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**Research Article**

# Exploring the Educational Usability of Popular 3D Scanning Applications

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***Abstract*** **–** This study explores the educational usability of four popular 3D scanning applications - LumaAI, Polycam, KIRI Engine, and 3D Scanner App, by comparing their performance, user experience, and potential integration into teaching and learning contexts. Three of the applications (LumaAI, Polycam, and KIRI Engine) were tested on an Android device, while the 3D Scanner App was examined on an Apple iPad Pro to leverage its built-in LiDAR sensor. To assess their ability to handle challenging conditions, the target object was placed under a transparent glass dome, allowing us to evaluate how each application processes light refraction and reflections during the scanning process.

The analysis focused on two main aspects: (1) the quality and accuracy of the generated 3D models, and (2) the overall user experience, including accessibility, workflow simplicity, and platform compatibility. These criteria were then evaluated in relation to their potential application in educational settings, particularly for subjects where interactive visualization, digital modeling, or augmented learning experiences can enhance engagement and understanding.

Findings indicate differences among the applications in terms of usability, rendering fidelity, and suitability for classroom use. While some applications demonstrated robustness and ease of use, others struggled with reflective surfaces or required more advanced features. The results highlight both opportunities and limitations of current mobile 3D scanning tools, providing insights for educators seeking to integrate such technologies into pedagogical practice.

*Keywords – Luma AI, Polycam, LiDAR, Photogrammetry, Education.*

## I. INTRODUCTION

As an introduction, let's examine what 3D scanning, or otherwise known as photogrammetry, is. Photogrammetry and 3D modeling are rapidly advancing technologies that exert a considerable influence across multiple industries, including geographic information systems, education, construction, cultural heritage preservation, medicine, video game development, and the film industry. At their core, these technologies transform images and sensor-derived data into three-dimensional models, enabling the digital

reconstruction of real-world objects and environments. This approach provides a richer and more accurate representation of visual information, thereby enhancing the scope of analysis and visualization to an unprecedented level [1], [2].
Modern photogrammetry is increasingly becoming automated and more accessible through the integration of artificial intelligence (AI) and machine learning. These algorithms not only accelerate processing speed but also enhance data accuracy while reducing the need for human intervention. Machine learning contributes to the identification of usable points, the execution of geometric reconstruction, and the analysis of inter-image relationships, particularly when working with large-scale datasets [1], [2].

Augmented Reality (AR) technology has emerged in recent years as a noteworthy development that has significantly transformed 3D modeling processes. AR-enabled devices, such as conventional smartphones, allow users to interact with three-dimensional models in real time through actions such as rotation, scaling, or texture modification. This technology proves particularly valuable in educational settings, where interactive visualizations can reduce cognitive load and facilitate the comprehension of abstract concepts [3], [4].

Mobile devices, such as standard smartphones and tablets, also play a pivotal role in the widespread adoption of photogrammetry. Augmented Reality (AR) applications, such as Polycam, provide users with the ability to create 3D models at minimal or no cost and with relative ease. These applications are not only valuable in professional industries but are also increasingly employed in educational contexts, creative projects, or personal archiving [3], [4].

The applications of photogrammetry and 3D modeling are highly diverse. In the construction industry, three-dimensional models support both planning and maintenance processes, while in archaeology and cultural heritage preservation they enable the digital documentation and conservation of monuments. In medicine, such technologies facilitate precise diagnoses and the development of treatment plans, particularly within the fields of facial and maxillofacial surgery [1], [3], [2].

In the field of education, photorealistic 3D models (PR3DMs) provide not only visually enriched learning experiences but also methodological opportunities for enhancing teaching practices. These models enable students to achieve a deeper understanding of complex topics, including mathematical, scientific, and geographical concepts. Through interactive engagement with the models, such as rotation, zooming, or the visualization of different layers, learners can actively participate in the educational process, thereby strengthening the link between theoretical knowledge and practical application.
From a methodological perspective, such models are particularly valuable in interactive learning environments, where students can explore geometric elements and complex structures at their own pace. For instance, in a virtual classroom, learners may use 3D models to examine the structure of geological layers, the organization of molecules, or the details of architectural designs. This form of interactive learning supports deeper cognitive processing, as students participate not merely as passive recipients but as active explorers in the acquisition of knowledge.

For educators, the implementation of 3D models facilitates differentiated instruction, as the models can be adapted to the needs and abilities of individual learners. While students at lower levels may benefit from simplified, more accessible models, advanced learners can work with detailed and intricate visualizations. This approach accommodates diverse learning styles and fosters greater motivation by aligning the complexity of instructional materials with the learner's level of proficiency.
In summary, the application of 3D modeling in education can represent a substantial step forward in the modernization of teaching and learning processes, as it simultaneously fosters visual learning, practical experience, and individual student development. The incorporation of such models may contribute to the acquisition of deeper and more lasting knowledge, while enhancing both the effectiveness and the overall enjoyment of the learning experience [2], [4].

## II. MATERIALS AND METHOD

During our research, we conducted an examination of four widely used 3D scanning applications: LumaAI, Polycam, KIRI Engine, and the 3D Scanner App. The analysis further assessed the performance of applications incorporating artificial intelligence (LumaAI and KIRI Engine) in comparison to conventional solutions, as well as the relative effectiveness of the LiDAR-based 3D Scanner App when measured against the other apps.

A matte figurine was selected as the target object for the scans, since matte surfaces are generally more suitable for 3D reconstruction. The object was intentionally chosen as a common decorative item, making it more easily adaptable to educational contexts. To further challenge the applications, the target object was placed beneath a transparent glass dome, allowing us to investigate how each application processed transparency, light refraction, and reflections during the scanning process.

The research was carried out indoors under controlled lighting conditions. Artificial illumination was employed to ensure the presence of reflections on the glass surface, with light intensity maintained at 822 LUX, measured using an MS6612 Digital Lux Meter. Throughout the scanning sessions, the position of both the target object and the glass dome, as well as the lighting conditions, remained unchanged to guarantee consistency across trials.

Used devices and materials:

- Samsung Galaxy S25 Ultra 256
- iPad Pro 12.9 2020 256
- transparent, clear glass dome
- matte figurine (owl)
- MS6612 Digital Lux Meter
- Luma AI: 3D Capture (Android) [5]
- Polycam 3D Scanner & Editor (Android) [6]
- KIRI Engine (Android) [7]
- 3D Scanner App (iOS – iPadOS) [8]

Three of the applications examined (Luma AI, Polycam, and KIRI Engine) were tested on an Android device (Samsung S25 Ultra), while the fourth application (3D Scanner App) was tested on an Apple iPad Pro, as it leverages the device's integrated LiDAR sensor. At the outset of the study, it was hypothesized that the LiDAR-based application would yield the weakest results, given that laser beams are likely to penetrate the transparent glass surface, leading to challenges with light refraction and reflections and ultimately compromising the integrity of the 3D model.
In addition, the research investigated the relative performance of the artificial intelligence–driven applications (Luma AI and KIRI Engine) compared to the other tools utilized.

At the conclusion of our research, the educational usefulness of the examined applications was evaluated according to two primary criteria. The first criterion concerned user experience, specifically the ease of use and overall accessibility of the applications, while the second focused on the quality and fidelity of the resulting 3D models. High-quality models are essential for providing learners with reliable representations of objects, as distortions or inaccuracies can hinder comprehension and limit the effectiveness of the learning process.

### 1. 3D Scan – 3D Scanner App (iPadOS)

This application employs a specialized sensor for scanning, namely LiDAR, which was tested on our iPad Pro device. One of its notable advantages lies in its highly user-friendly interface, designed to streamline the scanning process for users with varying levels of expertise. The application is capable of performing most tasks automatically, including the activation and utilization of the LiDAR sensor, thereby minimizing the need for manual adjustments during operation.

In practice, the scanning procedure required us to move around the target object, while the application captured the data in video mode. Throughout the process, it was clearly visible on the display that the LiDAR system successfully detected nearly all surrounding surfaces with considerable precision. However, despite multiple attempts, the application was unable to achieve complete coverage of the target object placed beneath the transparent glass dome. This limitation highlights a significant challenge for LiDAR-based scanning when confronted with transparent materials, as issues related to light refraction and reflection interfere with the accuracy of the reconstruction.

At this stage of the research, the initial hypothesis, that the LiDAR-based application would produce the weakest results, appeared to be provisionally confirmed, although further analysis was necessary to fully validate the extent of the performance gap.
The app created the 3D model locally on our iPad, without using AI or the cloud.

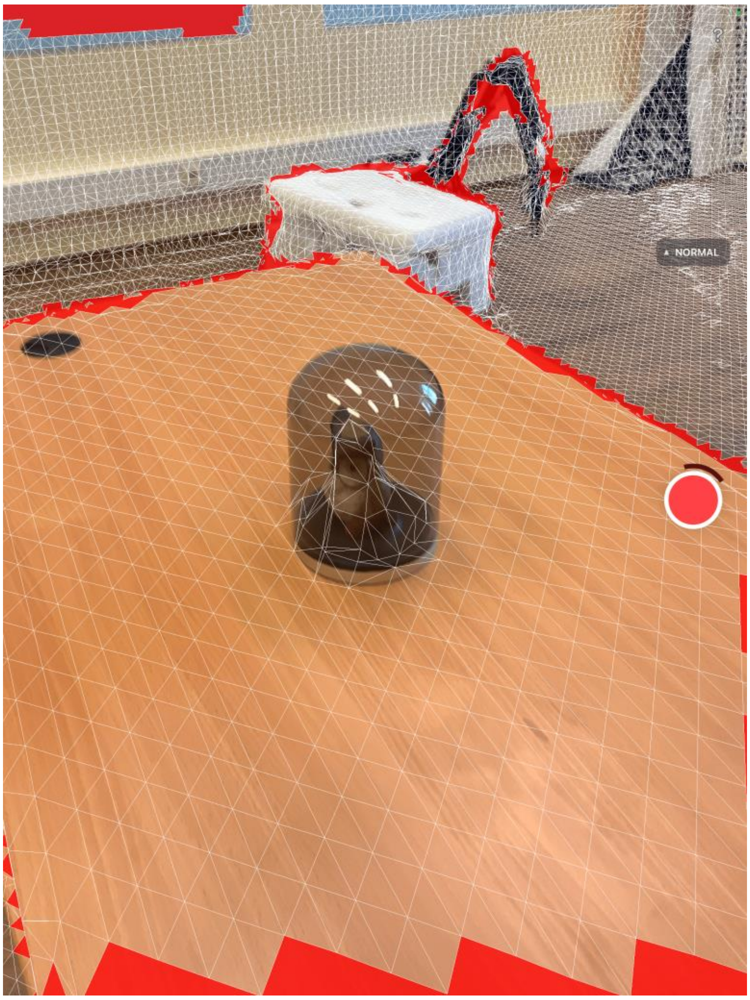


Fig. 1 Scanning process of the 3D Scanner App – the LiDAR covers almost all surfaces

**2. 3D Scan – KIRI Engine (Android)**
In contrast to applications employing specialized sensors, this particular app relied exclusively on the built-in camera of our Android device (Samsung S25 Ultra) for the scanning process. No additional hardware components or depth sensors were utilized, making the application accessible on a wide range of consumer devices.

The operation was straightforward and user-friendly, requiring only that the user move around the target object in order to complete the scan. For the purposes of our study, the application was tested in video mode, as this mode provided a more intuitive and efficient scanning experience.

The processing workflow of the application involved several distinct stages. First, the raw data collected during the scanning process were automatically uploaded to the developer's cloud service. Subsequently, the data were processed using artificial intelligence algorithms, which were responsible for reconstructing the three-dimensional geometry and generating a usable digital model. Once the computational procedures had been completed, the finalized 3D model was transmitted back to our device, making it readily available for further evaluation and analysis. This reliance on cloud-based AI processing illustrates the advantages of reducing local computational requirements.

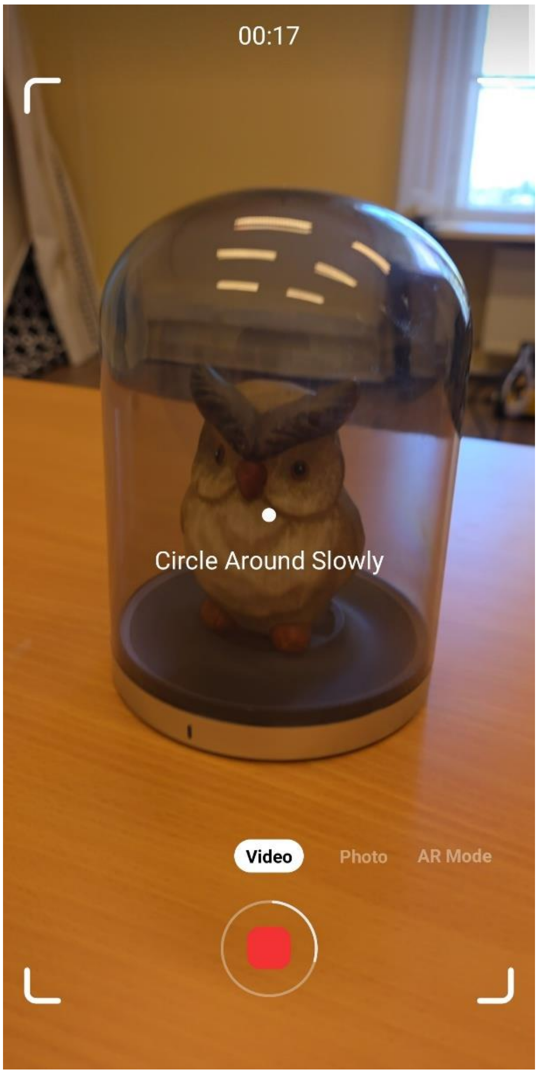


Fig. 2 Scanning process of the KIRI Engine app

**3. 3D Scan – Luma AI (Android)**

This application did not employ any specialized sensors for scanning; rather, it relied solely on the integrated camera of our Android device (Samsung S25 Ultra). The scanning procedure was designed to be both straightforward and visually engaging. Specifically, the application required the placement of an augmented reality (AR) dome over the target object, and then we had to walk around it in video mode to capture the necessary data for 3D reconstruction. During this process, the application provided immediate visual feedback by dynamically coloring sections of the AR dome to indicate which parts of the target object had already been successfully scanned. This feature not only enhanced usability but also assisted us in identifying unscanned areas that required additional coverage.

Once the data acquisition phase was completed, the application automatically uploaded the recorded information to a remote cloud server, where artificial intelligence algorithms were employed to perform the full reconstruction of the 3D model. Following this computational process, the finalized model was transmitted back to our device for review and further use.
This workflow demonstrates a clear emphasis on cloud-based AI processing, which reduces the computational demands placed on the mobile device while at the same time introducing a degree of reliance on external infrastructure for successful operation.

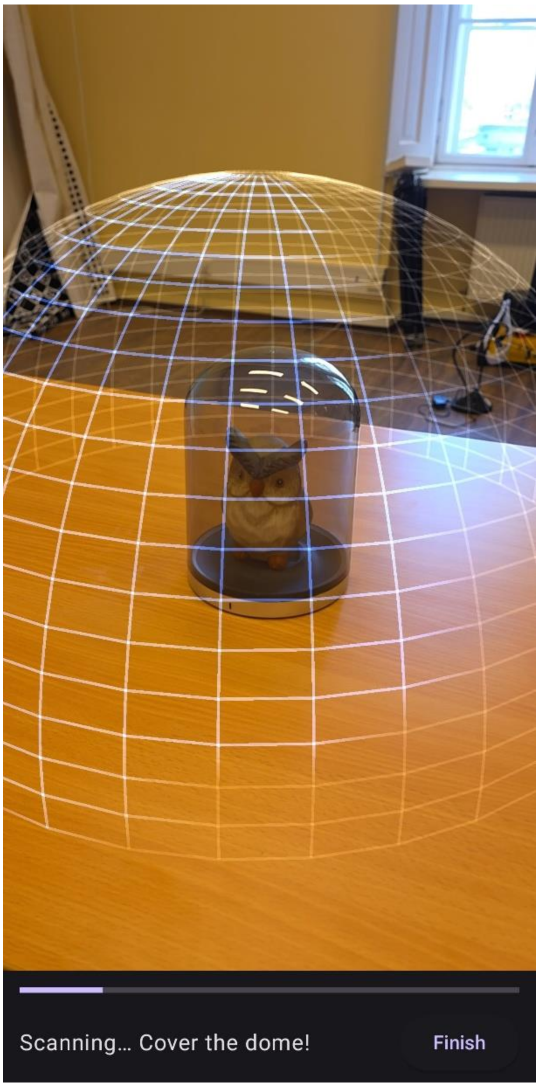


Fig. 3 Scanning process of the Luma AI app – the AR dome makes the process visually impressive

**4. 3D Scan – Polycam (Android)**
This application did not rely on any specialized sensors; instead, it utilized only the built-in camera of our Android device (Samsung S25 Ultra) to perform the scanning process. The overall user experience was straightforward and accessible, as the procedure simply required walking around the target object in video mode. Notably, despite operating in this mode, the application did not generate a continuous video file. Instead, it captured a sequence of still photographs, with the interface clearly indicating the number of images taken during the scan. This feature allowed us to monitor the progress of data collection in real time and ensured that sufficient coverage of the target object was achieved.

Once data acquisition was complete, the application automatically transferred the collected files to a cloud-based server for processing. No artificial intelligence algorithms were applied in the modeling phase. Instead, the 3D reconstruction was performed using conventional photogrammetric methods, after which the finalized model was transmitted back to our device. This workflow highlights a reliance on traditional computational techniques, which, while reducing potential algorithmic distortions introduced by AI, may also impose greater limitations on model fidelity and efficiency when compared with AI-enhanced approaches.


Fig. 4 Scanning process of the Polycam app

## III. RESULTS

The following section presents the resulting 3D models generated during the scanning process. These models serve as the primary basis for our subsequent analysis, allowing for a comparative evaluation of their accuracy, fidelity, and overall suitability for educational purposes.

**Results – 3D Scanner App**

The 3D model was generated in approximately ten seconds, without the involvement of artificial intelligence or reliance on external cloud-based services. Instead, the entire rendering and reconstruction process was executed locally, utilizing the processing capabilities of our iPad Pro.


Fig. 5 The 3D model generated by the 3D Scanner App, the model quality is poor

**Results – KIRI Engine**

The 3D model was completed in approximately one minute. In this case, the application employed artificial intelligence only partially during the rendering process, delegating the computational tasks to its proprietary cloud infrastructure. This workflow underscores the application's reliance on external servers for model generation, which reduces the processing burden on the mobile device itself but simultaneously introduces a dependency on stable internet connectivity and remote computational resources.


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Fig. 6 The 3D model generated by the KIRI Engine app, the model quality is good

**Results – Luma AI**

The 3D model was generated in approximately five minutes. In this case, the application relied entirely on artificial intelligence for the rendering process, delegating the complete reconstruction to its automated algorithms.

The extended processing time can be attributed to the application's use of a queue-based workflow management system, in which submitted tasks are processed sequentially on remote servers. While this approach allows for efficient allocation of computational resources across multiple users, it also introduces delays that may affect usability, particularly in time-sensitive educational or professional contexts.


Fig. 7 The 3D model generated by the Luma AI app, the model quality is exceptional

**Results – Polycam**

The 3D model was generated in approximately one minute. In this case, the application did not employ artificial intelligence during the rendering process. Instead, the captured data were uploaded to the developer's cloud infrastructure, where the reconstruction was performed using conventional photogrammetric techniques.

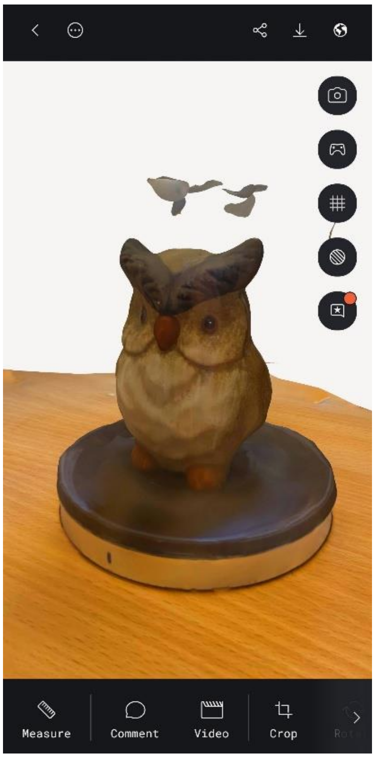


Fig. 8 The 3D model generated by the Polycam app, the model quality is good

## IV. DISCUSSION

After analyzing the resulting 3D models, several key conclusions were drawn. Our initial hypothesis, that the 3D Scanner App utilizing LiDAR technology would yield the weakest results, was ultimately confirmed. The output generated by this application may be characterized as a failure in terms of accurately reconstructing the intended target object. The LiDAR laser beams penetrated the transparent glass cover, disregarding both its material presence and its optical properties, such as refraction and reflection. Consequently, the application was unable to produce a faithful representation of the target. The resulting model proved unusable, as it bore virtually no resemblance to the original object apart from limited traces of color information. Nevertheless, it should be noted that the application was able to reconstruct the surrounding environment with a relatively high degree of accuracy, highlighting the context-specific strengths and limitations of LiDAR-based scanning.
The resulting 3D model was deemed unsuitable for educational use, as it failed to meet the quality and fidelity requirements necessary for effective teaching and learning applications. Nevertheless, the application demonstrates considerable potential when employed for the scanning of traditional matte surfaces, where its performance is likely to be more reliable and consistent.

The 3D model produced by the KIRI Engine application demonstrated a high level of quality and detail. The target object was reconstructed with notable accuracy, and the generated textures appeared sharp and well-defined. A particularly positive outcome was the application's ability to almost entirely exclude the transparent glass cover from the reconstruction. Nevertheless, minor imperfections were observed: due to light reflections on the glass surface, a small amount of extraneous "noise" or residual artifacts appeared in the vicinity of the target object. These distortions, however, were minimal in scope and could be easily removed during post-processing using supplementary software tools. Overall, the resulting 3D model can be considered not only usable but highly suitable for educational applications and classroom presentations, as it provides both visual fidelity and practical clarity.

The 3D model generated by the Luma AI application was of exceptionally high quality. Leveraging its artificial intelligence-driven reconstruction algorithms, the application was able to successfully model not only the target object but also the transparent glass cover, accurately preserving its optical characteristics, including transparency and reflections. The 3D representation of the target object beneath the glass dome exhibited a remarkable level of precision, with fine details faithfully captured and textures rendered sharply and consistently. Beyond the object itself, the application also reconstructed the surrounding environment with notable accuracy, resulting in a model that approaches photorealistic quality. Taken together, these outcomes indicate that the models produced by Luma AI are not only technically robust but also pedagogically valuable, making them highly suitable for integration into educational contexts as well as for use in professional presentations.

The 3D model produced by the Polycam application exhibited a quality comparable to that of the model generated by the KIRI Engine, although Polycam achieved these results without the use of artificial intelligence during the rendering process. The application was able to successfully filter out the transparent glass cover, reconstructing the target object beneath it with a high degree of accuracy and detail. The resulting textures appeared sharp, and the color information was rendered with fidelity, contributing to the overall realism of the model. Similar to the outcome observed with the KIRI Engine, minor artifacts caused by reflections on the glass surface were present in the final model. These imperfections, however, were minimal in scope and can be readily removed during post-processing using supplementary software tools. Taken as a whole, the 3D model created by Polycam can be regarded as fully usable for both educational purposes and professional presentations, providing a reliable and visually convincing representation of the scanned object.

## V. CONCLUSION

After testing the applications and examining the resulting 3D models, several conclusions can be drawn. From the perspective of user experience, specifically the ease of handling and operation, all four applications can be regarded as suitable for educational use. Each application is equipped with an intuitive and user-friendly interface, and complex computational processes are executed automatically in the background, thus minimizing the cognitive and technical demands placed on the user. This characteristic is particularly relevant in educational environments, where both teachers and students benefit from reduced barriers to entry and straightforward usability.

Among the applications tested, the 3D Scanner App provided the most favourable user experience. It proved to be the easiest to operate and, unlike the other tools, did not require user registration, thereby streamlining access. Furthermore, it generated the fastest 3D model, although the output was flawed and ultimately unsuitable for instructional use. In terms of overall processing speed, all applications completed the 3D reconstruction in a relatively short timeframe. However, in the case of the Luma AI application, the queueing system employed in its cloud-based infrastructure must be taken into account, as it can introduce delays that may limit its practicality in time-sensitive educational scenarios.

After analyzing the resulting 3D models, it can be concluded that the highest-quality outputs were produced by the Luma AI and Polycam applications. The model generated by Luma AI exhibited properties that approached photorealism, making it not only technically impressive but also particularly valuable in educational contexts where realistic and visually engaging representations can significantly enhance the learning experience. Polycam, while not achieving the same level of visual fidelity as Luma AI, produced a model with fewer extraneous artifacts - often referred to as “garbage” - than those observed in the reconstruction produced by the KIRI Engine. For this reason, Polycam is recommended as the second most effective tool, offering both realism and practical usability. Its output can be considered fully appropriate for integration into teaching and presentation settings.

The model produced by the KIRI Engine application, though exhibiting slightly more noise than that of Polycam, nevertheless achieved an excellent overall quality. Its detailed textures and accurate reconstruction confirm its suitability for educational use, particularly in contexts where visual precision is important for supporting conceptual understanding. Thus, while Luma AI and Polycam demonstrated the strongest overall performance, the KIRI Engine can also be considered a highly capable tool for educational applications.

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