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Plunge Into an (Augmented Reality) Supermassive Black Hole

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Abstract

A combination of a real scene viewed by a user and a virtual scene generated by a mobile device augments the scene with additional information. An Augmented Reality (AR) system adds virtual computer-generated objects, audio, and other elements to a real-world environment in real-time. AR is being used across various sectors like gaming, entertainment, education, medicine, science, physics, spacetime, and so on, worldwide. AR brings together a new way of sharing information and interaction capabilities. It provides an experience to view objects in 3D, and explore them in their minutest details. AR, due to its immense potential, is the next step in interactive education. Why AR? Here's why:

1. Improved Information: One of the pros of Augmented Reality applications is that it provides the user with additional information on the product, space, and material in real-time. Also, the consumer can retrieve valuable information about the product's characteristics, its use, availability, and more.
2. Easy Visualization: AR makes it possible to visualize an object in a personalized context. The consumer or user can modify its characteristics (size or color) or observe it under all its seams.
3. User Experiences: Another significant advantage of Augmented Reality applications is that it is extremely easy to use. Suitable for all age groups and easy to learn, these applications help the user understand things and visualize them better.
4. All-in-one experience: AR applications, specially dedicated to education, can provide a sonic and visual experience at the same time. The concept being viewed can be explained through audio, which makes the experience even more immersive and interactive. Also, features such as pop-up texts containing additional information can be included.

Keywords

Augmented Reality, Virtual Reality, Mixed Reality,
Augmented Reality Wearables, Smart Glasses,
Human-Computer Interaction, Spatial Computing,
Artificial Intelligence, Machine Learning,
Computer Vision, ARCore, ARKit, MLKit, Unity

Introduction

AR creates a 3D image on your phone or tablet and allows you to manipulate it the way you want. Once the app is opened, users can navigate and hold their device over a plane surface and the Augmented Reality representation will appear on their screen. AR aims at simplifying the user's life by explaining difficult concepts by displaying interactive information in real-time by bringing virtual information not only to immediate surroundings but also displaying it in a three-dimensional perspective. AR application can help users to showcase complex physics and spacetime topics easily within minutes. It will also assist physicists and astrophysicists in explaining spacetime concepts and ideas in greater detail using AR. On the tip of fingers, animated simulation and visualization of a black hole and how its gravity distorts the view, warping its surroundings. The application simulates the appearance of a black hole where the matter has collected into an accretion disk. The black hole's extreme gravity distorts light emitted by different regions of the disk, producing a misshapen appearance. Moreover, it explains various aspects of the black hole visualization such as:

1. Doppler beaming
2. Image of the disk's far side
3. Photon ring
4. Blackhole shadow
5. Image of the disk's underside
6. Accretion disk
7. Event horizon
8. Singularity
9. Relativistic jets
10. Innermost stable orbit
11. Schwarzschild radius

The Augmented Reality iOS application uses Apple iPhone smartphone's camera and sensors such as Lidar to detect the present location of surrounding items, then it detects and calculate the plane surface, when the user taps on the surface, then the application places a marker, once the markers are active the 3D model of a black hole will appear on the screen. Users can scale in/out, rotate and tap it.

Methodology

1. Understanding Augmented Reality Programming, Black hole, and its Concepts
2. Designing 3d Model of a Black hole with Blender
3. Programming with Swift, Unity, ARKit in Xcode
4. Assessment, Evaluation, and Validation of Program

Understanding Black Hole

A black hole is a space, a black body, as it reflects no light. A matter compressed in a very small area - imagine a star three times huge than Sun from our Solar System constrict into a sphere approximately the diameter of 20 miles. This results in a place where gravity is so strong that particles, electromagnetic radiation, and even light cannot accept it. Scientists can't directly observe black holes with telescopes that detect x-rays, light, or other forms of electromagnetic radiation. We can, however, infer the presence of black holes and study them by detecting their effect on other matter nearby. If a black hole passes through an interstellar matter,

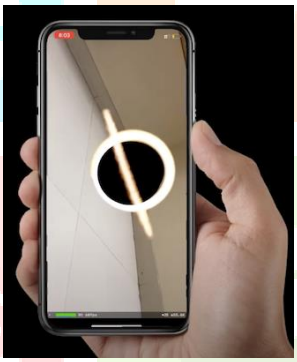
it will draw matter inward in a process known as accretion. A similar process can occur if a normal star passes close to a black hole. In this case, the black hole can tear the star apart as it pulls it toward itself. As the attracted matter accelerates and heats up, it emits x-rays that radiate into space.

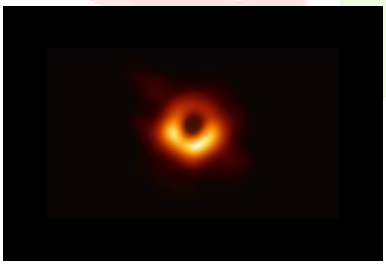
M87 Supermassive Black Hole

It is a supermassive black hole in the center of Messier 87, an elliptical galaxy some 55 million light-years from Earth. This black hole is 6.5 billion times the mass of the Sun. Catching its shadow involved eight ground-based radio telescopes around the globe, operating together as if they were one telescope the size of our entire planet.

(Image Credits: Nasa, Event Horizon Telescope)

Insight of M87 Supermassive Black Hole in Augmented Reality





As it can be seen from the images, the black hole when displayed in Augmented Reality, is of great benefit. This technology can be useful to physicists and astrophysicists to entirely explain about M87 supermassive black hole and its various aspects in real-time animated simulation and audio information.

(Developed by: 'Author' Atharva Kulkarni, for iOS platform: Application preview)

Future Scope

Augmented Reality is a more recent technology than Virtual Reality and shows an interdisciplinary application framework, in which, nowadays, education and learning seem to be the most field of research. Indeed, it allows supporting learning, for example, increasing-on content understanding and memory preservation, as well as on learning motivation. AR, VR is set to dominate the next age of retail through product visualization. It is the kind of tool, which will be useful for years to come.

Conclusion

Augmented Reality in Physics, Astrophysics, Space exploration, and Astronomy is surging in popularity. Through AR, users can improve learning outcomes through increased engagement in real-time. It is crystal clear that AR in the above fields can turn out to be a very exciting and useful intervention that will change it for the next years. Although it is still in an infancy stage, its future possible applications are infinite. Advanced research in AR includes the use of wearable for visualization purposes with controlled systems.

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