Uluslararası İleri Doğa Bilimleri ve Mühendislik Araştırmaları Dergisi
Sayı 8, S. 43-51, 5, 2024

Araştırma Makalesi

International Journal of Advanced Natural Sciences and Engineering Researches
Volume 8, pp. 43-51, 5, 2024

Research Article

https://as-proceeding.com/index.php/ijanser
ISSN: 2980-0811

Photogrammetry Through the Luma AI Application and the Possibilities of its Use in Education

Gergely Kocsis*, Ondrej Takáč[1]

[1]*Department of Informatics, J. Selye University, Slovakia, EU*

(gk10156@gmail.com) Email of the corresponding author

(Received: 09 June 2024, Accepted: 25 June 2024)

(3rd International Conference on Frontiers in Academic Research ICFAR 2024, June 15-16, 2024)

ATIF/REFERENCE: Kocsis, G. & Takáč, O. (2024). Photogrammetry Through the Luma AI Application and the Possibilities of its Use in Education. *International Journal of Advanced Natural Sciences and Engineering Researches*, 8(5), 43-51.

Abstract **–** This document presents and analyses the user experience and functionality of the Luma AI application, with a specific focus on its photogrammetry capabilities. The application is accessible across multiple platforms including the Apple App Store, Google Play, and it has a website as well. Through the procedure of object scanning using common devices available to everyone - like an iPad or a cell phone, the document provides a detailed walkthrough of the scanning process, guiding the reader step-by-step through a real-world scanning scenario.

By analyzing the challenges and limitations encountered during the scanning and rendering procedure, the document offers critical insights into the efficiency and usability of Luma AI. From the firsthand experience gained during scanning sessions, this document identifies potential areas for improvement and highlights any inherent drawbacks in the application's functionality.

Furthermore, the document explores the educational implications of Luma AI's capabilities. By leveraging its photogrammetry features powered by AI, the application presents interesting possibilities for integration into educational settings, like constructing interactive learning experiences to enable virtual object exploration. The potential of Luma AI in education is examined and discussed in detail.

Through a combination of practical experimentation and theoretical analysis, this document provides a comprehensive overview of Luma AI's capabilities focused on photogrammetry, showcasing its potential as a tool for object scanning and as an asset in education as well.

Keywords – artificial intelligence, luma ai, photogrammetry, education, 3D models

I. Introduction

In order to better understand the subject, let's first take a look at what photogrammetry is. It is a technique for creating 3D models of the physical world by stitching together images, similar to assembling a puzzle. Photogrammetry is used in multiple industries, for example in mapping, architecture, archaeology, and more, it allows for detailed digital models and virtual walkthroughs of sites. There are two types of photogrammetry: aerial (capturing images from above) and terrestrial (close-range, detailed

image captures). Photogrammetry as a technique for capturing the world around us is constantly evolving, for example modern GPUs, like NVIDIA RTX, enhance photogrammetry by speeding up processing and handling large datasets for high-fidelity models. [1]
Nowadays, the spread of artificial intelligence also appears in photogrammetry. NVIDIA has developed a neural rendering model called “Instant NeRF” that can learn and render high-resolution 3D scenes in seconds. This technology significantly speeds up the photogrammetry process, which traditionally requires many photos and intensive software to mesh them together. Instant NeRF uses AI to deconstruct light in images, allowing for the creation of 3D scenes without depth sensors, achieving near-instant results. The model has vast potential applications, including training robots, self-driving cars, or rapid digital environment generation. [2]

In the following, we will try the application in guided object scanning mode. We will perform the test as an average user, in order to gain as comprehensive experience as possible about the use of the application, its possible errors, shortcomings and the results obtained.

II. Materials and Method

Since the creators of the application write on the App Store page that no special devices or Lidar scanners are necessary for its use, we performed the test with ordinary devices. [3]
Used materials and devices:

- Samsung Galaxy S22 Ultra 256GB
- iPad Pro 12.9 2020 version 256GB
- broadband internet connection
- matte black travel bag

The application can be downloaded from the App Store or GooglePlay. After downloading, the user must sign in with either their Google account or their Apple account. After logging in, the user interface of the application is clean, not too cluttered. The completed scans are available online from the user's account. Scans can be stored privately or publicly.

We chose a travel bag as the scanned object, due to its appropriate size and matte dark color. The scanning was done outdoors in natural light with a Samsung Galaxy S22 Ultra cell phone.
At the start of the scan, the user is greeted by a short tutorial section, which presents the scanning process through pictorial illustrations.

Fig. 1 Short tutorial section

After enabling access to the camera, a circular marker must be placed around the scanned object. The marker uses an AR view so it stays in place. The size of the marker can be changed freely. It is advisable to place this from the top camera angle, so that the scanned object is definitely located in the center of the marker.

Fig. 2 on the left Starting the scan

Fig. 3 on the right Placing the marker

Once the marker has been placed, we can move on by pressing the Scan button. With this, the application creates a virtual dome around the scanned object. By walking around the dome, we can perform the scanning process itself. Of course, we have to keep the camera of our device constantly on the dome.

The application also indicates the completion of the process visually, with a dark blue color on the dome and a progress line at the bottom of the window. After we have carefully walked around the dome from all angles with our device, the application automatically moves on to the next step, where we can give a name to our scan.

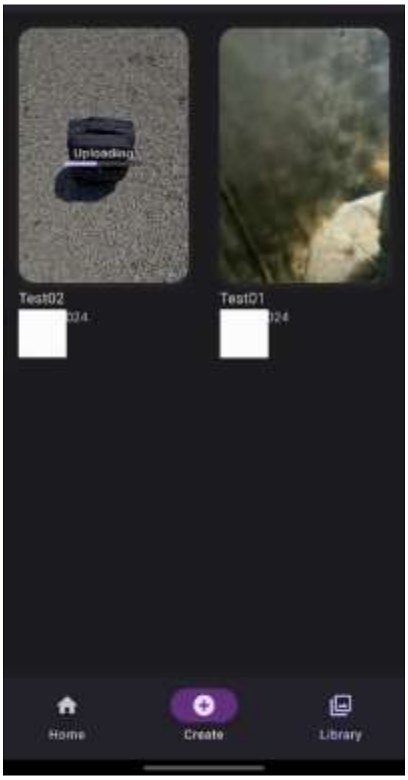
Fig. 4 on the left
Virtual dome around the object

Fig. 5 on the right
The scanning process

After naming our scan, it is possible to set the file to be publicly available or private. This is necessary because the application uploads the collected scan data to the cloud, where an AI-based system creates the final file from it. If, during the scanning, people were accidentally included in the data package, we have the possibility to use AI to filter them out of the final file.

Fig. 6 Naming our scan

After we move on, the application uploads the data collected during the scanning to the cloud and uses AI to create the final file, which is ideally a perfect 3D scan of our chosen object. The upload and processing process takes approximately 30 minutes, depending on the speed of our internet access.



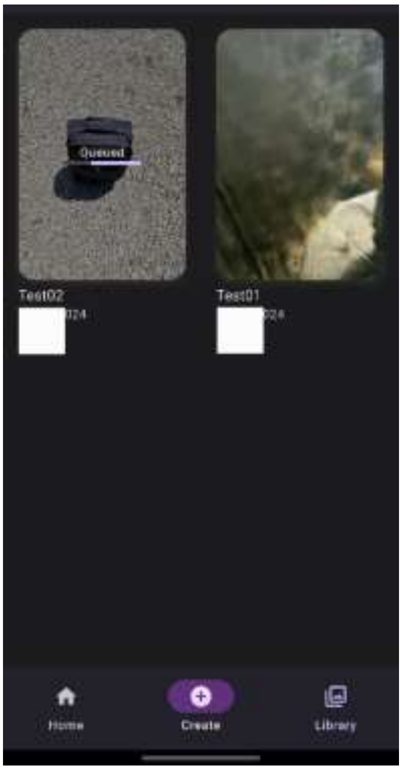
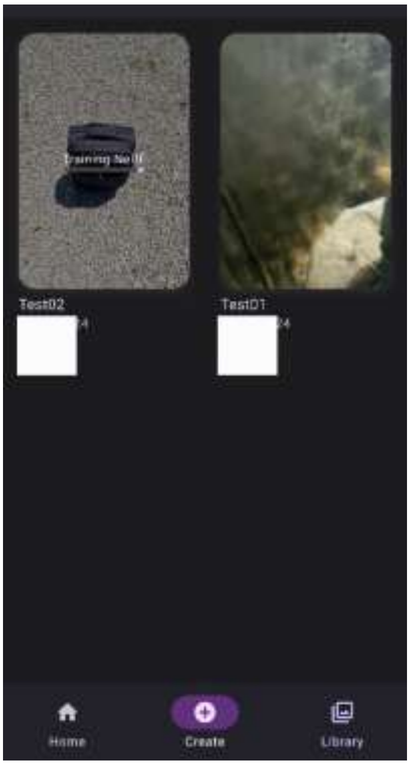


Fig. 7 on the left
Uploading our scan

Fig. 8 on the right
AI is preparing to process the data



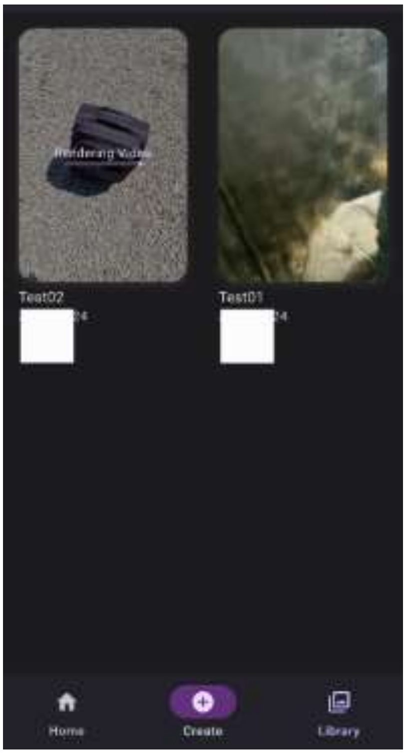


Fig. 9 on the left
AI is processing our scan data

Fig. 10 on the right
AI is rendering the final file

After the AI is done with the rendering, we get our 3D scan of the chosen object. The application first presents this in a spectacular video. We can stop the video at any time and rotate our now 3D object freely by touching it.

Fig. 11 on the left
The final 3D scan

Fig. 12 on the right
Even the ground
has details

The application gives us the option to download the final file in different formats or simply share it over the Internet.

Fig. 13 Sharing options inside the app

III. RESULTS

The scanning was primarily performed with an Android-based smartphone, and then repeated with an Apple iPad as well. (This document only describes Android scanning in detail). The end result was similar on both devices. Using the application and the scanning process was spectacular and relatively easy to use. The resulting 3D render of the scanned object (travel bag) was detailed, the colors reflected reality. The 3D render was sufficiently interactive, it could be rotated and zoomed. The application provided a sufficient number of options for sharing and saving the final 3D render of our object.

IV. DISCUSSION

Basically, the scanning process was intuitive and user-friendly, but we have to mention some areas where the application could improve in order to become even more usable.

- The application uses an AR view during the scanning process, which, although it is spectacular and works, sometimes the scanned object was visually out of alignment during the scanning. Obviously, this is only a limitation of the AR view and does not affect the final result, but it can confuse ordinary users.
- The app uses different AR displays on Apple and Android devices. While on Android the user has to scan around a 3D dome, on Apple devices the user has to scan along some virtual lines. The end result is the same, but the form of scanning in AR view is different. A unified AR view can be less confusing for users.
- During indoor testing, the application gave an incomplete final result. Some parts of the 3D render we received were not properly displayed, this could be caused by poor indoor lighting conditions or the fragmentation of the scanning process. We definitely recommend using the application in good lighting conditions, with enough free space around the scanned object, so that the scanning process is not fragmented, and we can walk around the object without interruptions.
- We found the sharpness of the final 3D render texture to be adequate, but it could be higher.
- The final rendering is done by an AI system, during our tests it took around 30 minutes in all cases. With the development of AI, this time could be shortened, making it more user-friendly.

The application can also have great potential in education. Students may find it interesting to use the AR view. They can learn about artificial intelligence and its uses in an interactive way. Since the application does not require special hardware, such as a Lidar scanner, its use in education is definitely easier, the students' smartphones are enough. In accordance with ISCED, students can learn about graphics and artificial intelligence in an interactive way, but the application also has great potential in the transition between different subjects. For example, they can scan plants (biology), small ruins or tools (history), paintings and drawings (arts), everyday objects (technical education) and the list goes on. The rendering time of about 30 minutes must be taken into account, but for homework, this is not a problem. Students can download the finished 3D renderings or share them directly with the teacher. Only the creativity of the teachers and students sets a limit to how it can be used.

V. CONCLUSION

During our tests, the application proved that expensive individual hardware (such as a Lidar scanner) is no longer necessary for photogrammetry. With the development and rise of AI, this area is also undergoing great development. Due to its relatively simple and user-friendly use, this application and similar ones have great potential for use in education as well.

ACKNOWLEDGMENT

The paper was supported by the national project, KEGA 014TTU-4/2024 “Intelligent Animation-Simulation Models, Tools, and Environments for Deep Learning.”

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