International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 12 Issue: 04 | Apr 2025 www.irjet.net p-ISSN: 2395-0072

AR Solarscape

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Abstract - In recent years, the integration of technology into education has become a focal point for both researchers and educators. Among the emerging technologies, Augmented Reality (AR) stands out due to its potential to transform traditional learning methods. AR enhances the learning experience by creating immersive environments that engage students more deeply.For students, Augmented Reality offers an engaging and immersive learning environment that enhances enjoyment and curiosity in the classroom. By bringing abstract or complex topics—like the structure of the solar system—to life, AR-based educational tools can also support teachers in delivering clearer, more interactive lessons that capture students' attention and improve comprehension.Thus, this report proposes to develop a mobile application to help students in learning process with the help of AR. In conclusion, this project offers a immersive and interactive experience and improves the teaching learning process and benefits teachers as well as students to explore and learn more effectively utilizing 3D visuals. Whether you're an educator, student, or space enthusiast, AR offers an unparalleled gateway to the stars. The future of space exploration is not just something we read about—it's something we can now experience firsthand, right here on Earth.

Key Words: AR, 3D Model, Solar System, Planets, Unity and Scene form Framework, Android Studio.

1. INTRODUCTION

"AR Solarscape" aims at combining the new information technologies (Augmented Reality) available to take advantage of recent gadgets, hence giving access to knowledge in a simplified and fun manner. The AR Solarscape, a small component of the vast universe, encompasses celestial bodies including the Sun, its planets-Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune. The traditional learning process typically involves explanations and exercises provided by educators, requiring students to be diligent in reading and attentive during lessons to master the content effectively. However, this approach can sometimes lead to monotony and student disengagement. Augmented Reality represents a fusion of real-world objects with virtual elements, operating interactively to bring virtual technology into the real world. Utilizing advancements in 3D visuals, AR is used in education to revolutionize the learning process of the solar system, which traditionally relied on textbooks, by introducing an interactive, smartphone-based learning experience. Augmented Reality allows users to interact with digital content overlaid on the real world through the use of smartphones, tablets, or AR glasses. Unlike traditional 2D representations of the solar system, AR creates an immersive, interactive experience. Users can visualize the planets, moons, and even spacecraft in their real-world environment, observing these celestial objects in 3D as if they were physically present. This interactive exploration offers an engaging and educational experience for both casual space enthusiasts and dedicated learners alike. One of the most exciting aspects of AR is its ability to make the vastness of space accessible to people of all ages and backgrounds. From students in classrooms to families at home, AR offers a hands-on, visual way to learn about the solar system, making abstract concepts more tangible and easier to understand. Teachers can use AR applications to bring the solar system to life for students, sparking curiosity and inspiring the next generation of astronomers, scientists, and explorers.

1.1 Literature Survey

Muhammad Nasiruddin Bin Mohd Kamal, The simulation of solar system using augmented reality technology cab helps the students of science subject to understand the topic much more effective. The simulations conveyed the information in an interactive and entertaining way which will trigger the interest of the students to learn. The students will be able to understand and memorize the information through the simulation as they enjoyed the learning process.[1]

Research and Applications Overview, The focus was on the various applications of AR in tourism, including wayfinding and navigation. The study also emphasized the dependence on specific devices and connectivity, as well as the challenges associated with maintenance and updates in the context of AR in tourism.[2]

Paulo Siqueria, a web-based platform that enables users to explore the Solar System using Augmented Reality. By scanning printed markers, students can view the planets in AR through any internet-connected device equipped with a webcam. The system also provides access to Virtual Reality (VR) visualizations for an enhanced learning experience..[3]

P Janardhana Reddy, Augmented Reality is an effective tool for this emerging learning paradigm, making the learner in active role of self-directed learning, providing flexibility and interactivity in the teaching and learning process. We need to have interactive teaching learning process and this changing role of education is inevitable with the introduction of Augmented Reality in education.[4]

IJSECS, This research has resulted in the creation of a cutting-edge Augmented Reality (AR) application designed to enhance education about the Milky Way galaxy's solar system. This application addresses the challenge of limited understanding among elementary school students regarding the solar system, which was previously taught using traditional globes and pictures.[5]

Muhammad Andika Putra, This technology not only stimulates students' curiosity, strengthening critical thinking skills, but also enhances creativity, observation skills, analysis, communication, self-confidence, and responsibility individually and in group work. Furthermore, the use of AR also strengthens the collaborative relationship between teachers and students, creating a closer and more interactive learning environment.[6]

Georgios Lampropoulos, Students, teachers, and parentsAccording to Georgios Lampropoulos, the integration of augmented reality (AR) into Natural Sciences education has been met with favorable responses from students, teachers, and parents alike. Research consistently shows that students who engaged with AR-based learning tools demonstrated improved academic outcomes compared to their peers who were taught using conventional instructional methods. In most cases, the performance of students using AR was either comparable to or significantly better than those relying on traditional approaches.[7]

2. METHODOLOGY

This methodology outlines a structured approach to developing an Augmented Reality (AR) Solarscape application, emphasizing user engagement, technical implementation, and evaluation.

1. Research and Analysis: Identify target audience (eg. students). Analyze existing AR applications related to space and planets. Research solar system models (eg.. planets, moons, orbits). Evaluate the best AR platforms (eg. Unity, etc.) for the project. Understand hardware limitations (smartphones, tablets) and user requirements. Set project goals.

2. Design and Prototyping: Design user interface (UI) and user experience (UX) for smooth AR interaction. Create initial wireframes and sketches of AR components (planetary models, control panel, etc.). Prototype interactions (e.g., scaling planets, rotating orbits, zooming in/out).

3. Technical Development: Develop 3D models of the solar system components (planets, sun, moons). Implement orbital mechanics to simulate accurate movement of celestial bodies. Develop AR code for device camera integration, allowing users to view models in real-world space. Optimize performance for mobile devices, balancing graphics quality and efficiency.

4. Implementation of AR Features: Use AR development frameworks like ARCore/ARKit or Unity. Implement plane detection for realistic placement of solar system models in physical spaces.Add features like real-time scaling and planetary rotations..

5. Testing and Validation: Perform internal testing on multiple devices to ensure compatibility. Test the features in different environments (indoors, outdoors, dark-light). Validate accuracy of the solar system model and AR positioning. Gather user feedback to refine interaction design, UI/UX, and educational content. Debug performance issues such as lag, crashes. Ensure that content is accurate and scientifically sound.

6. Deployment and Marketing: Publish the app on relevant platforms (Google Play, Apple App Store). Create promotional content (videos, demo reels) showcasing the AR experience. Implement social media campaigns to reach target audiences.

Collaborate with educational institutions or space enthusiasts for endorsements. Utilize user testimonials and reviews to build credibility.

7. Post-Launch Evaluation: Collect user feedback and reviews from app stores and surveys. Monitor app performance (downloads, crashes, engagement metrics). Fix post-launch bugs and release updates for improving user experience. Analyze data to understand user behavior and feature usage. Plan additional features or future updates based on feedback (e.g., adding new celestial bodies, educational modules).

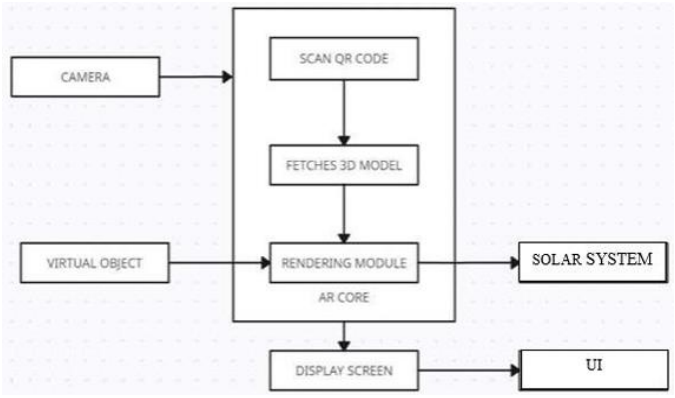

Fig: Architecture of AR Solarscape

2 Flow chart for System

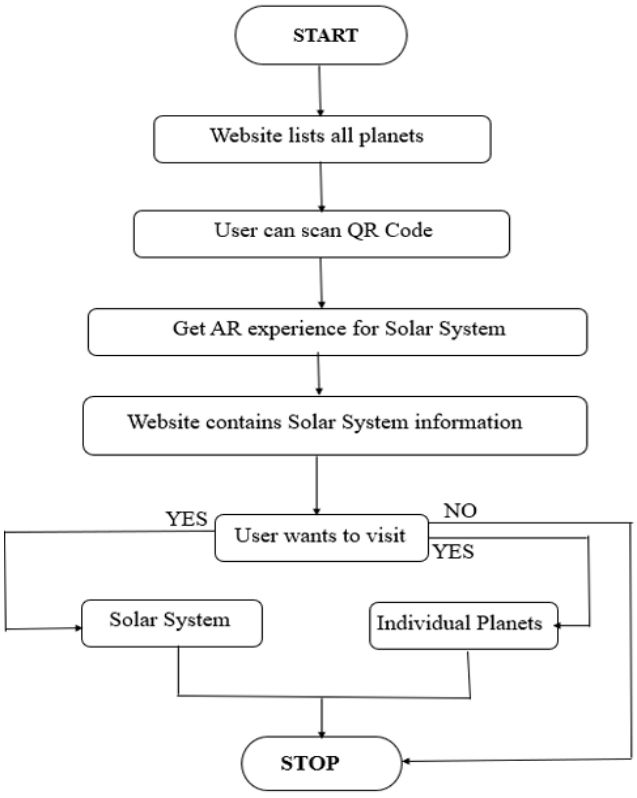

Fig. System Flow Chart

2.Related Work

Several innovative projects have explored the integration of augmented reality (AR) technology into solar system education and exploration. These initiatives aim to enhance the learning experience by allowing users to visualize and interact with celestial bodies in their real-world environment. By overlaying virtual planets, moons, and spacecraft onto physical surroundings through smartphone or tablet screens, AR enables users to explore the solar system up close, examine planetary orbits, and understand astronomical concepts in an immersive way. Such applications not only make space education more engaging but also help learners grasp complex spatial relationships and planetary movements. Additionally, AR-based solar system models have the potential to revolutionize astronomy education by offering interactive simulations, real-time celestial tracking, and personalized learning experiences, ultimately empowering users to explore the wonders of space like never before.

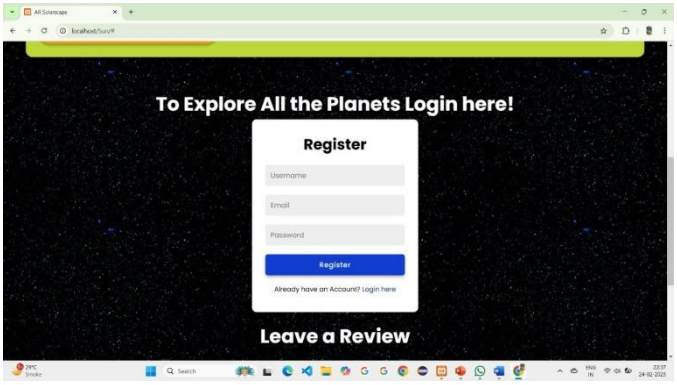

Fig: Register page

Registering on the SolarSystem website is a simple process that allows users to access a wide range of interactive features and educational resources. To sign up, users need to visit the official website and click on the "Register" or "Sign Up" button. They will be prompted to enter basic information such as their name, email address, and a secure password. Some platforms may require email verification to activate the account. Once registered, users can explore augmented reality (AR) solar system models, participate in virtual space tours, and access exclusive astronomy content.

With a registered account, users can fully immerse themselves in the wonders of the solar system through an interactive and engaging digital experience.

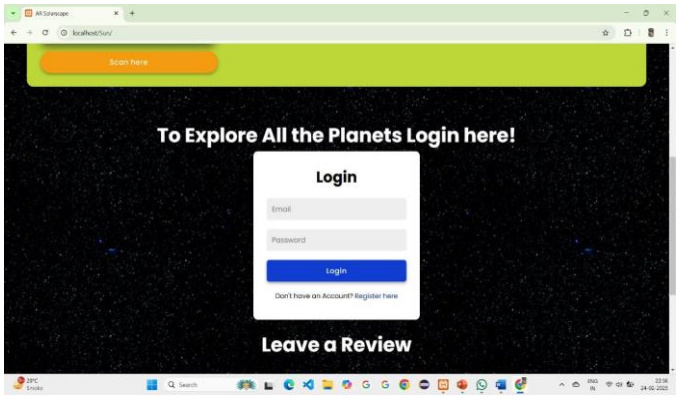

Fig. Login Page

Accessing the Solar System website is a simple and straightforward process that allows users to engage with a variety of interactive tools and educational materials. To begin, users should navigate to the official site and select the "Login" or "Sign In" option. They will then be asked to provide their registered email address and password. For added security, some websites may include features like two-factor authentication. After successfully logging in, users can explore immersive AR models of the solar system.

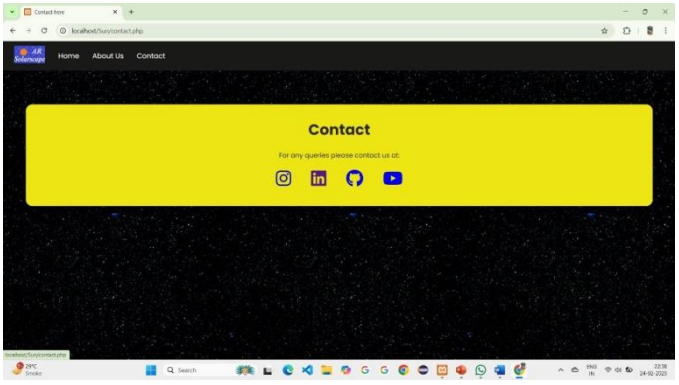

Fig: Contact Us

The Contact page of the AR Solarscape website provides users with multiple ways to reach out for inquiries. It features a bright yellow contact section against a starry space-themed background, reinforcing its astronomy focus. The page includes links to Instagram, LinkedIn, GitHub, and YouTube, encouraging engagement through social media and developer platforms. The navigation bar allows users to access other sections like Home and About Us. The presence of a localhost URL suggests that the website is still in the development phase, likely being tested before its official launch.

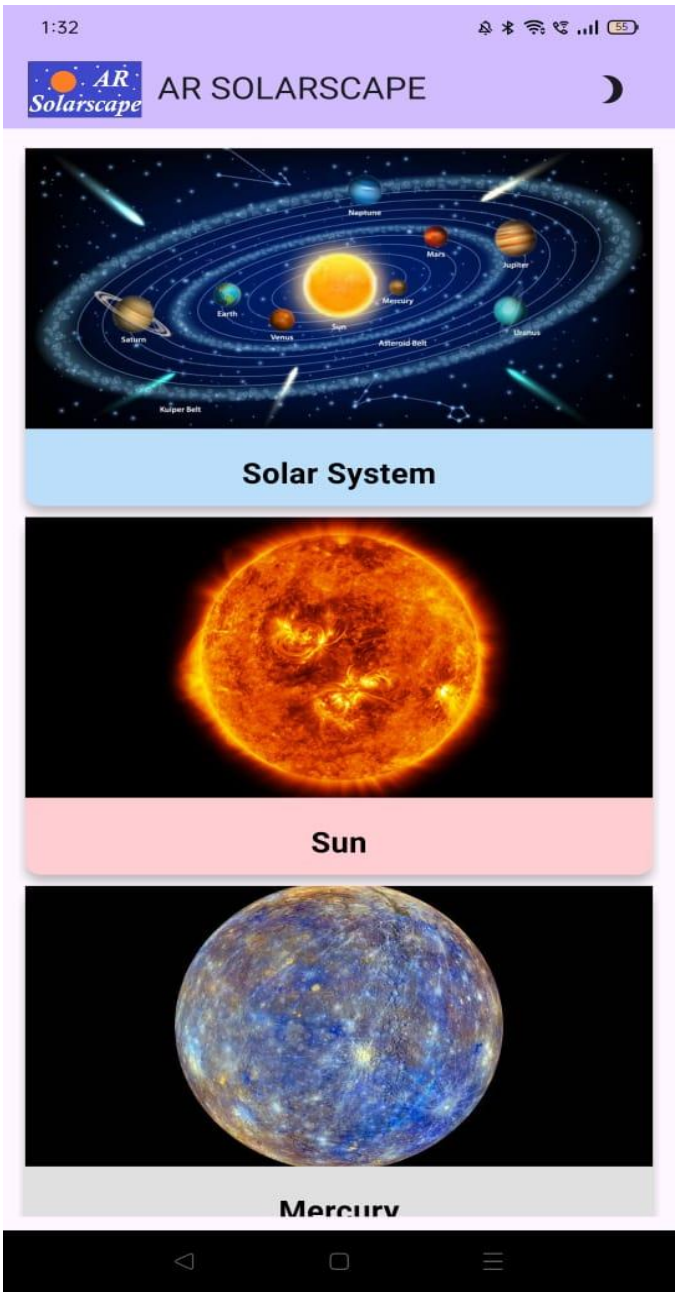

Fig. Application Page

The App section presents a structured layout with images and labels for different celestial objects. The Solar System section displays a complete diagram of planetary orbits around the Sun. Below that, individual celestial bodies such as the Sun , Mercury, Venus, etc. have dedicated sections, each accompanied by high-quality images and labeled buttons. This design suggests that tapping on these sections provides users with detailed information, AR interactions, or educational content about each planet or star.

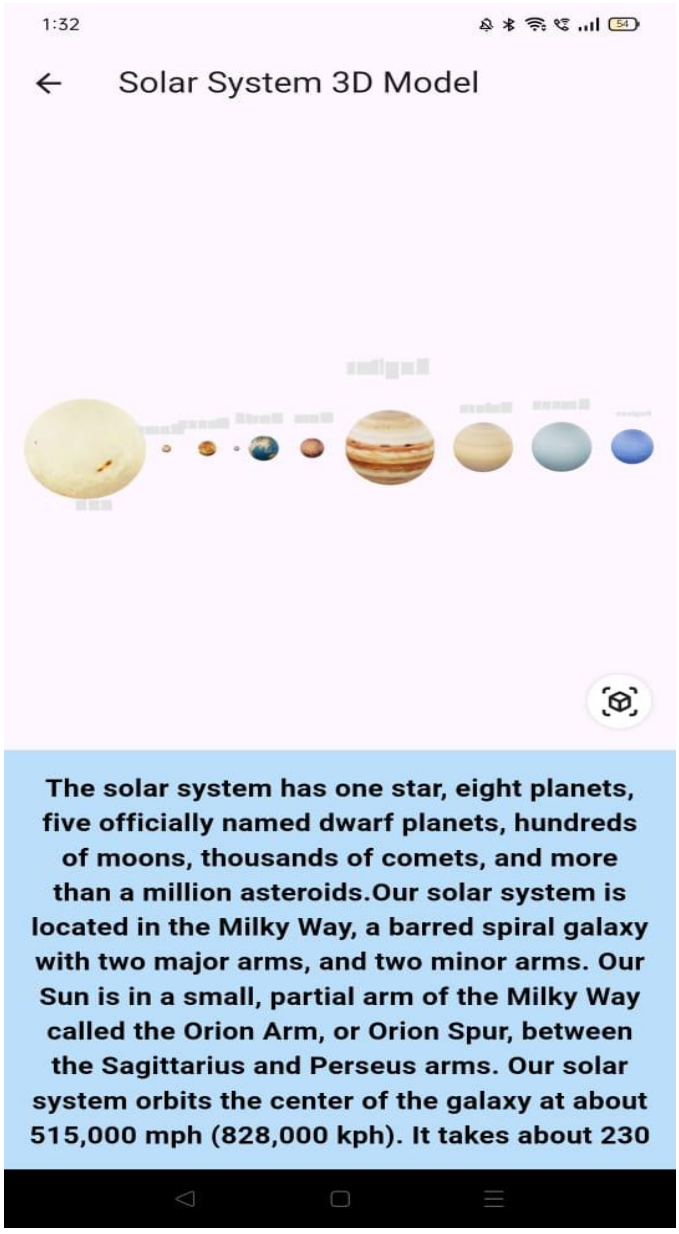

Fig. AR App Model

This page from the AR Solarscape app provides an interactive 3D model of the solar system, allowing users to explore celestial bodies in detail. At the top, a scrollable planetary lineup visually represents the Sun, eight planets, and other celestial objects, making it easy for users to navigate through different elements of the solar system. The presence of an AR interaction button suggests that users may have the option to view these celestial bodies in augmented reality, enhancing the learning experience.

Below the 3D model, a detailed informational section explains key facts about the solar system.

Fig. AR view

This AR rendering page from the AR Solarscape app showcases an interactive Augmented Reality (AR) model of Earth and its Moon, projected into the real-world environment. The Earth is depicted with detailed geographical textures, while the Moon appears realistically positioned near it, maintaining accurate scale and surface detail.

By integrating AR technology, the app bridges the gap between traditional learning and interactive exploration, making it an effective tool for students, educators, and anyone interested in understanding our solar system in an innovative and visually appealing manner.

3. USES OF AUGUMENTED REALITY

Augmented Reality (AR) is utilized across numerous industries, enriching user interactions by integrating digital elements into the real world. Below are some key areas where AR is commonly applied:

1. **Gaming:** AR has made a significant impact in the gaming industry by blending virtual elements with real-world surroundings. Popular titles like *Pokémon GO* and *Harry Potter: Wizards Unite* allow players to interact with digital characters and objects in their actual environment, creating a highly immersive experience.

2. **Education:** In the field of education, AR transforms traditional learning by offering dynamic and engaging visualizations. Through AR apps, students can explore complex subjects such as human anatomy, space science, or historical reenactments in a more interactive and meaningful way.

3. **Retail:** AR is revolutionizing the shopping experience by enabling customers to preview products in real-world settings before committing to a purchase. With AR-powered apps, users can virtually try on clothes, see how furniture fits in their living spaces, or test cosmetic products on their faces.

4. **Navigation:** Augmented reality enhances navigation by overlaying directions and landmarks directly onto the user's view of the real world. These applications offer live guidance, display tourist attractions, and highlight key locations, making it easier to find one's way in new or unfamiliar places.

5. **Industrial Training:** In sectors like manufacturing, maintenance, and technical repair, AR is used to support hands-on training. By projecting visual instructions directly onto machinery or equipment, AR helps workers follow procedures more accurately and efficiently, reducing the likelihood of mistakes.

4. CONCLUSION AND FUTURE SCOPE

Integrating Augmented Reality (AR) in the study of the Solar System provides an immersive and interactive learning experience that enhances both engagement and comprehension. By visualizing planets, moons, and other celestial bodies in 3D space, AR allows students to explore the Solar System in a more dynamic and interactive way compared to traditional methods. It brings abstract concepts to life, helping users understand complex spatial relationships, planetary movements, and sizes on a much deeper level. This project demonstrates how technology like AR can revolutionize education by making learning both fun and informative, and for more innovative approaches in science education. This immersive method of learning enhances engagement, allowing students and users to explore planetary details that are otherwise difficult to grasp through textbooks or static images. By bringing the Solar System into our immediate environment, AR provides an intuitive way to bridges the gap between the theory knowledge and real-world experience.

5. REFERENCES

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