Cosmogaze - Navigating the Cosmos in Your Pocket

STAR-TRACKING APP

Project progress report submitted

to

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Project Group Name
COSMOGAZE

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1. Introduction

Cosmogaze sets out to offer a captivating blend of astronomy and technology, creating an Android app that transforms stargazing into a personalized and educational adventure. The primary goal is to craft a seamless and enlightening experience for users fascinated by the mysteries of the night sky. We aim to redefine stargazing by offering an immersive experience for users to explore the wonders of the night sky. Our team has been diligently working to transform this vision into reality, focusing on delivering a user-friendly and captivating app.

2. Literature Survey:

- **Real-Time Sky Visualization:**
  - Real-time sky visualization allows users to see an accurate representation of the night sky based on their location and time. Research by Vistas, M. V., & Delgado-Martí, H. (2017) explored the implementation of real-time sky visualization in mobile apps, highlighting the importance of accurate celestial data and smooth rendering for an immersive user experience. The study demonstrated the effectiveness of using algorithms such as the International Celestial Reference System (ICRS) for precise sky mapping.

- **Celestial Object Identification:**
  - Celestial object identification lets users point their device at the sky and identify stars, planets, constellations, and other celestial objects in real time. In their research, Anderson, J., & Oliva, L. (2019) discussed using computer vision techniques for celestial object identification in mobile apps. They proposed a method based on image processing and star pattern recognition to identify celestial objects accurately using smartphone cameras.

- **Augmented Reality Integration:**
  - Augmented reality (AR) integration enhances the stargazing experience by overlaying digital information onto the real-world view of the sky. Chittaro, L., & Ranon, R. (2018) investigated the use of AR in astronomy apps, emphasising its potential to provide interactive and educational experiences for users. Their study demonstrated how AR can superimpose labels, information, and animations onto celestial objects, enriching the user's understanding of the night sky.

- **Educational Resources:**
  - Educational resources provide users with information about celestial objects, astronomical phenomena, and stargazing techniques. In their review, Hazy, J. K., & Cowie, J. C. (2016) discussed the role of educational content in astronomy apps for public outreach and science communication. They emphasized the importance of accurate, engaging, and accessible educational

materials to foster a deeper appreciation for astronomy among users of all ages.

- **User Location Tracking:**
  - User location tracking enables the app to determine the user's position on Earth, allowing for accurate sky mapping and celestial object positioning. Research by García, D. A., et al. (2018) examined the implementation of user location tracking in mobile astronomy apps, focusing on the use of GPS and other location-based services. They highlighted the challenges of ensuring accuracy and reliability in different environmental conditions and geographical locations.

- **Social Sharing and Community Engagement:**
  - Social sharing and community engagement features allow users to share their stargazing experiences, observations, and discoveries with others. In their study, Krippendorff, B. B. (2019) investigated the impact of social features in astronomy apps on user engagement and community building. They found that integrating social sharing functionality can enhance user interaction, facilitate knowledge exchange, and foster a sense of belonging within the stargazing community.

- **Customizable Observing Lists:**
  - Customizable observing lists enable users to create personalized lists of celestial objects they want to observe or track. Research by Miller, S. T., et al. (2020) explored the design and implementation of customizable observing lists in astronomy apps, emphasizing the importance of user-centred design principles. They recommended providing users with flexible options for organizing, filtering, and annotating observing lists to meet diverse stargazing preferences and goals.

- **Night Mode and Dark Sky Preservation:**
  - Night mode and dark sky preservation features optimize the app's interface for low-light conditions and promote awareness of light pollution and its impact on stargazing. In their review, Gastón, M. C., & Pereyra, A. (2019) discussed the significance of incorporating night mode and dark sky preservation initiatives in astronomy apps. They underscored the importance of reducing screen brightness, using red light filters, and promoting responsible outdoor lighting practices to protect the nocturnal environment and preserve the beauty of the night sky.

3. Problem Definition

In addressing the challenges faced by stargazers, Cosmogaze seeks to democratize celestial exploration. We recognize the hurdles encountered by both novice and experienced users in traditional stargazing methods. Hence, our goal is to provide an accessible solution that simplifies the stargazing process and makes the beauty of the cosmos accessible to all.
Cosmogaze is envisioned as a comprehensive celestial companion, merging visually immersive elements with precise astronomical data.

4. Objective

Cosmogaze sets out to offer a captivating blend of astronomy and technology, creating an Android app that transforms stargazing into a personalized and educational adventure. The primary goal is to craft a seamless and enlightening experience for users fascinated by the mysteries of the night sky.

5. Methodology

Architecture Design:

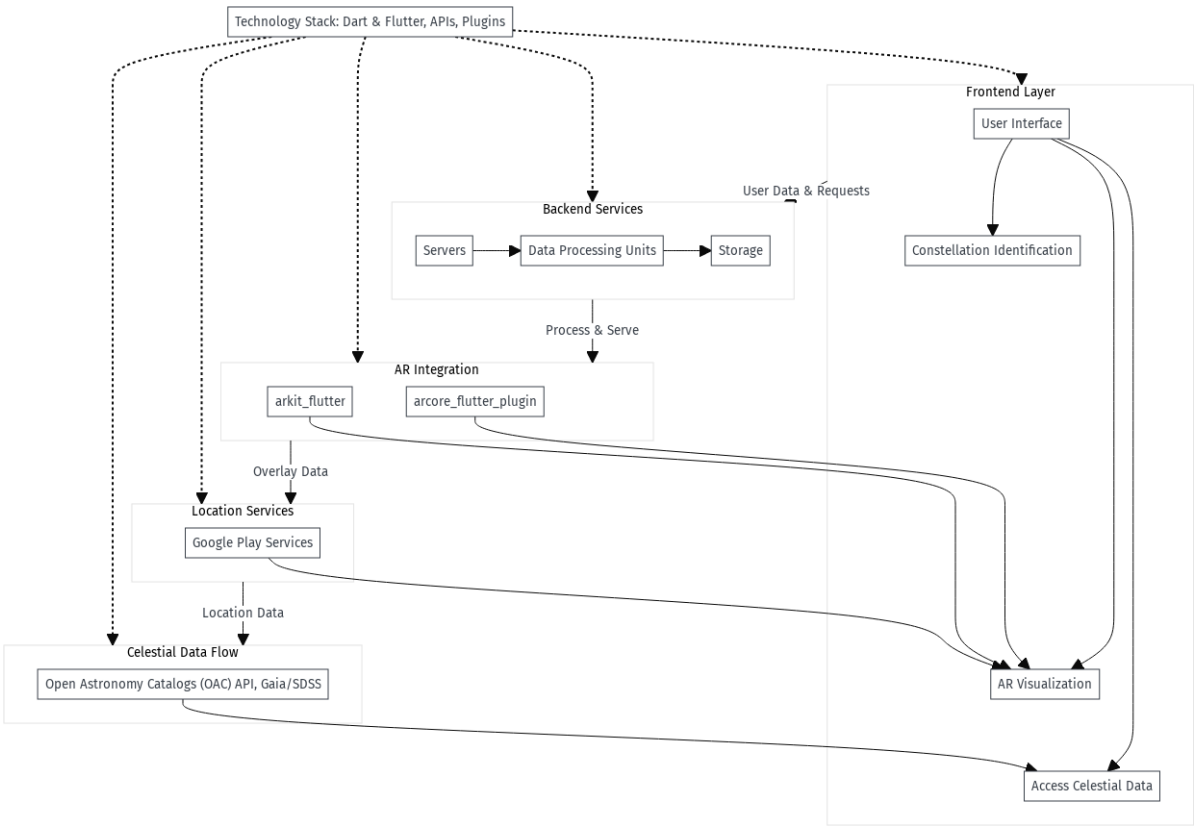


Fig.1 Architecture Design

-**Frontend Layer:** Showcases the user interface components such as AR visualization, constellation identification, and accessing celestial data, along with their interaction flow to backend services and external API requests.

-**Backend Services**: Details the infrastructure including servers, data processing units, and storage, emphasizing their roles in managing user data, processing location inputs, and serving AR content.

-**AR Integration**: Illustrates the use of AR technology within the app, highlighting the integration of tools like arcore_flutter_plugin and arkit_flutter for Flutter, and their interaction with real-time data and user inputs.

- **Location Services**: Displays the use of Google Play Services for precise location tracking, which is crucial for aligning the AR overlay with the actual night sky.

- **Celestial Data Flow**: Maps the flow of data from external sources such as the Open Astronomy Catalogs (OAC) API and Gaia or SDSS databases, detailing how this information is processed and presented to the user.

- **Technology Stack:** Provides an overview of the technology stack including Dart and Flutter for app development, and the use of various APIs and plugins for AR and location services.

FLOWCHART:

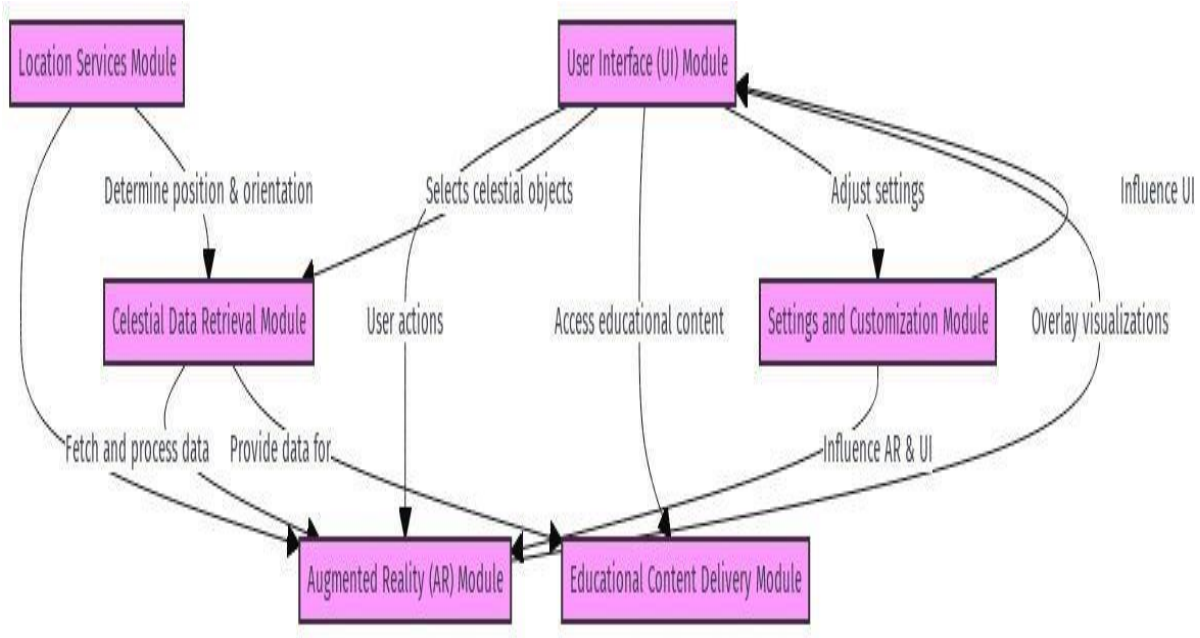


Fig.2 Flowchart

This flow chart visually depicts how the app's modules, including the User Interface (UI), Augmented Reality (AR), Location Services, Celestial Data Retrieval, Educational Content Delivery, and Settings and Customization, interact with each other. Key interactions such as user actions triggering responses in other modules, the flow of location data to adjust AR content, and the retrieval and utilization of celestial data across the app are all highlighted.

LOW-LEVEL DESIGN:

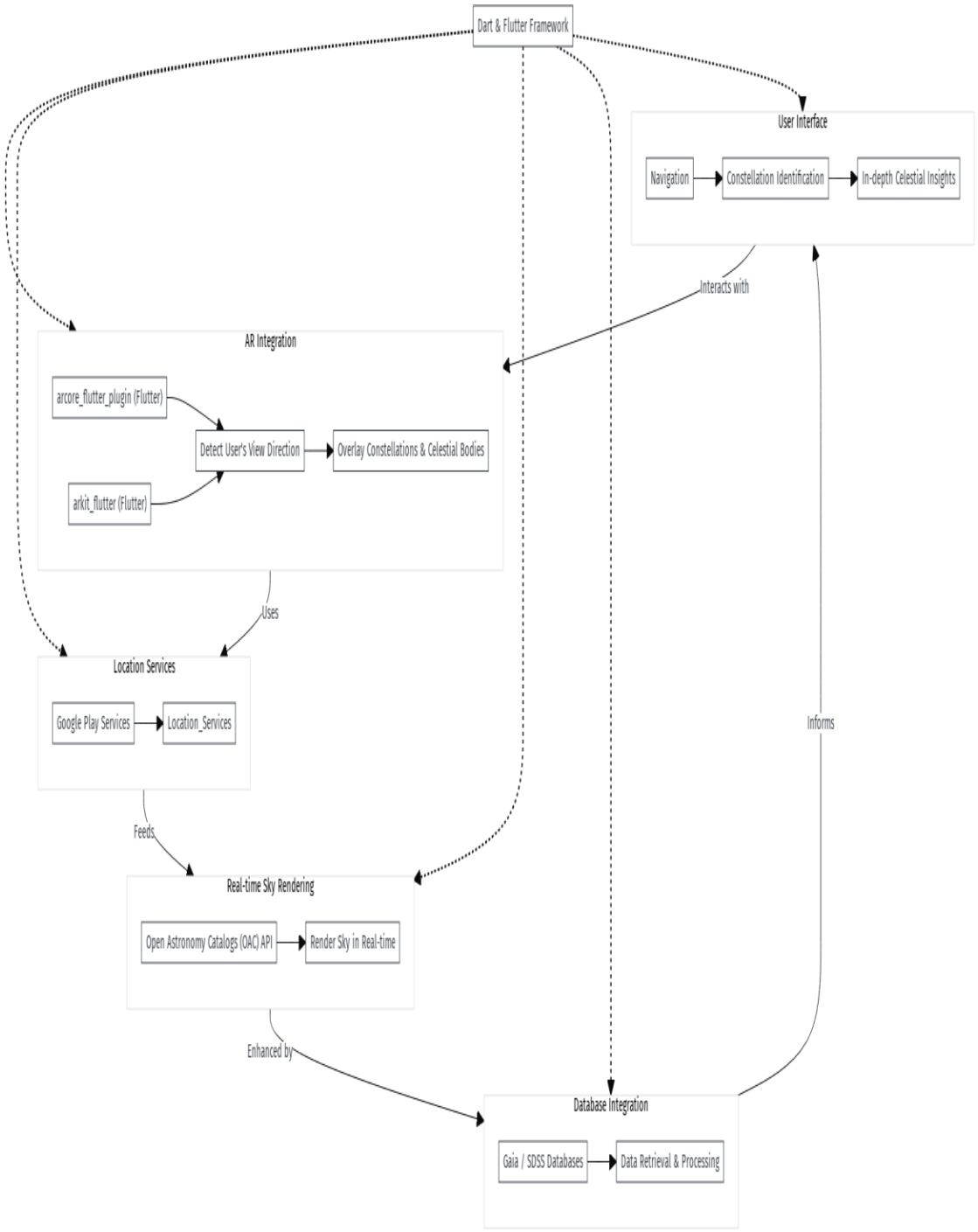


Fig.3 Low-level Design

HIGH-LEVEL DESIGN:

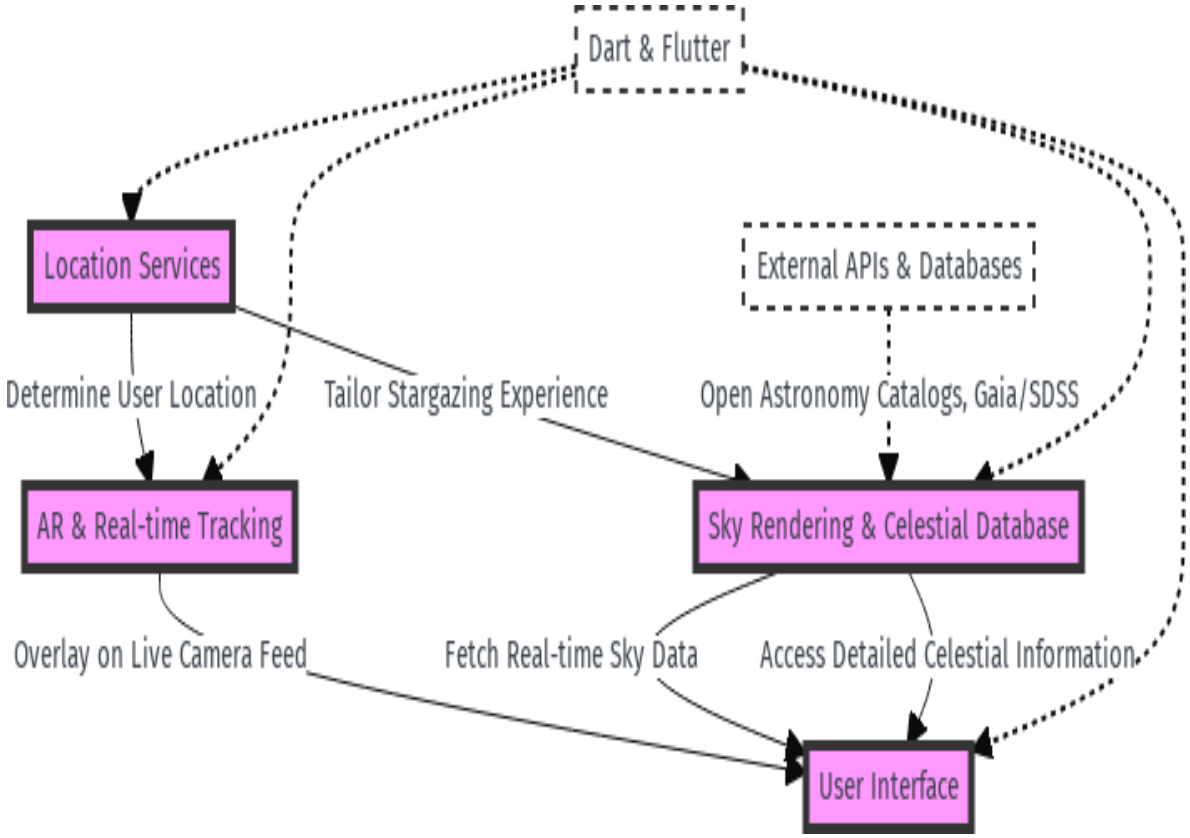


Fig.4 High-Level Design

This diagram outlines the app's key functionalities, including AR and real-time tracking, location services, sky rendering and celestial database integration, and the user interface. It also highlights the technology stack, emphasizing the use of Dart and Flutter for development, and external APIs and databases for celestial data.

Userflow:

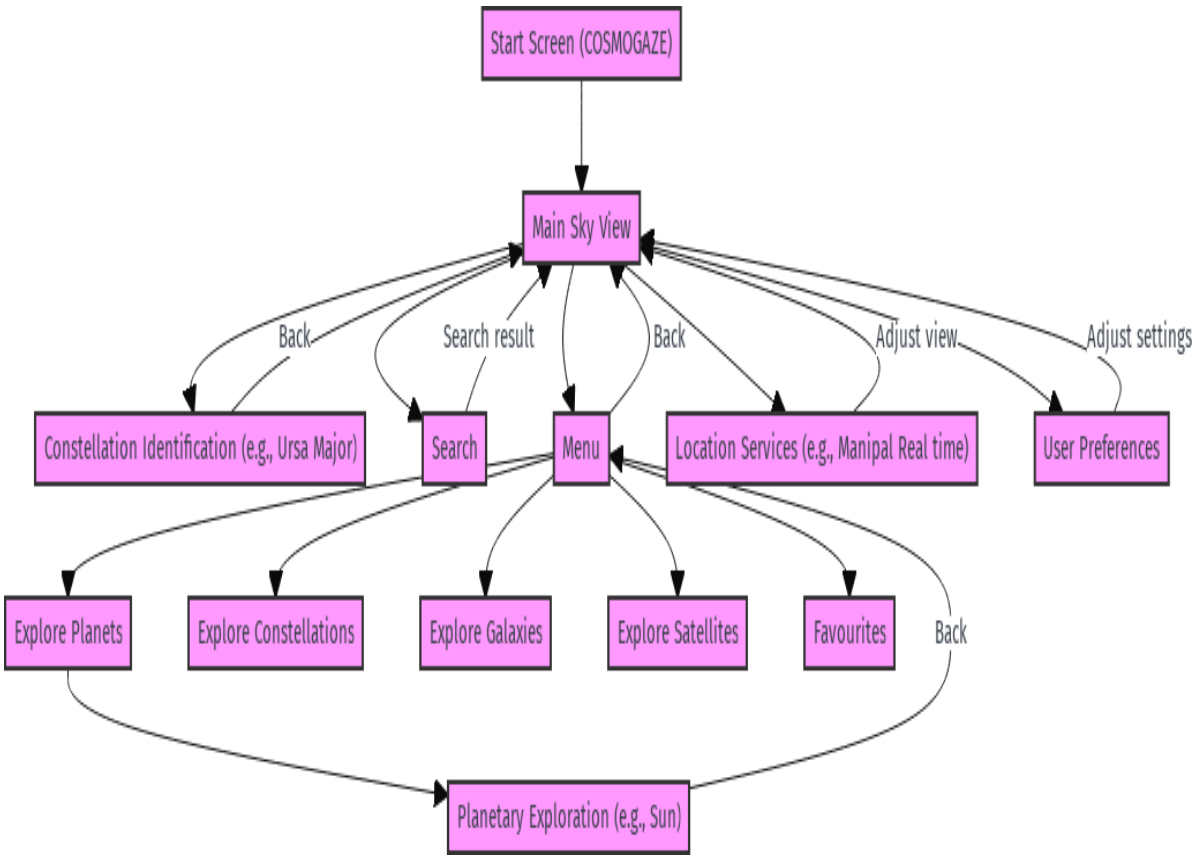


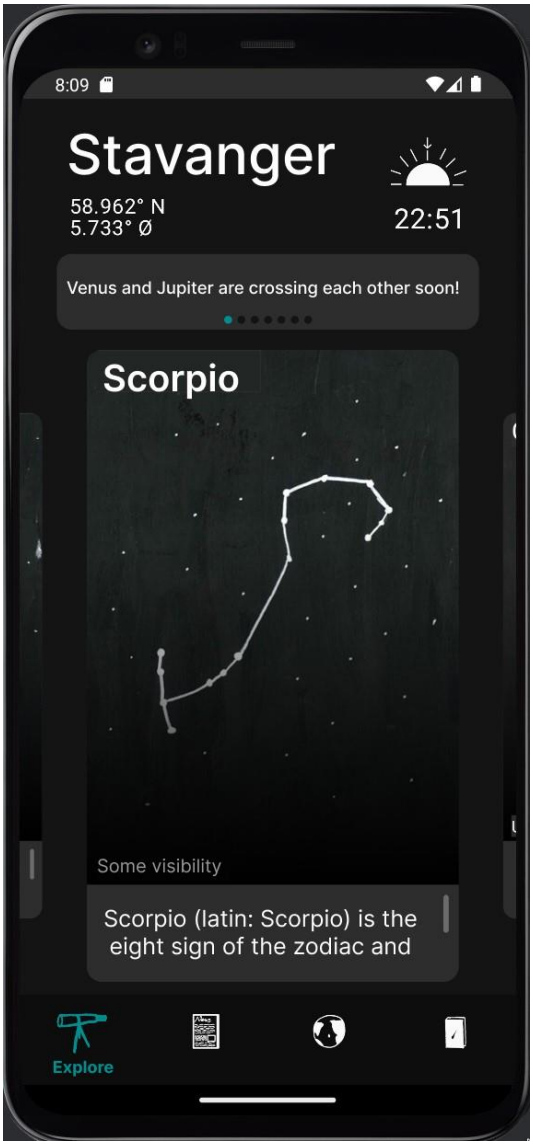
Fig.5 User flow

6. Results & Conclusion

CosmoGaze's success is not only a testament to its user-friendly interface but also to its robust backend architecture. The integration of Google Maps API key within the app's infrastructure It has enabled precise mapping functionalities, crucial for the globescreen's accurate representation of stargazing conditions.

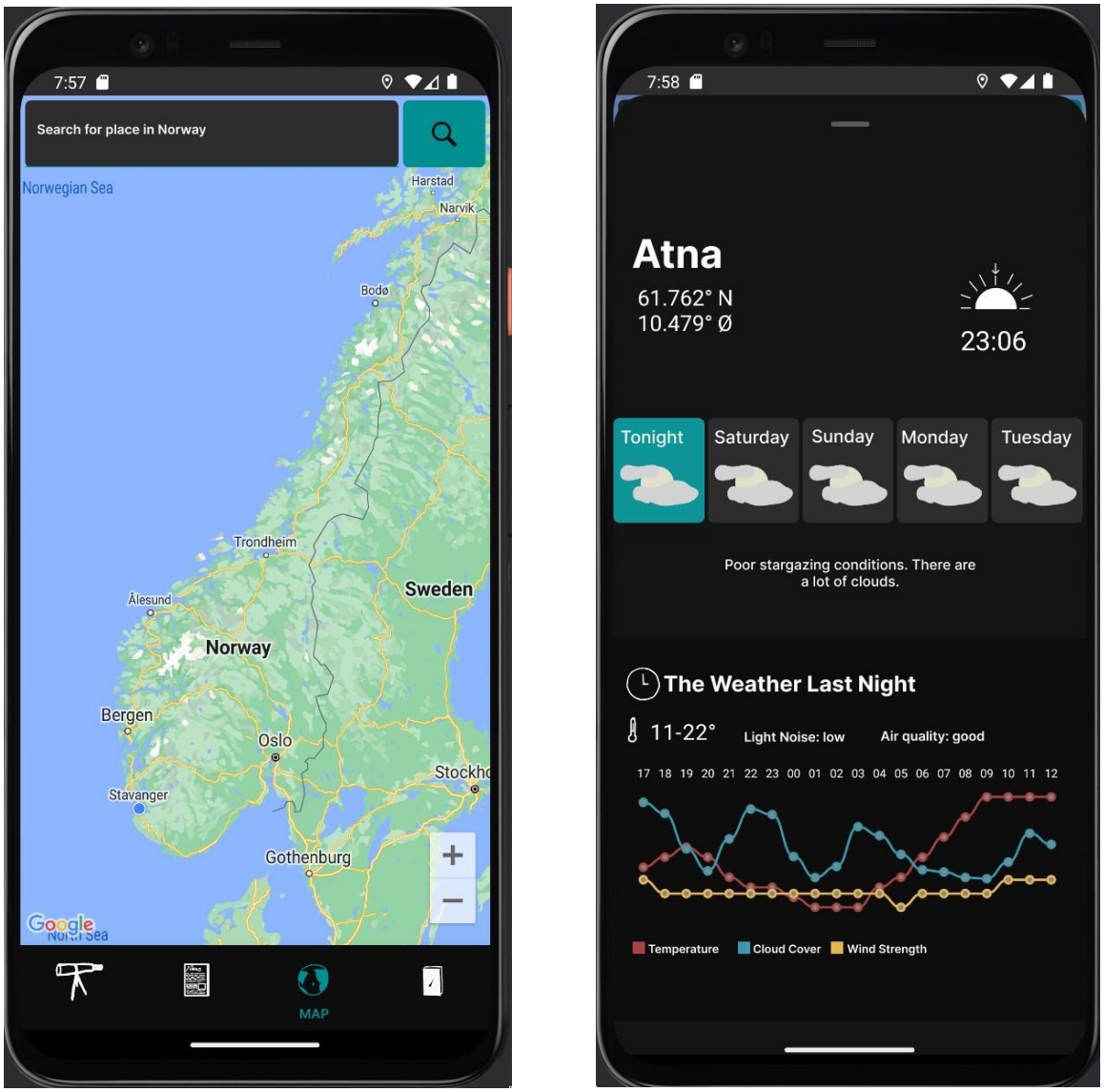
The application's backend efficiently queries MET APIs using location parameters granted by the user, or entered manually, to provide real-time visibility forecasts of celestial bodies. This seamless fusion of backend data processing with frontend display is a core feature that has resonated well with our users.

Homescreen: Homescreen effectively displays location-based sunset times, celestial events, and constellation visibility, confirming the reliability of location data parsing and thematic consistency is maintained.



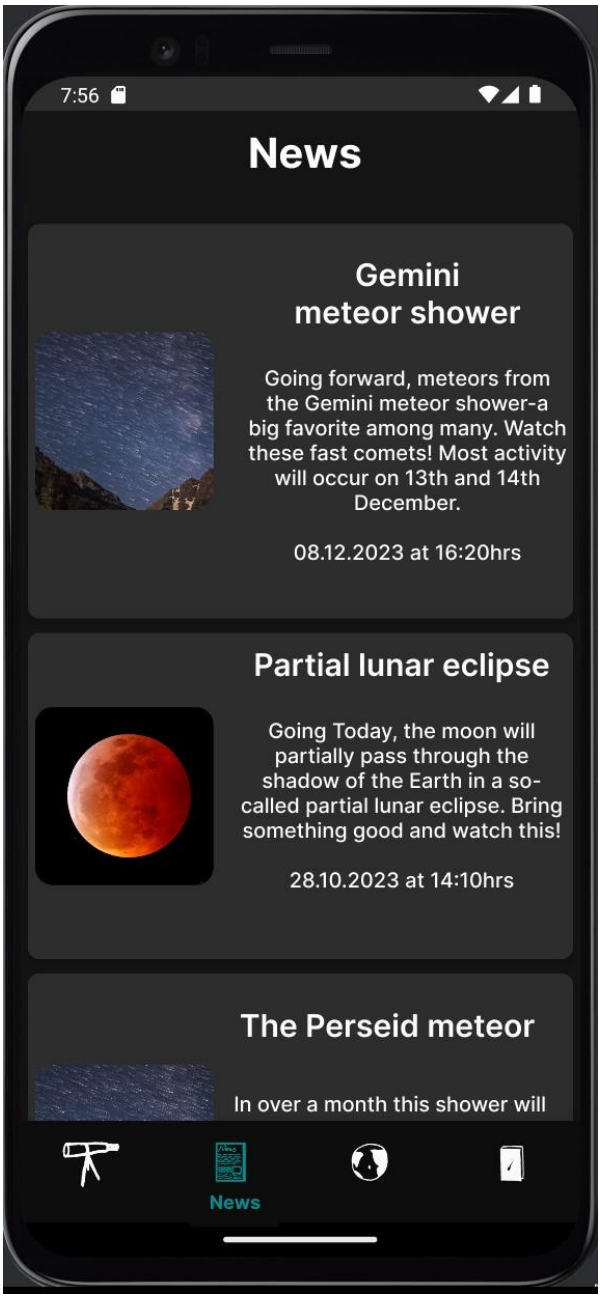
Homescreen

Globescreen: The team's work shines in the detailed night viewing conditions provided, enhancing user experience by incorporating graphical data representation, which relies heavily on accurate data fetched from the backend.



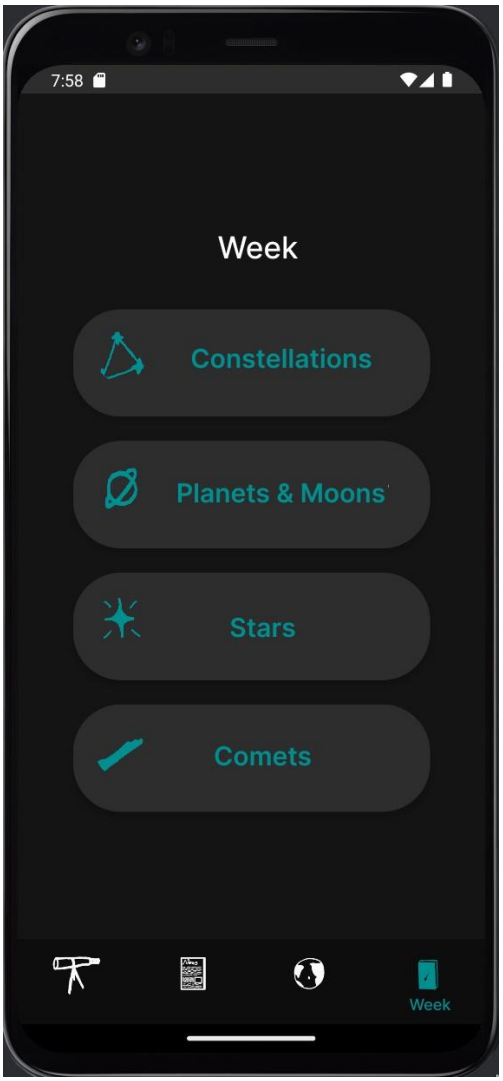
View the sky conditions for a particular region via the Globescreen

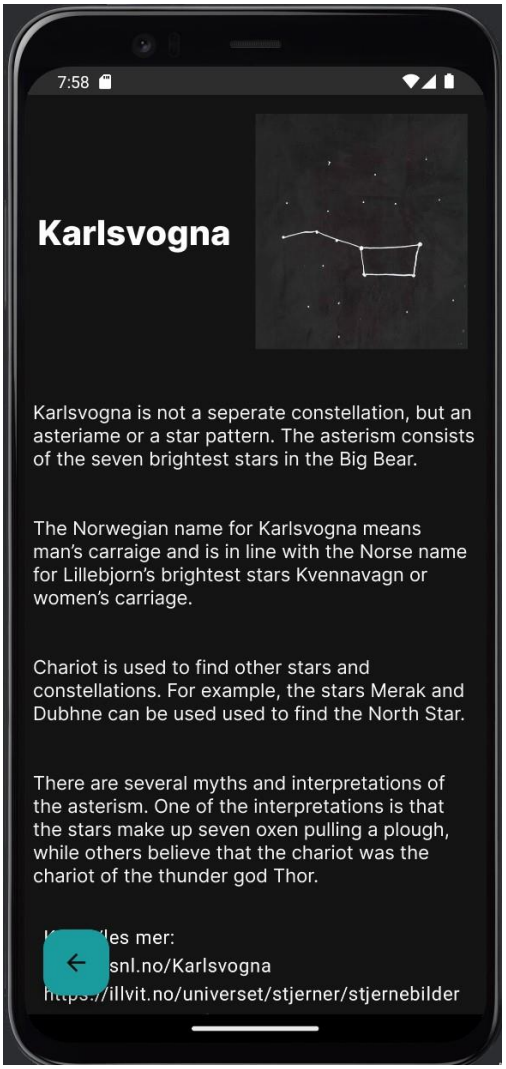
Newsscreen: This feature, showing past and upcoming celestial events, has been brought to life. Relevance and timeliness of the content is dynamically retrieved and updated via periodic api fetching.



Newscreen

Weekscreen: This screen stands out for its rich, well-sourced information about all sorts of constellations, plants, moons, comets and stars, delivering a comprehensive educational experience.





Constellation information retrieved from the week screen

Backend Processing: Crucial to the application's functionality is the adept handling of the Google Maps API for location services and the MET API for stargazing data. This processing allows for a dynamic and responsive app experience, as seen in the globescreen and homescreen, which adapt to provide personalized stargazing conditions.

Navigation and Thematic Consistency: The smooth navigation and cohesive theme across the app, will significantly contribute to a positive user experience, reducing the cognitive load and making the journey through the app intuitive.

In conclusion, the successful integration of the backend services with the front end of CosmoGaze has resulted in an application that will not only meet the needs of the users for stargazing but will do so with elegance and precision. The application's architecture, both visible and under the hood, stands as a testament to the effective collaboration and expertise of the development team, providing users with a reliable and enriching stargazing tool. Moving forward, the potential for expansion and the integration of new features promise to maintain CosmoGaze's position at the forefront of astronomical exploration tools.

8. Scope

CosmoGaze is poised to transcend the traditional boundaries of a stargazing application to become an expansive platform for astronomical engagement. The app's potential extends far beyond mere observation, aiming to become a holistic portal to the heavens. Through CosmoGaze, users can not only identify various celestial objects but also access a wealth of educational content that enriches their knowledge and appreciation of the cosmos.
The scope of CosmoGaze includes:

- **Educational Empowerment**: Providing users with detailed information and narratives about stars, planets, constellations, and other celestial phenomena to foster learning.
- **Community Building**: Creating a space where users can share their stargazing experiences and findings, thus encouraging a community of like-minded enthusiasts.
- **Personalized Experience**: Utilizing user location and preferences to offer customized viewing conditions, notifications for optimal stargazing, and a personalized journey through the cosmos.
- **Scientific Contribution:** Enabling users to contribute to citizen science initiatives by reporting sightings and participating in global stargazing events

The pursuit of making CosmoGaze the premier app for celestial discovery is fueled by a dedication to excellence and a passion for bringing the stars closer to everyone. Whether for educational purposes, amateur stargazing, or professional use, CosmoGaze is on its way to becoming the definitive digital companion for anyone curious about the night sky. The journey ahead is bright, with continuous improvements and additions planned to enhance functionality and user engagement, making the marvels of the universe accessible with just a few taps on a screen.

9. References

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