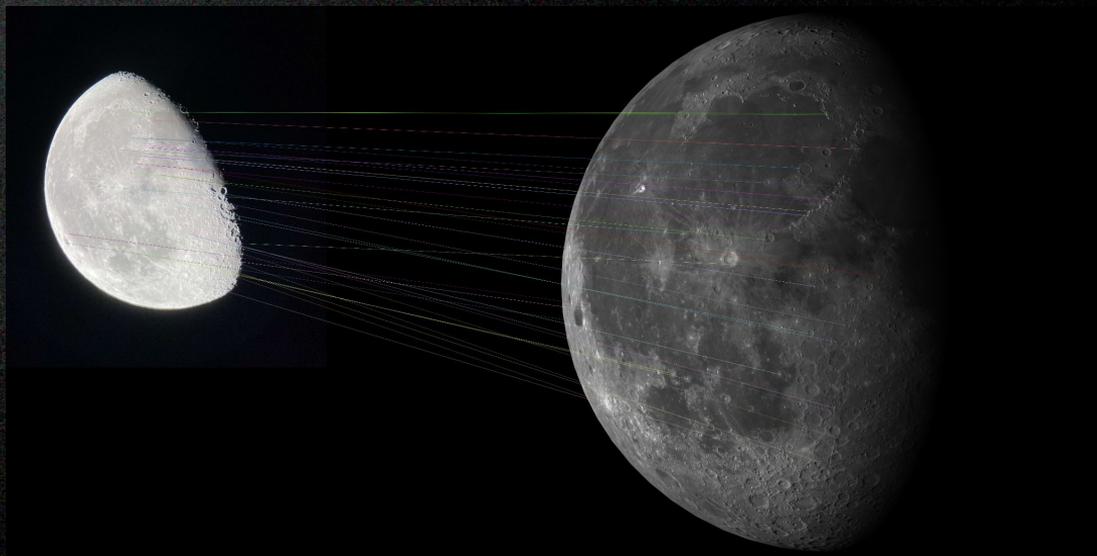


Meta Data

(Time Stamp & Location)



Context Aware Image Registration



Registration Matches



Transformed User Image





Overlay with Context Aware Image Registration





02

Semester Progress

Observe the Moon Night, Front-End, Back-End

Developing AR Apps is Difficult



Developing AR Apps is Difficult



Your Moon

Upload Your Moon Image

image.png Upload

Latitude:

34

Longitude:

-118

Date:

08 / 29 / 2023

Time:

09 : 32 PM



Front End Progress: Landing Page



YourMoon

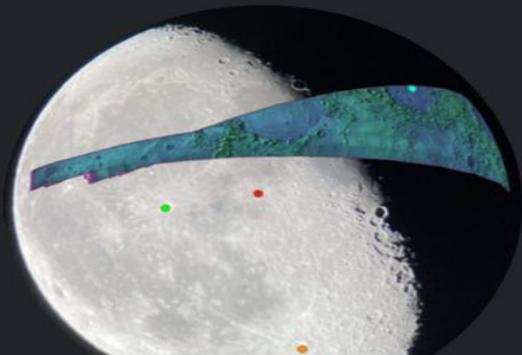
[Home](#) [Upload](#) [Contact](#)

Welcome

Welcome to YourMoon, a web application inviting users to submit images of their Moon. Explore your lunar captures with labels from NASA JPL's MoonTrek, aiding the 'MoonTrek AR' team in gathering data.

What is YourMoon?

YourMoon is a vital component of an ongoing Capstone Senior Design project, a collaborative effort between NASA's JPL and California State University, Los Angeles (CSULA). The primary objective is to create a user-friendly interface for [Moon Trek](#), a powerful NASA tool empowering users to delve into the mysteries of the lunar by offering user-friendly tools that simplify browsing, data layering, and detailed feature searches. YourMoon invites users to contribute their Moon images and utilize NASA JPL's MoonTrek data, aiding the 'MoonTrek AR' team in their data collection endeavors. The metadata provided by users is kept anonymous and used strictly for research purposes.



UPLOAD YOUR MOON

For enhanced security measures, we kindly ask you to log in using your preferred email address. This ensures a secure interaction for both you and our system. Thank you.

[Sign in with Email](#)

MOONTREK AR TEAM

MoonTrek AR aims to advance lunar education and exploration using augment reality (AR).

[Read More](#)

Upload Page

Upload and crop your image.

Choose File



Country Code

Nearest City

Altitude

Date

Time

Instrument Make

Instrument Model

Upload

Upload and crop your image.

Choose File



Country Code

Altitude

Nearest City

Date

Time

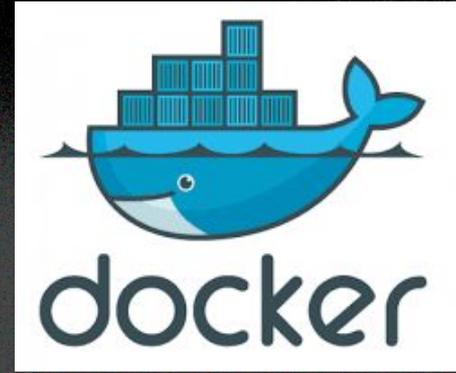
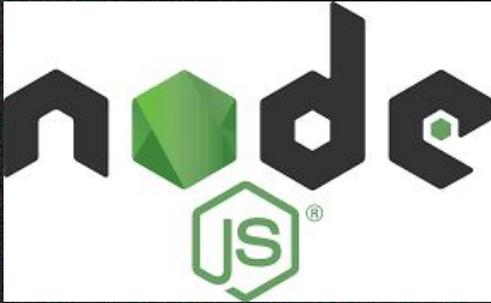
Instrument Make

Instrument Model

Upload



Backend



Cybersecurity measures

- Users' emails are encrypted with AES before stored in database.
- Coordinates of nearest city/town is stored rather than exact coords of where photo was taken
- Users' emails are not associated with images they upload



Deployment





04

Future Work

What we will be looking at next Semester

MoonRegistration Library

- A C++ library for
 - Using user uploaded images
 - Moon Location Detection
 - Moon Image Registration
- In Progress
- Inherit from previous team
- Python script → Proper library
- Improve accuracy & Optimization



MoonRegistration Library Current State

- Has Two Modules:
 - Moon Location Detection: done
 - Moon Image Registration: ready to work on
- Contains interfaces for C++, python, and javascript (WebAssembly)



MoonRegistration Library

Original



Old



New



MoonRegistration Library

Original



Old



New



MoonRegistration Library

Original



Old



New



MoonRegistration Library

- Enable us to run all those algorithms in different places
 - Your-Moon Frontend (already in use)
 - Moon-Trek Frontend (for registration)
 - Live Registration
 - Infinite Zoom
 - And more...





Full Implementation of Overlays

Simon Johansen

Full Implementation of Overlays

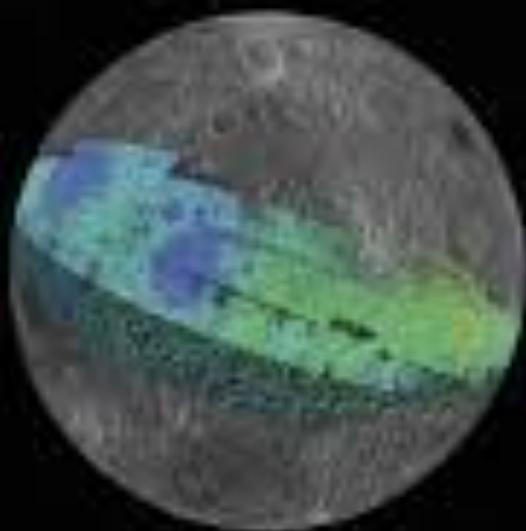


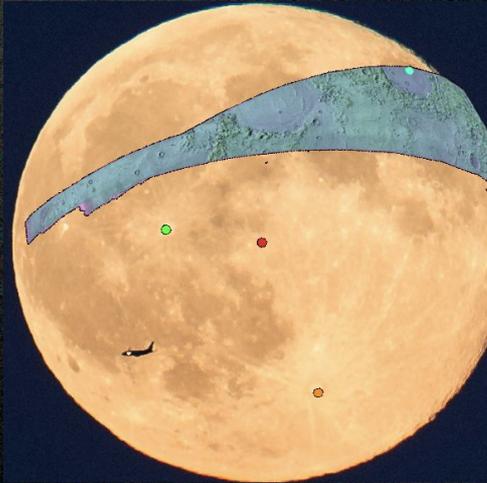
Image from NASA MoonTopo site with multiple layers added

What needs to be done?

- Build user friendly interface
- Frontend/Backend support
- Creative additions

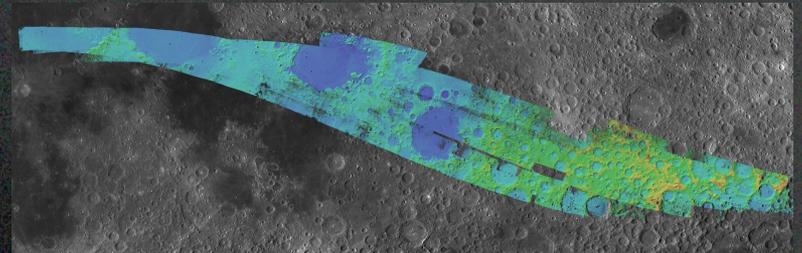
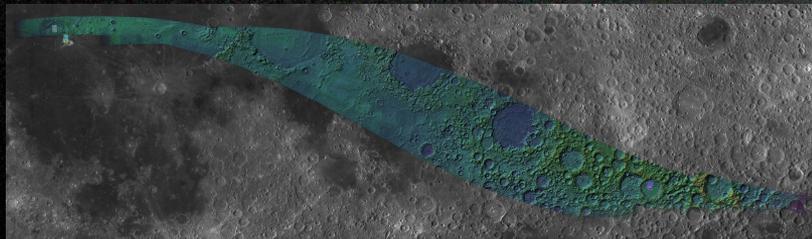
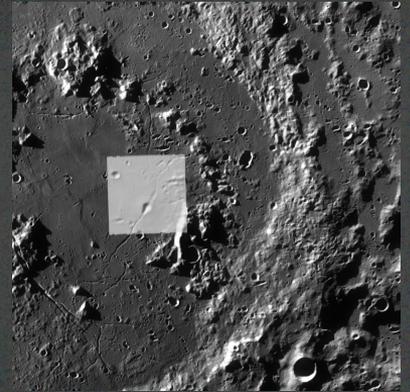


Full Implementation of Overlays

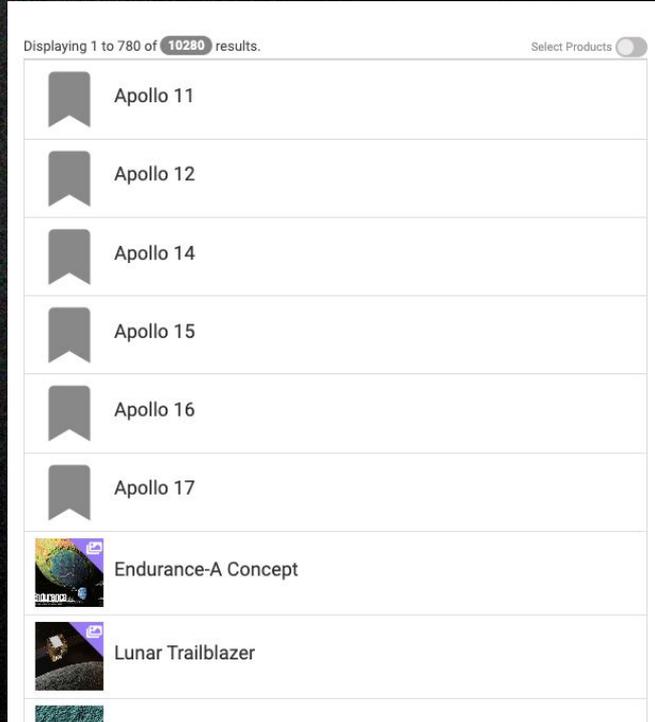


Expansion of the GUI

- Multiple layers or annotations
- Only one default layer, proof of concept
- New: entire selection of layers



Full Implementation of Overlays



A few of the selectable layers

Problems faced and solutions

- Source of the layers
 - Huge files, storage issues
- API
 - Provide more layers
 - Performance of the site
 - New: received a testing API

Full Implementation of Overlays

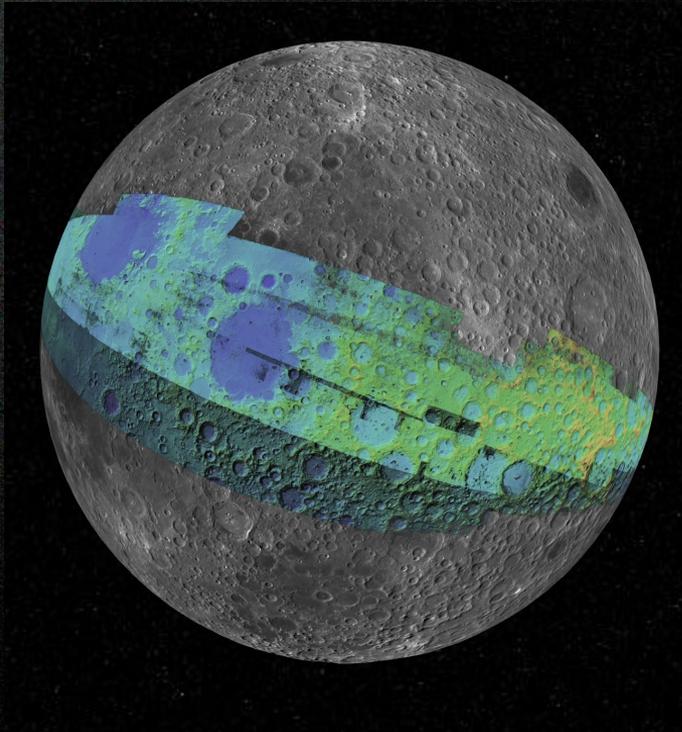


Image from NASA MoonTrek site with multiple layers added

What needs to be done?

- Build user friendly interface
- Frontend/Backend support
- Creative additions

A screenshot of a web interface for data search and filtering. The interface has a dark background with white text and elements. At the top, there are three tabs: "Search", "Layers", and "Downloads". Below the tabs is a search bar with a magnifying glass icon and the text "Search for...". Underneath the search bar are three filter tabs: "Spatial", "Metadata", and "Product Type", with a "Clear" button to the right. Below the filter tabs are three dropdown menus labeled "Category", "Sub Category", and "Category 3", each with "Any" selected. At the bottom of the interface, it says "Displaying 1 to 780 of 10280 results." and "Select Products" with a toggle switch.



Toggle Visibility **etric Cam DEM, ColorHillshade**

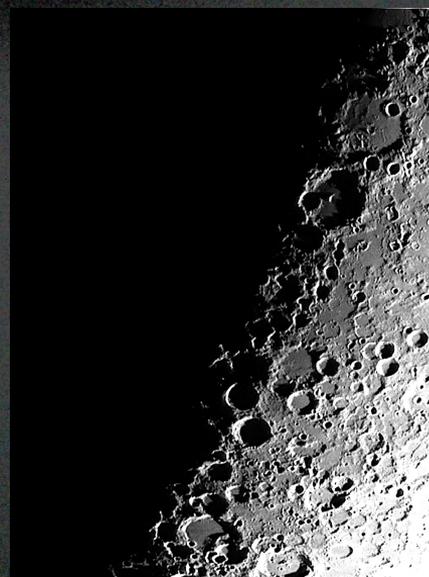
0% 50% 100%



Improve our 3D Context Aware Model



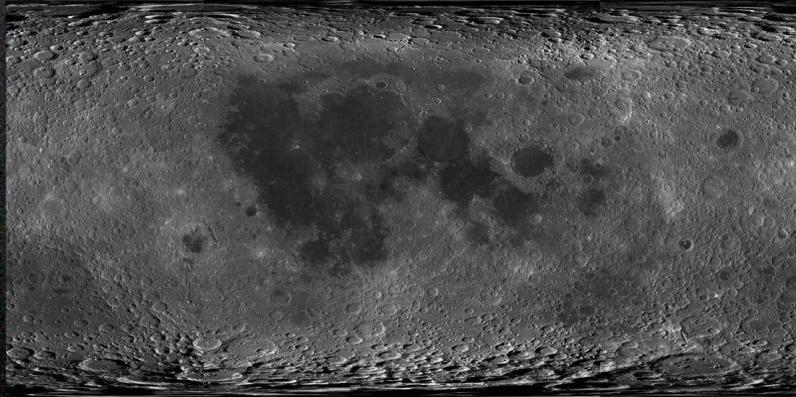
Model Moon



Goal Moon



Improve our 3D Context Aware Model



Current 2D Image



Projected Normal Mapping



Live Registration

- Running Moon image registration algorithm on live
- Running on
 - Static Video feed
 - Camera video feed
 - And more...

Moon-Trek
+
Video



Live Registration

A proof-of-concept demo →

- Running Moon Location Detection
 - First step of Moon Image Registration
- Can be change to full registration algorithm in the future



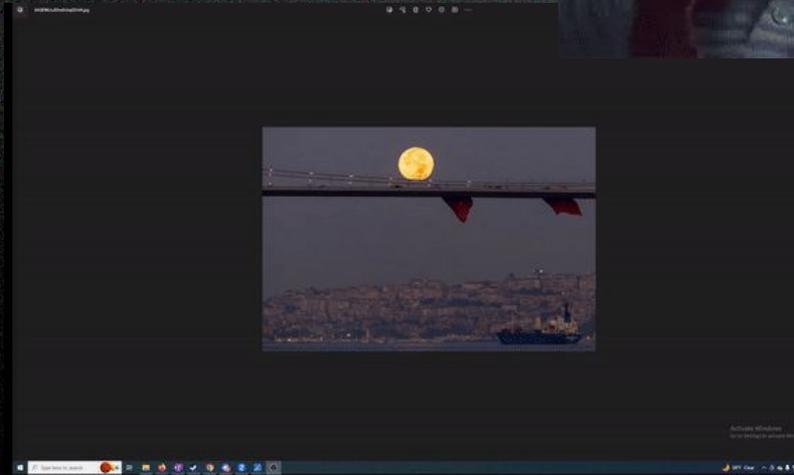
[Watch On YouTube](#)



Live Registration



Infinite Zoom

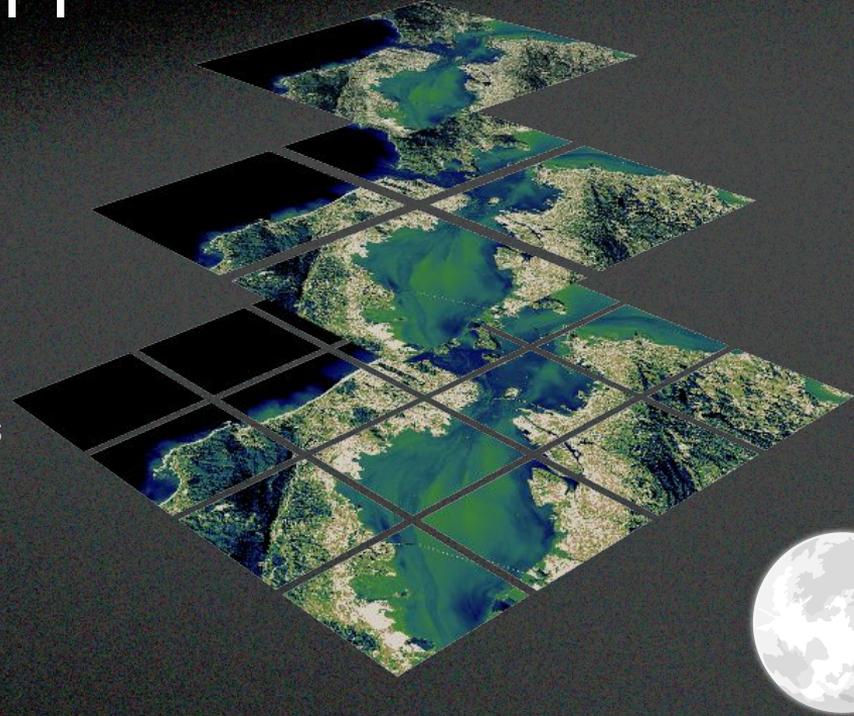


Infinite Zoom with Cloud Optimized GeoTIFF

Plan to implement this feature using cloud optimized GeoTIFFs

GeoTIFF is a bitmap raster file with embedded georeferencing

COG breaks down the tiling into smaller blocks
Uses HTTP GET requests to narrow down the areas to display



CALIFORNIA STATE UNIVERSITY LOS ANGELES

OBSERVE THE MOON NIGHT

Saturday, October 21

6:30 PM - 10:30 PM

Telescope Platform at Rosser Hall

SCAN ME



RSVP: https://Moon_Night.eventbrite.com

Experience the magic of the moon at our 'Observe the Moon Night.'
Telescopes, lunar exploration, and family-friendly activities await you.



OtMN: Moon through the telescope







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