NASA INTERNATIONAL™ SPACE APPS CHALLENGE

NASA SPACE APPS
JAIPUR 2024

ExoVision

Team Details:

Team Name: ExoSkyFive

Team Leader Name : Ms. Kritika Agarwal

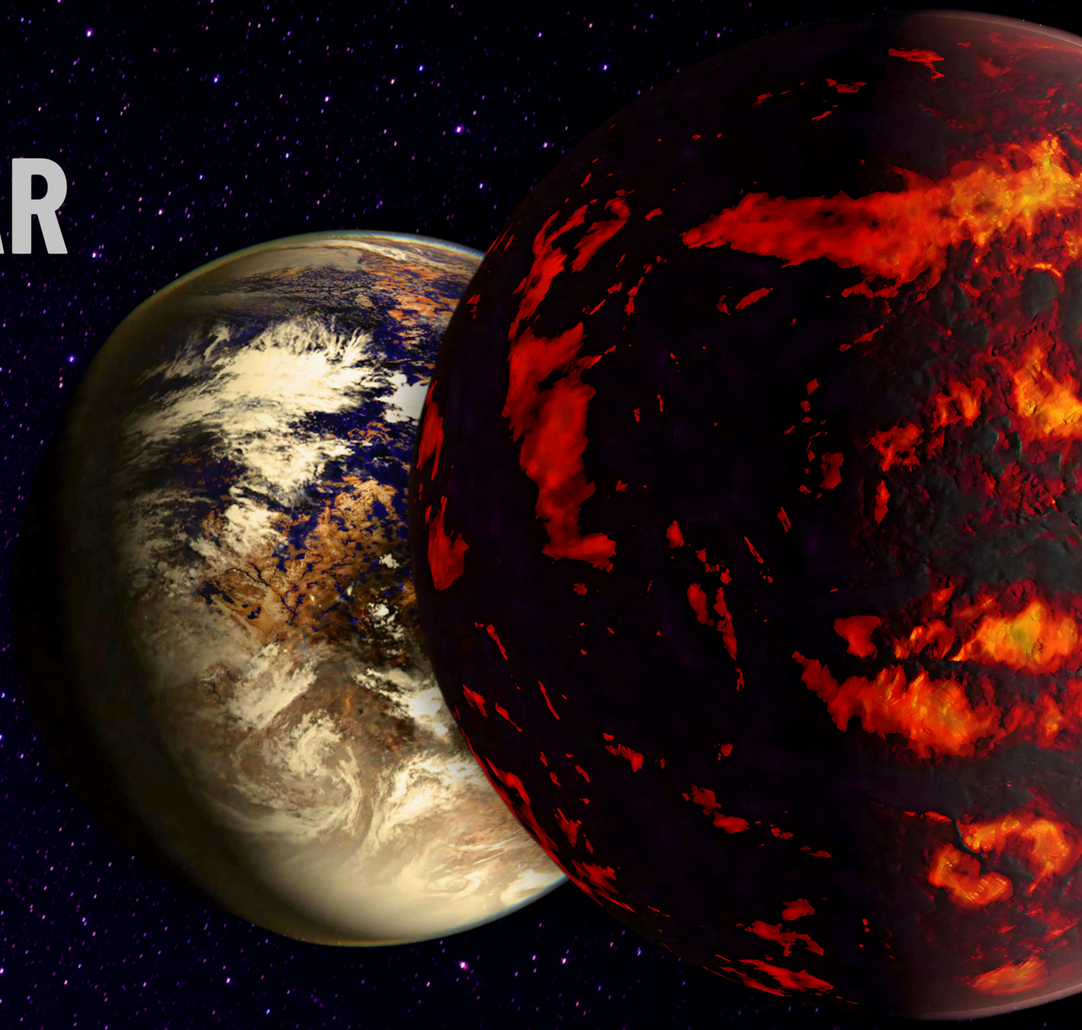
Problem Statement: Design and Development of an Exoplanet Star Visualization Website for Educational Use

NASA INTERNATIONAL SPACE APPS CHALLENGE™

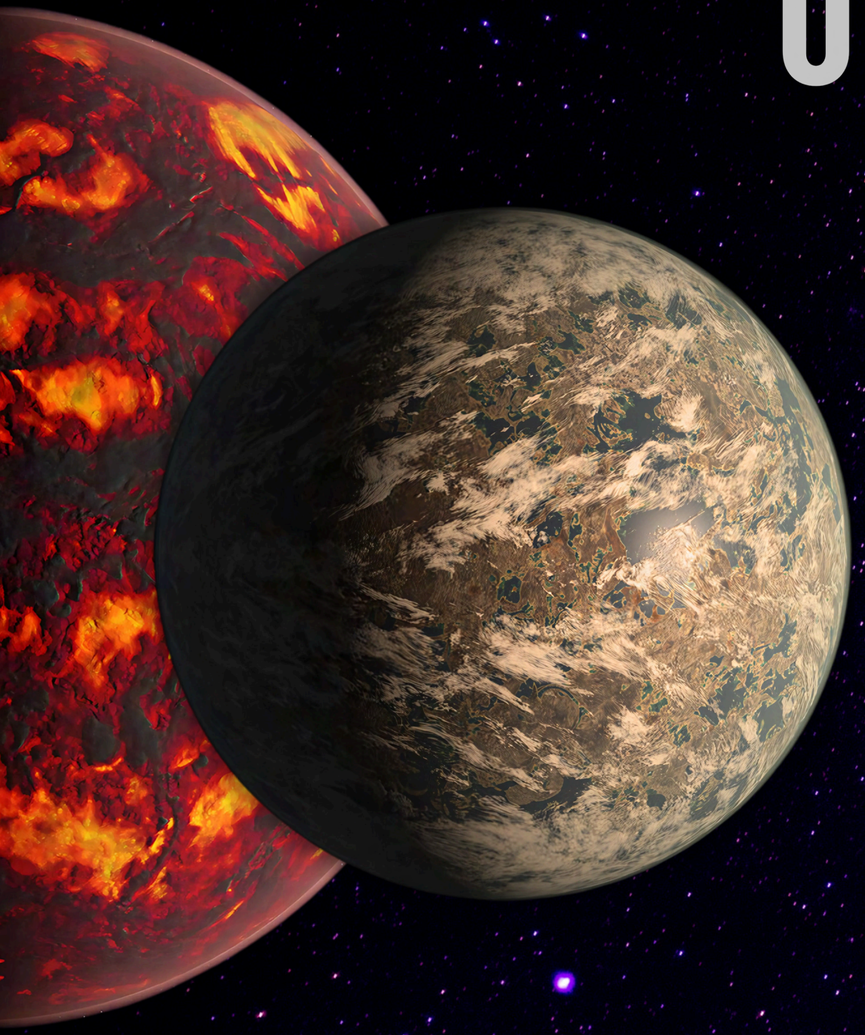
ExoVision

VISUALIZING EXOPLANET STAR MAPPING FOR STUDENTS

Our project aims to revolutionize the way students interact with astronomy by providing a unique, immersive experience of viewing the night sky from exoplanets.



UTILIZING NASA DATASETS



HIPPARCOS Star Catalog

Provides high-precision measurements of stars, including their positions, distances, and movements, essential for generating accurate point clouds from exoplanets.

Link: https://www.cosmos.esa.int/?project=HIPPARCOS

GAIA Star Mapping Mission

GAIA's star catalog provides the most detailed map of our galaxy, offering precise stellar positions and distances, crucial for creating realistic 3D star maps from exoplanet perspectives.

Link: https://science.nasa.gov/mission/gaia

Exoplanet Archive

NASA's Exoplanet Archive provides detailed information about known exoplanets and their host stars, helping us simulate accurate views of the night sky from those locations.

Link: https://exoplanetarchive.ipac.caltech.edu/

Transiting Exoplanet Survey Satellite

Offers data on thousands of exoplanets, allowing us to pinpoint their exact locations and generate the correct star fields visible from these planets.

Link: https://svs.gsfc.nasa.gov/13876/

OPPORTUNITIES & UNIQUE VALUE PROPORTION

Opportunities

- With the increasing popularity of space exploration and discoveries of new exoplanets, there is a rising demand for interactive educational tools that allow students to explore astronomy beyond Earth's perspective.
- The availability of NASA's datasets, such as GAIA and HIPPARCOS star catalogs, offers an incredible opportunity to create accurate, high-quality visualizations of the sky from exoplanets.
- The ability for students to create, trace, and name their own constellations promotes personalized and immersive learning experiences that encourage deeper engagement with the subject matter.

Uniqueness

- Allows users to explore the sky from the viewpoint of different exoplanets, offering a unique and educational experience that is unavailable elsewhere.
- Integrates real-time data from NASA's star catalogs with educational overlays such as star names, brightness, and galactic grids, offering a robust platform for both beginners and advanced astronomy students.
- Students can create their own constellations, personalize their sky map, and explore different layers of data, giving them a sense of ownership and deeper connection with the material.

HOW IT SOLVES THE PROBLEM

Exoplanet Selection

Students choose an exoplanet from a catalog, setting the stage for a unique perspective of the universe.

Educational Overlays

The app provides customizable data layers such as star names, brightness, and grids, enriching the educational experience.

Star Data Integration

The app uses NASA's star catalogs to gather accurate data on star positions and movements from exoplanet's viewpoint.

Interactive Exploration

Students can explore the sky interactively, zooming in, rotating, & tracing constellations to enhance their understanding.

3D Star Map Creation

A 3D point cloud map is generated, visualizing how the stars and constellations appear from the exoplanet.

DATA FLOW DIAGRAM

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ExoVision

1. Data Collection

Sources: NASA datasets (e.g., HIPPARCOS, GAIA, TESS)
Data Types: Star positions, distances, exoplanet details, and related astronomical information.

2. Data Processing

Data Integration: The system combines multiple datasets (star catalog and exoplanet data) to generate a 3D point cloud of stars from the exoplanet's perspective.

Data Analysis: Machine Learning/AI algorithms analyze and process the data to create accurate sky visualizations, constellations, and predict star movements over time.

3. Visualization and Insight Generation

3D Star Map Generation: The system creates a 3D map of the sky as viewed from the selected exoplanet, with real-time interaction.
Real-Time Analysis: The user receives real-time feedback when interacting with the star map, such as zooming in, tracing constellations, or exploring individual stars.

4. User Interaction

Web/Mobile Application: The interface allows users to select exoplanets, explore star maps, and customize the visualization with educational overlays.

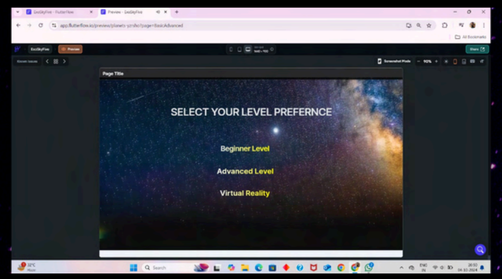
VR/AR Experience: For immersive exploration, the user can switch to VR or AR mode to interact with the exoplanet sky in a virtual environment.

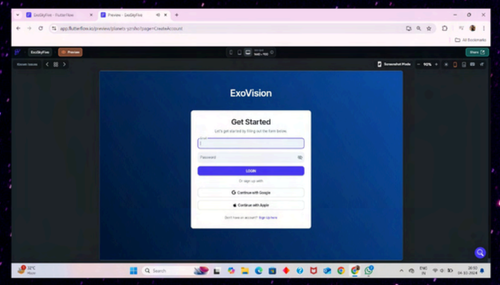
5. Feedback and Improvement

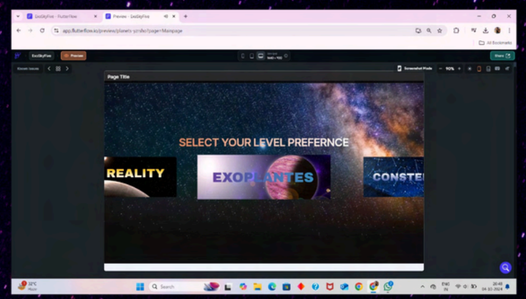
User Input: Users provide feedback on their experience, star map accuracy, or constellations created.
System Improvement: Incorporate feedback for continuous updates, accuracy improvements.

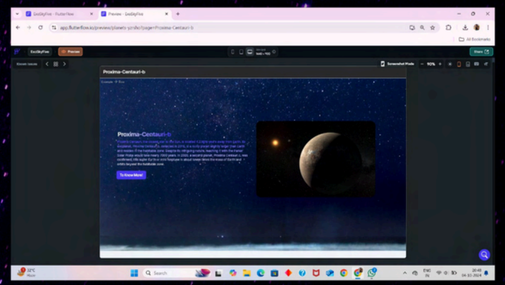
SNAPSHOTS OF PROTOYPE

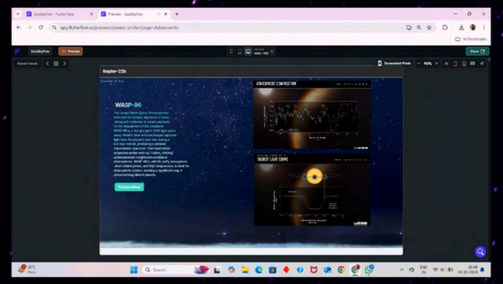
Premium Plan: $9/month or $99.99/year (Save 15%) !

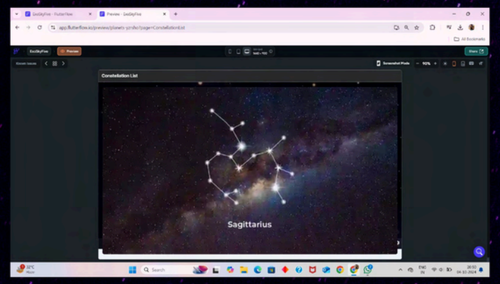


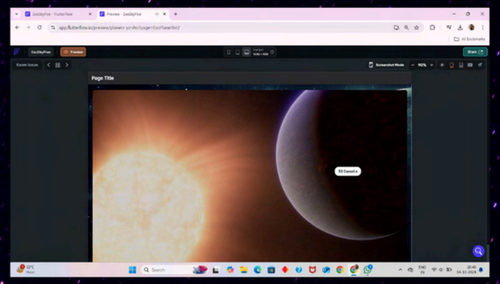


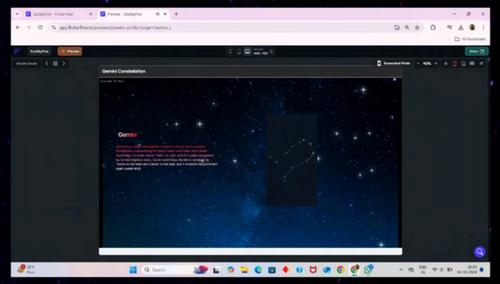




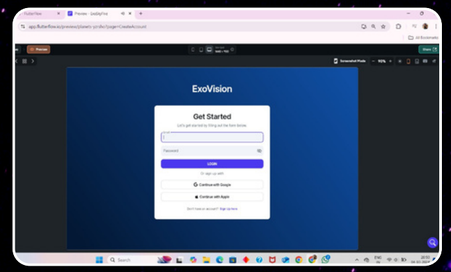








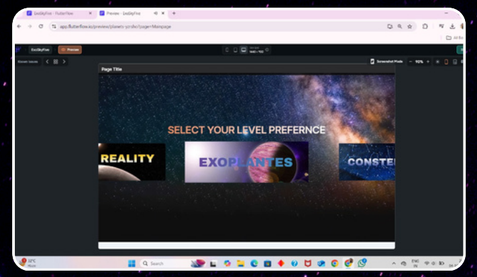
WIREFRAMES



Login Page

Key features

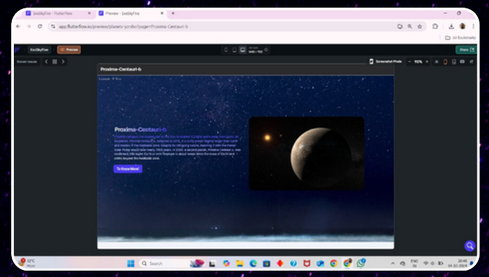
- Sign-up links
- forgot password links
- Secure login mechanisms
- Clear and concise design
- Username & password fields



Option Slider Page

Key features

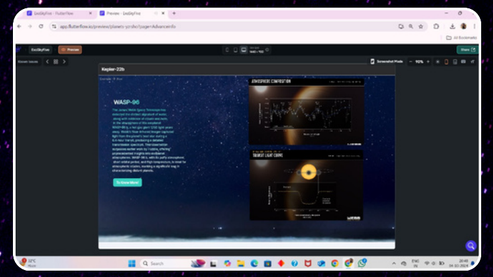
- Horizontal navigation
- Labeling for menu items
- Responsive design for different screen sizes
- Collapsible or expandable sections



Information Page

Key features

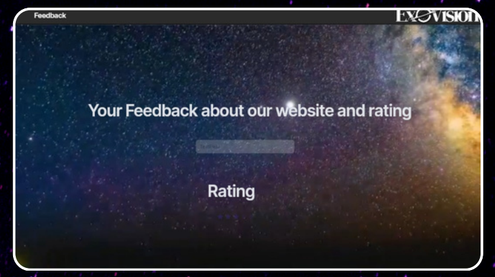
- Clear & concise content
- Informative content
- Easy navigation
- Search functionality
- Content suggestions



Statistics Page

Key features

- Visual representation of data
- Key performance indicators
- Filtering & sorting options
- Export functionality (CSV)



Feedback Page

Key features

- Contact form with fields
- Rating system (e.g., stars)
- Option to attach files
- Clear instructions

ARCHITECTURAL DIAGRAM

Components	*Description*
Data Sources	**NASA Datasets: Star catalogs like HIPPARCOS, GAIA, and TESS. External Data: Additional astronomical databases (exoplanet data, space weather, etc.).**
Data Ingestion	ETL (Extract, Transform, Load): Processes the star catalog data and exoplanet information, ensuring accurate and up-to-date data is available for star map generation.
Data Storage	Database: Centralized storage for structured data (e.g., PostgreSQL, MySQL) to manage data.Data Warehouse: Stores historical data for star movements and advanced queries on the changing sky over time.
Data Processing	AI and Machine Learning algorithms analyze star positions, generate 3D point clouds, and simulate the sky from exoplanet perspectives. GIS tools analyze spatial data and render the 3D maps and sky visualizations.
Application Layer	Backend Server: Handles business logic, processes data requests, and manages API interactions. Frontend Interface: The web and mobile interface that delivers the interactive sky map, constellation tracing, and educational overlays.
User Interaction	Passed basic encryption and user authentication tests
Admin Interface	Tools for administrators to monitor data ingestion, update datasets, manage user feedback, and maintain system health.
Security & Compliance	Ensures secure access for users, using protocols like OAuth for user login and session management.

TECHNOLOGIES TO BE USED

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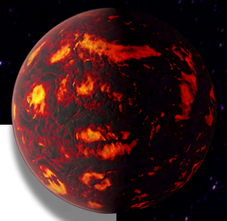

Data Storage

SQL Databases:
PostgreSQL, MySQL
NoSQL Databases:
MongoDB, Cassandra
Data Warehouses:Amazon Redshift, Google BigQuery

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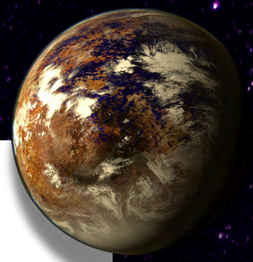

Frontend Development

Web Technologies: HTML5, CSS3, and JavaScript
Frontend Frameworks: React, Angular, or Vue.js
3D Visualization Libraries: Three.js or WebGL

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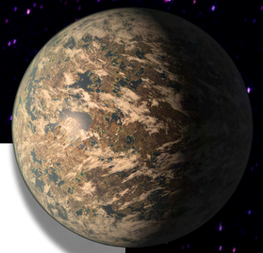

Backend Development

Server Frameworks:
Node.js,Python frameworks like Flask/Django
API Management: RESTful APIs (e.g., Flask-RESTful, Express)

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Security and Compliance

Authentication/Authorization: OAuth2, JWT (JSON Web Tokens
Data Encryption: TLS/SSL protocols

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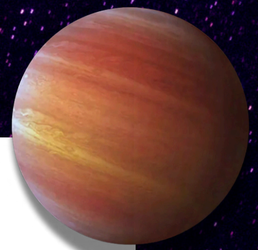

Data Processing and Analysis

Machine Learning/AI Frameworks: TensorFlow, PyTorch, and Scikitlearn
Geospatial Data Analysis Tools: ArcGIS and QGIS
Geospatial Libraries: GeoPandas, Rasterio

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Cloud Infrastructure

Cloud Computing Platforms: AWS, Microsoft Azure, or Google Cloud
Edge Computing: To handle real-time data processing on devices with limited internet connectivity

Prototype Performance Report/Benchmarking

Performance Metric	*Prototype Performance*	*Benchmark Comparison*
Data Accuracy	98% accuracy in star positioning from exoplanets	Industry average: 95-97% for similar astronomy tools
Rendering Speed	3D star map with 1,500 stars rendered in < 2.5 sec	Industry average: 4-6 sec for star maps of similar size
User Interaction Latency	< 100ms response time for interactions	Industry standard: 150-200ms
Customization Processing Time	Custom star maps and overlays applied in < 1 sec	Benchmark: 2-3 sec
Scalability	Supports up to 500 users with 70% CPU utilization	Benchmark: 60-80% CPU usage for similar user loads
Security	Passed basic encryption and user authentication tests	Industry-standard encryption (TLS/SSL protocols)
Offline Functionality	In development (not fully implemented yet)	Benchmark: Most apps require online connectivity

Estimated implementation cost (Optional)

Development Phase	*Estimated Cost*	*Details*
UI/UX Design	$3,000 - $5,000	Design of the user interface and experience for the 3D star maps and user interaction.
Basic Branding	$1,000 - $2,000	Creation of branding materials, logos, and app identity.
Core Features Development	$15,000 - $20,000	Development of core features such as 3D star mapping, constellation tracing, and data visualization.
Backend Development	$5,000 - $7,000	Setting up the backend, including API integration, data processing, and cloud infrastructure.
Testing and QA	$2,000 - $3,000	Quality assurance, performance testing, and user feedback integration.
User Testing	$1,000 - $2,000	Conducting user trials to ensure smooth user experience and gather improvement suggestions.
Project Management	$2,000 - $3,000	Coordination of project tasks, timelines, and resource allocation.

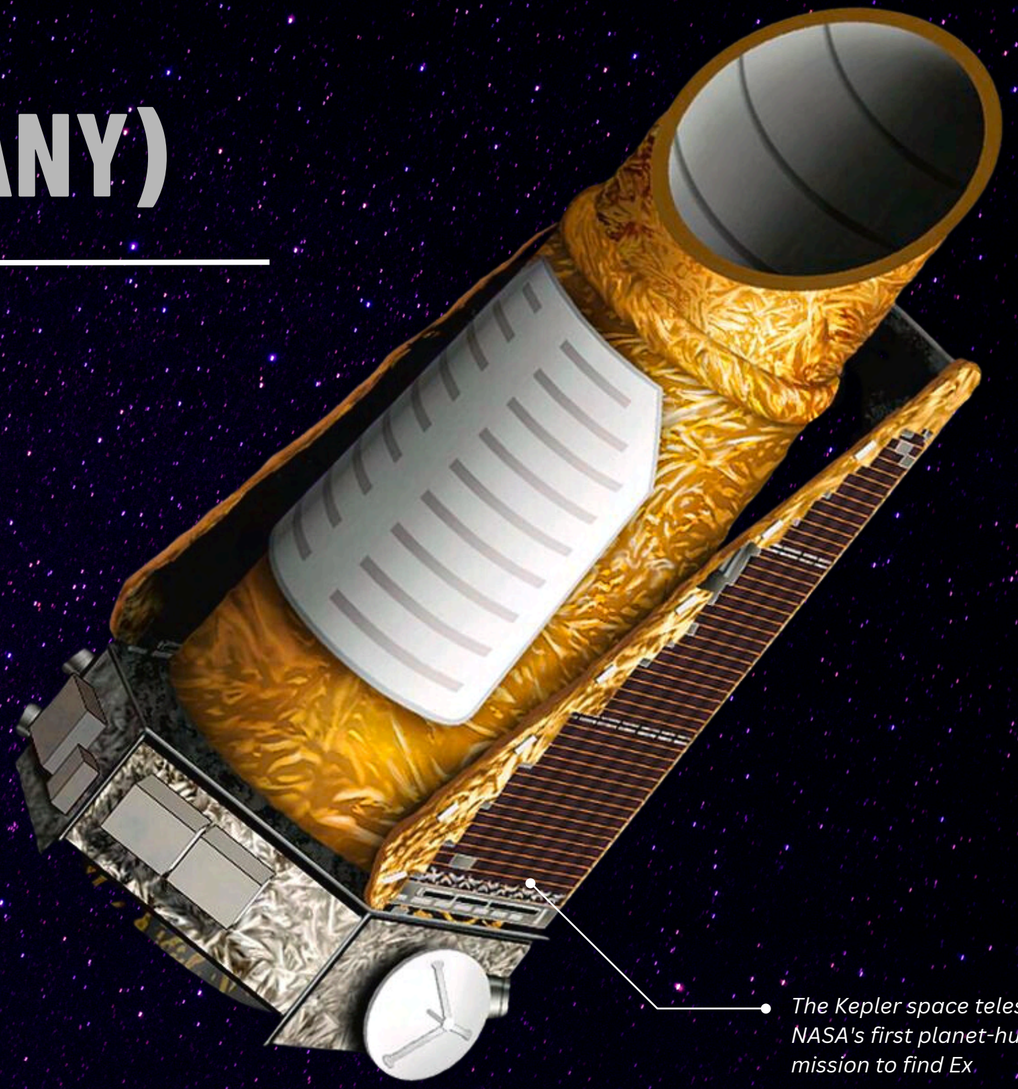
ADDITIONAL DETAILS / FUTURE DEVELOPMENTS (IF ANY)

Collaborative Learning Platform

Developing a feature that enables multiple users (students or educators) to collaborate on the same star map. This could include group constellation creation or live astronomy lessons in a shared environment.

Advanced Analytics and Reports

Providing students and educators with in-depth analytics on the star systems they explore, such as star composition, age, or distance from Earth. This would be a valuable resource for advanced learning modules.



The Kepler space telescope was NASA's first planet-hunting mission to find Ex

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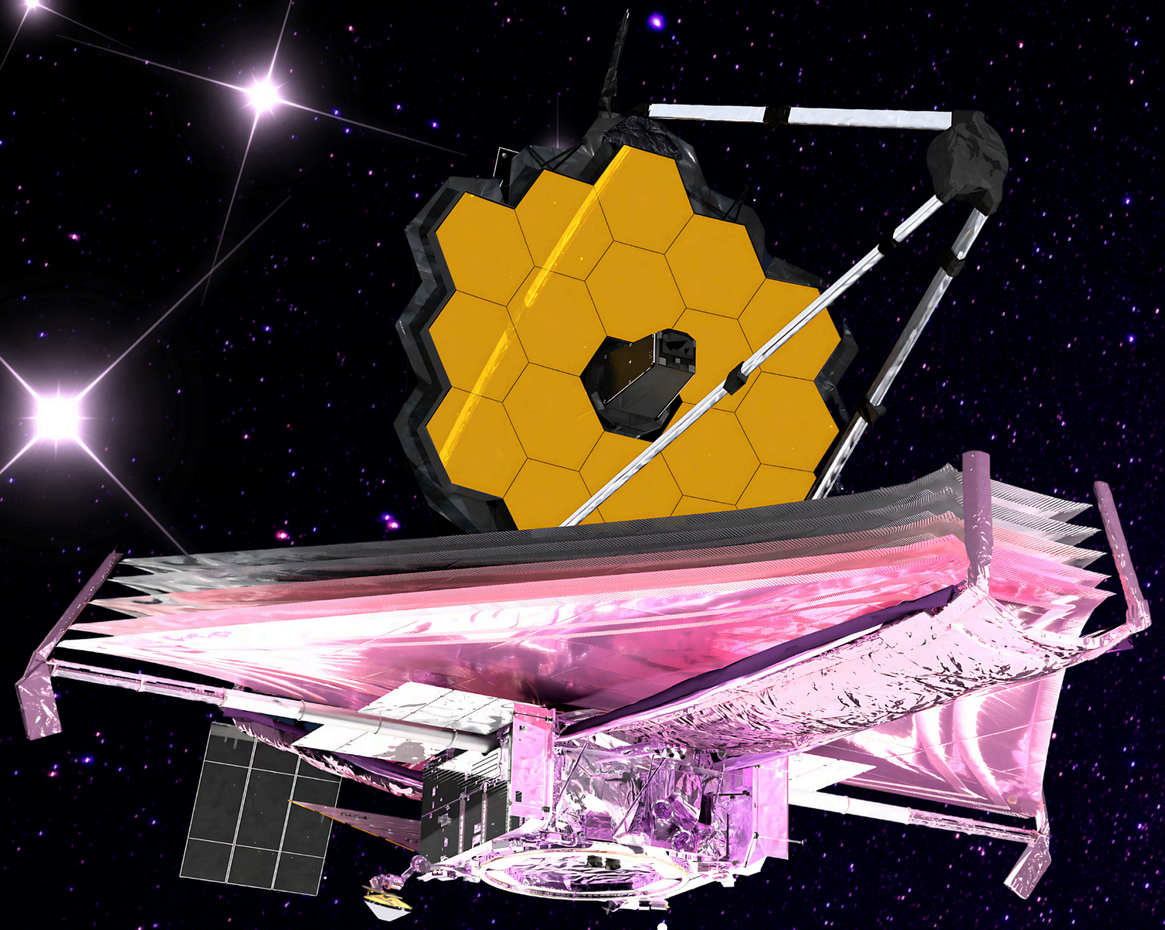


The Jame Webb Space Telescope is the largest, most powerful and most complex telescope, designed to find and study exoplanets.

INSTAGRAM PAGE LINK:

https://www.instagram.com/exovision.ai/

FINAL PRODUCT LINK:

https://exovision.flutterflow.app/

SOLUTION PRESENTATION LINK:

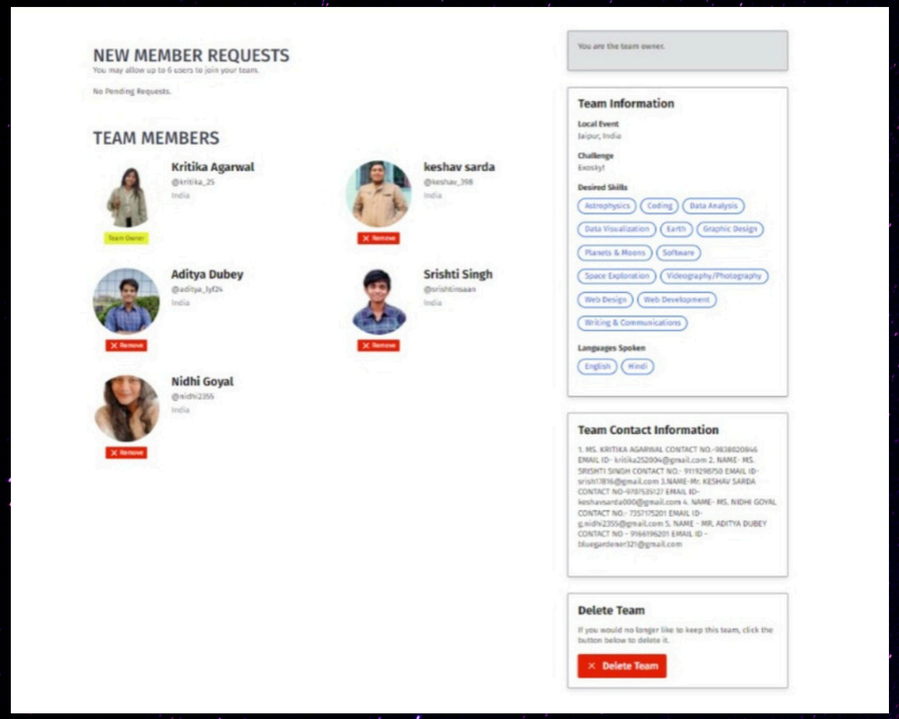
https://www.dropbox.com/scl/fi/7mesijyvzkgmi5kx17p51/Exovision.mp4?rlkey=ede7bca47dxis2z3qo793pjng&st=kakvop2f&dl=0

GITHUB REPOSITORY LINK:

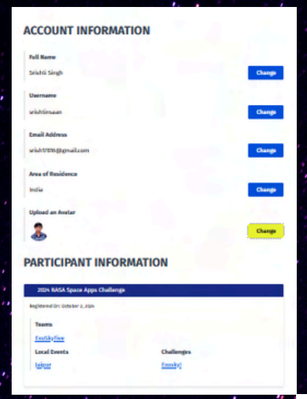
https://github.com/srishtinsaan/NASA-Space-Apps-Challenge-Jaipur-2024?tab=readme-ov-file

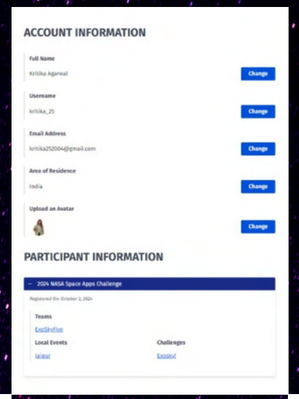
PROOF OF REGISTRATION

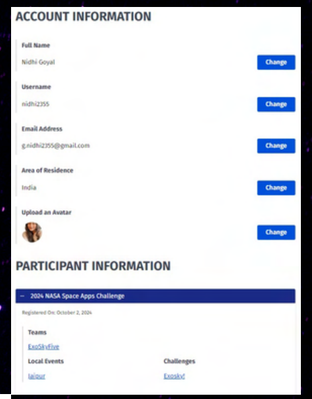
Team Proof

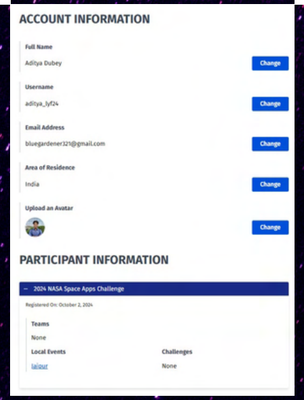


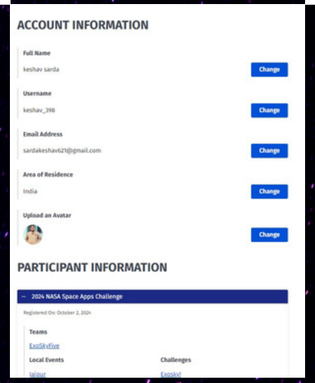
Individual Proof











MEET OUR TEAM MEMBERS

Srishti Singh

Nidhi Goyal

Kritika Agarwal

Aditya Dubey

Keshav Sarda

Thank You

TEAM ExoSkyFive