

Enhancing Engineering Education with Augmented Reality Visualization

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Abstract: *An augmented reality mobile app is an application that overlays digital content on top of the real-world environment through a mobile device's camera. Our project, named ARchino, is an augmented reality mobile application designed to assist users in visualizing hardware components in a 3D model format. The application utilizes the Vuforia engine for database management and Unity software for 3D model integration. The project aims to improve the user experience in understanding and identifying the hardware components by providing an interactive and immersive experience. The goal of this project is to develop an augmented reality (AR) app used for self-paced learning. This AR app allows IT students to learn about different components of computer hardware in a more interactive and engaging way. AR apps use 3D models of computer hardware components such as CPUs, servers, Keyboard, Mouse and other hardware components. Students can use AR app to view these components in a 3D layered structure, giving them a clear understanding of the various layers and their relationships. The AR app also allows students to rotate and zoom in/out on components, and learn about the different specifications of each component. Overall, this AR app has the potential to revolutionize engineering education by providing students with a more engaging and interactive way to learn about computer hardware.*

Keywords: Augmented Reality, Mobile App, Vuforia SDK, Unity3D, Blender, AR Camera, 3D Model

I. INTRODUCTION

The field of engineering education has always been challenging, with students often finding it difficult to grasp complex concepts related to computer hardware architecture. Traditional teaching methods have limitations in terms of providing an interactive and engaging learning experience for students. To address this, the use of augmented reality (AR) technology and 3D modeling has gained popularity in recent years. AR technology allows users to overlay digital content in the real world, while 3D modeling provides a more realistic and detailed representation of objects. This project aims to develop an AR app for engineering education that uses both AR technology and 3D modeling to provide students with a more interactive and engaging learning experience. This app allows students to visualize computer hardware architecture in a 3D layered structure, giving them a clearer understanding of the various layers and their relationships. In addition, the app allows students to rotate and zoom in/out on components so they can view the various specifications of each component in greater detail. The use of AR technology and 3D modeling in this app has the potential to revolutionize engineering education by providing students with a more engaging and interactive way to learn about computer hardware. By allowing students to interact with virtual components in a 3D environment, the app will enable them to gain a deeper understanding of the concepts in a way that traditional teaching methods cannot. Overall, this project has the potential to enhance the learning experience for engineering students and improve their overall performance in the field.

II. METHODOLOGY

A. Software

Blender is the primary software that will be used in the development of the 3D models for the AR engineering education app. Blender is a free and open-source 3D modelling software that offers powerful tools for creating complex

3D models, animations, and visual effects. Blender can be used to create 3D models of the computer hardware components that will be incorporated into the app. Using Blender, the 3D models can be created with high accuracy and detail, ensuring that the students have a clear understanding of the different layers and relationships of the computer hardware components. Blender allows for the creation of realistic textures and materials that can be applied to the 3D models, making the app more engaging and interactive. Software is a critical aspect of the development process for the AR app. Unity is a powerful game engine that provides tools and features to develop interactive 3D applications, including AR. The platform is well-suited for creating complex 3D models of computer hardware components that can be visualized in a 3D layered structure. Additionally, Unity's AR Foundation package, along with other AR plugins, will be used to create the AR experience. Another significant software used in this project is Vuforia Engine, a popular AR platform that provides image recognition and tracking capabilities. Vuforia is designed specifically for creating AR experiences on mobile devices and is a widely-used AR tool in the industry. The software will be used to enable image recognition of the computer hardware components and to provide tracking capabilities so that students can interact with the 3D models. In summary, the software used in this project will enable the creation of a highly interactive and engaging AR experience for engineering students. By leveraging the capabilities of Unity and Vuforia, the app will provide a unique and effective way for students to learn about computer hardware.

B. Hardware

Augmented reality applications can be implemented through a variety of technologies such as desktop computers, handheld devices, head-mounted displays, and optical projection systems. The application described in this document requires only one hardware device, either a smartphone or a tablet, with the AR application pre-installed. Our application is specifically focused on Android devices.

C. Stages of App Development

Working with Blender

Blender is a 3D modeling software that can be used to create high-quality 3D models of computer hardware components for the AR engineering education app. Blender is a versatile and powerful tool that can be used to create detailed and realistic models of computer hardware components, such as CPUs, Servers, and other hardware. Blender can be integrated with Unity, the game engine used to develop the AR engineering education app, using various plugins and scripts. This integration allows developers to import 3D models created in Blender directly into Unity, where they can be used in the AR app. Using Blender to create 3D models for the AR engineering education app can enhance the quality and detail of the models, providing a more realistic and engaging visualization of computer hardware components. Additionally, Blender can be used to create custom animations and special effects, further enhancing the interactivity and engagement of the AR app. Furthermore, Blender can also be used to create custom textures and materials for the 3D models, giving them a more realistic and polished appearance. In summary, incorporating Blender into the development process of the AR engineering education app can significantly enhance the quality and detail of the 3D models, improving the overall user experience and effectiveness of the app.

Working with Vuforia Engine

In our project of creating an AR app for engineering education, Vuforia plays a crucial role in enhancing the interactivity and engagement of the app. Vuforia provides advanced computer vision capabilities that enable the AR app to recognize and track real-world objects and images, such as computer hardware components, and overlay digital content on them in real time. This allows users to interact with the 3D models of the computer hardware components in a more intuitive and natural way, enhancing their understanding of the components. One of the key features of Vuforia is its image recognition technology, which can detect and track real-world images and objects. In our project, this technology can be used to detect and track images of computer hardware components, such as keyboards or CPUs, allowing the AR app to display relevant information and 3D models associated with each component. These features can be leveraged in our project to enable users to interact with the 3D models of the computer hardware components in a more intuitive and engaging way.

Working with Unity AR

Unity is a critical component in the development of an AR engineering education app for computer hardware visualization. Unity is a cross-platform game engine that provides a robust set of tools for developing 3D applications, including AR apps. Unity's support for AR development includes the AR Foundation package, which provides a high-level interface for accessing AR features on different platforms. Unity is an essential tool for developing an AR engineering education app for computer hardware visualization. It provides a robust set of tools and features that make it easier to create high-quality, interactive AR experiences on mobile devices.

III. MODELING AND ANALYSIS

The augmented reality application approach makes it easy to achieve this. Today people are tech-savvy and have smartphones that support AR. So, the concept of designing an application for trying on a Mobile app that renders 3D layered model of Hardware. Better cameras and more accurate sensors have become available in mainstream devices these days. The current implementation of the application uses the Vuforia framework to probe the real-world environment, and allow users to place virtual objects in real-world context. The proposed system uses augmented reality for image tracking as a basis for improving user experience and better to understanding the content. With image tracking, when the user points their phone at an image or object, the app scans and recognizes the image and overlays a 3D model on top of it. Overlaying a digital 3D model with a target image by a camera is a basic requirement of the proposed system.

1. This application uses an AR-enabled mobile phone to scan a target image and display a 3d layered model of object to engage themselves in learning hardware.
2. Blender is software that provides a comprehensive set of creative capabilities for 3D computer animation, modeling, simulation, rendering, and composition.
3. The next step is to set the lights, shadows, and camera position for these models using various Unity3D components.
4. Next, a hardware model is selected, and the selected model is rendered, processed, and loaded into the scanned target image by the Vuforia Framework.
5. The 3D model is mapped onto the smartphone screen, determining the dimensions and appearance of the model displayed on the screen.

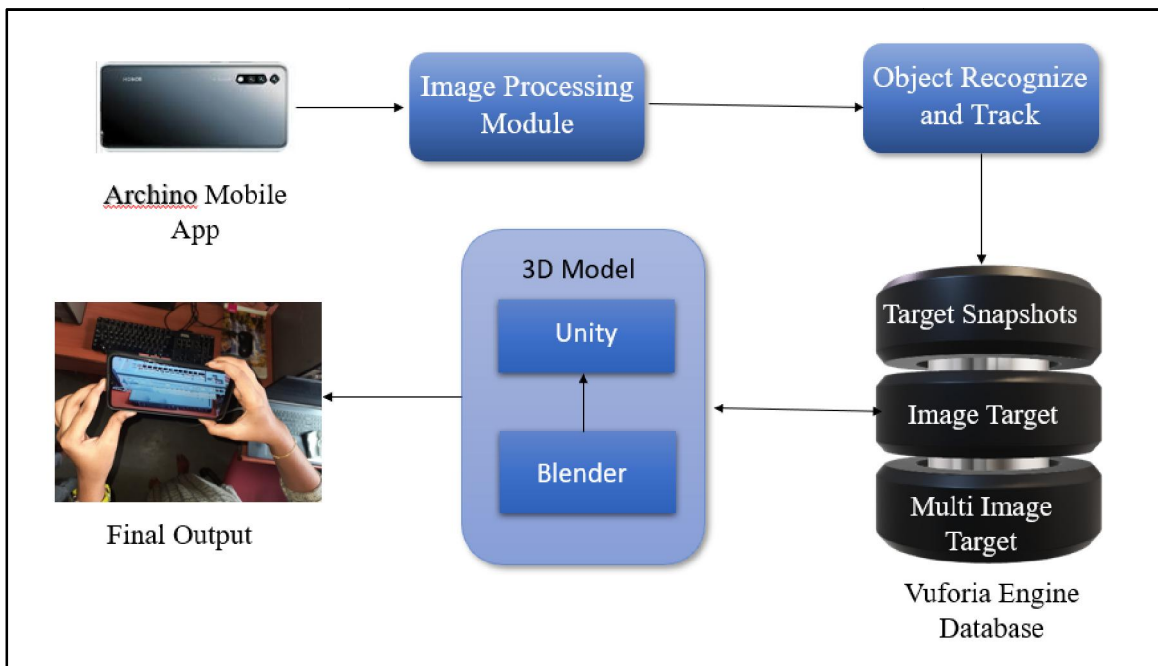


Fig. 1. System Architecture.

IV. MODEL IMPLEMENTATION

A. Creating a 3D Model

Collect reference images of the hardware from different angles to get a clear idea of its shape and dimensions. Start modeling the hardware by creating basic shapes and adding details. Use the reference images as a guide to create an accurate model and use tools like extrude, bevel, and loop cut to create different shapes and edges. Once the model is complete, add textures to give it a realistic appearance.

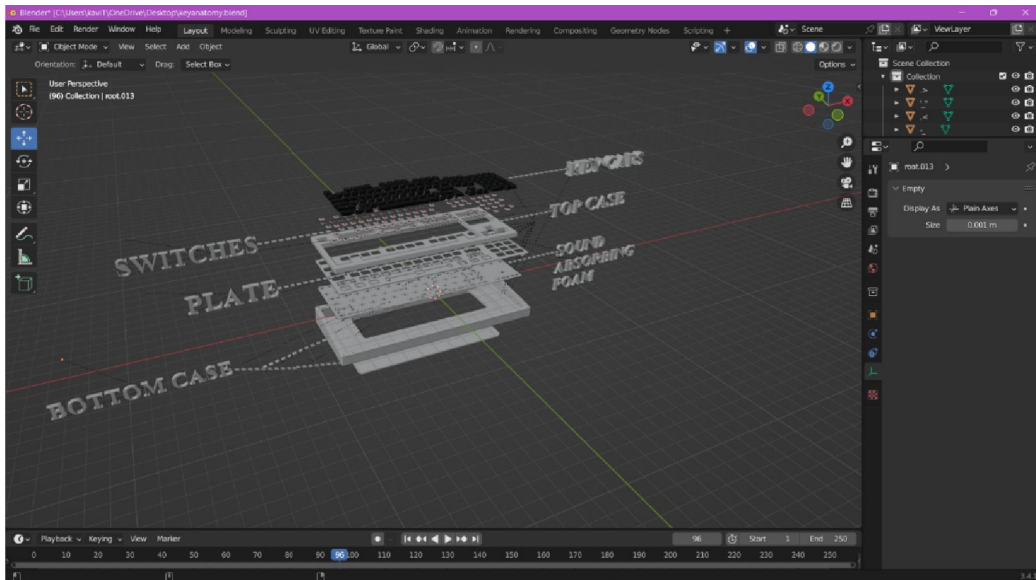


Fig. 2. Create a 3D model using Blender

B. Importing 3D Model into Unity

In Blender, export the 3D model in a compatible format for Unity, such as FBX. In the Unity editor, go to the "Assets" folder and select "Import New Asset." Browse to the location where you saved the exported 3D model from Blender and select it. Unity will then import the 3D model and create a new asset in the "Assets" folder. Drag the 3D model asset from the "Assets" folder to the Unity scene. Then manipulate the 3D model using Unity's various tools and components, such as adding materials, textures, and lighting.

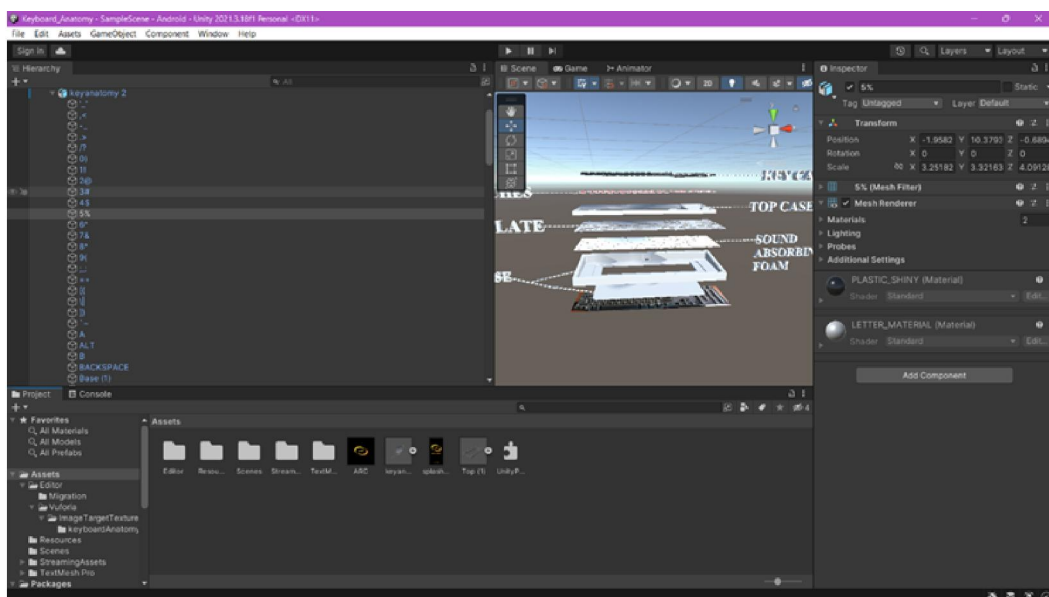


Fig. 3. Import 3D model into Unity

V. RESULTS AND DISCUSSION

A. Logo and Splash Screen

This is the logo and splash screen; the user can use the application in offline mode itself. We named the app "ARchino". It means the words "AR" (short for Augmented Reality) and "chino", which is the Italian word for "cypress tree". The name was likely chosen to evoke a sense of growth and stability. In this sense, the name "ARchino" could be interpreted to mean a stable and reliable platform for learning about computer hardware layers through augmented reality technology.



Fig. 4. Logo



Fig. 5. Splash Screen

B. View 3D Model

After the target image is scanned and the dots of the image are received, the 3D layered visualization of computer hardware will appear on the screen, with different components of the computer hardware.



Fig. 6. View 3D Model

VI. CONCLUSION

In Summary, the development of an augmented reality (AR) app for engineering education that utilizes 3D modeling has the potential to revolutionize the way students learn about computer hardware. While the current version of the app may have a limited number of 3D models in our database, adding more models in the future will greatly improve its functionality and usefulness for students. The app's ability to provide a more interactive and engaging learning experience for students has the potential to increase their interest and motivation in the field of engineering. By allowing students to visualize and interact with virtual components in a 3D environment, the app provides a more realistic and detailed representation of computer hardware architecture, which can be difficult to achieve with traditional teaching methods. This project not only has the potential to improve the learning experience for engineering students but also the potential to pave the way for the development of innovative educational tools in other fields. Overall, the AR app for engineering education is a promising tool that has the potential to transform the way students learn and engage with complex concepts related to computer hardware.

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