https://doi.org/10.36007/5093.2024.292

COMPARING PHOTOGRAMMETRY APPS IN LOW-LIGHT CONDITIONS FOR EDUCATION

Gergely KOCSIS[1] - Ondrej TAKÁČ[2]

ABSTRACT
This research provides a comparative analysis of the results obtained from three different photogrammetry applications, focusing specifically on the quality and accuracy of the 3D scans produced by each. The applications used, named Luma AI: 3D Capture, Polycam 3D Scanner & Editor and 3D Scanner App are widely available in the Apple App store and Google Play. The Luma AI and Polycam apps were tested on an Android smartphone, the 3D Scanner app on an iOS system, because it uses the LIDAR technology found on Pro Apple devices. The applications were purposefully tested in poor lighting conditions, then the results were compared and the usability of the applications was evaluated based on this. Furthermore, based on the analysis of the obtained results, we examined the usefulness of each application in education.

KEYWORDS
photogrammetry, artificial intelligence, 3d scanning, lidar, polycam, luma ai, education

INTRODUCTION

In order to better understand the subject, let's briefly examine what photogrammetry is. Photogrammetry is the art, science, and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring, and interpreting imagery. There are two general types of photogrammetry: aerial (camera in the air) and terrestrial (camera handheld or on a tripod). Photogrammetry is used for making precise measurements of three-dimensional objects and terrain features from two-dimensional photographs, including measuring coordinates, distances, heights, areas, and volumes, preparing topographic maps, and generating digital elevation models.[3]
It is used in various fields like archaeology, construction, agriculture, space exploration and many more. Innovations in drones and software have made photogrammetry more accessible and efficient.[4]
Based on this information, it can be said that photogrammetry means realistic 3D modelling of real physical objects and areas.

In the following, we will compare the 3D models obtained by 3 different photogrammetry applications. These applications are widely available in the Apple App Store and Google Play. We will perform the scanning indoors, with the same object in low-light conditions. The goal

[1] Mgr. Gergely Kocsis, J. Selye University, Faculty of Economics and Informatics, Department of Informatics, 106319@student.ujs.sk
[2] Ing. Ondrej Takáč, PhD., J. Selye University, Faculty of Economics and Informatics, Department of Informatics, takaco@ujs.sk
[3] ScienceDirect, Photogrammetry, 2015
[4] BuiltIn, What is Photogrammetry?, 2023

is to assess the usability of these applications in low-light conditions by visually comparing the obtained 3D models.

USED MATERIALS AND RESEARCH PROCESS

The research was carried out indoors, in low-light conditions. During the 3 scans, we used the same object (backpack) and the lighting conditions did not change.
Used devices and materials:

- Samsung Galaxy S22 Ultra 256
- iPad Pro 12.9 2020 256
- grey matte coloured ordinary backpack
- Luma AI: 3D Capture (android)[5]
- Polycam 3D Scanner & Editor (android)[6]
- 3D Scanner App (iOS)[7]

Adequate lighting conditions cannot always be ensured during the educational process or during classes. Our aim was to assess the usability of the listed photogrammetry applications in low-lighting conditions, and then, based on the results, to determine which application or applications can be used in education as well.

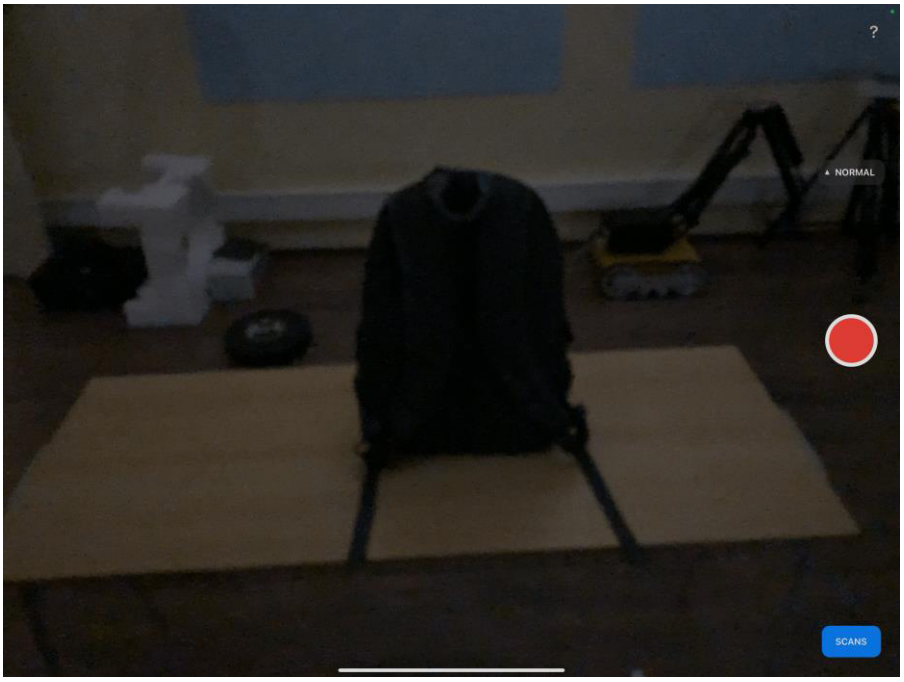
We tested two of the three applications (Luma AI, Polycam) on an Android device (S22 Ultra), the third application also uses the LIDAR sensor found on Apple Pro devices, so it was tested on an iOS iPad Pro device. Before conducting the experiment, our hypothesis was, that the best result would be provided by the application used on the Apple device, the 3D Scanner App, because of the use of the LIDAR sensor.

As the subject of the scans, we chose an everyday object that occurs in education. Gray matte backpack, which thanks to its texture and sufficiently detailed surface design is perfectly suitable for 3D scanning. The scans were performed indoors, with minimal light conditions. During the scans, the position of the scanned object did not change and the lighting conditions were also constant. During all three scans, the devices only used their cameras and sensors, no flash or other additional light sources were involved.

The first scan – 3D Scanner APP (iOS)

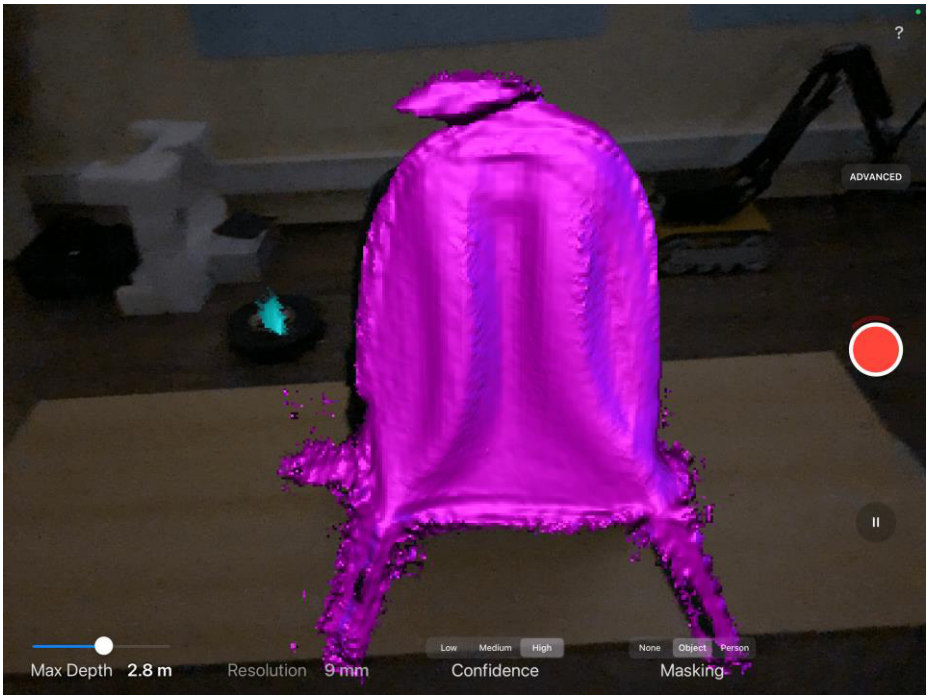
The first scan was performed with the 3D Scanner App installed on the Apple Ipad Pro device. The application continuously used the device's LIDAR sensor during scanning, but did not artificially illuminate the half-dark environment on the device's display.

[5] Google Play, 2024
[6] Google Play, 2024
[7] Apple App Store, 2024



1. *Figure: Scanned object in the field of view of the 3D Scanner App. The low-light conditions in the room are clearly noticeable.*

During the scanning process, the application did not give any error messages for low-light conditions, the LIDAR sensor detected the scanned object without any problems. Rendering the final 3D model took about 15 seconds and used the computing power of the iPad's processor.



2. *Figure: Scanning process with 3D Scanner App. The LIDAR sensor detects the scanned object correctly even in poor lighting conditions.*

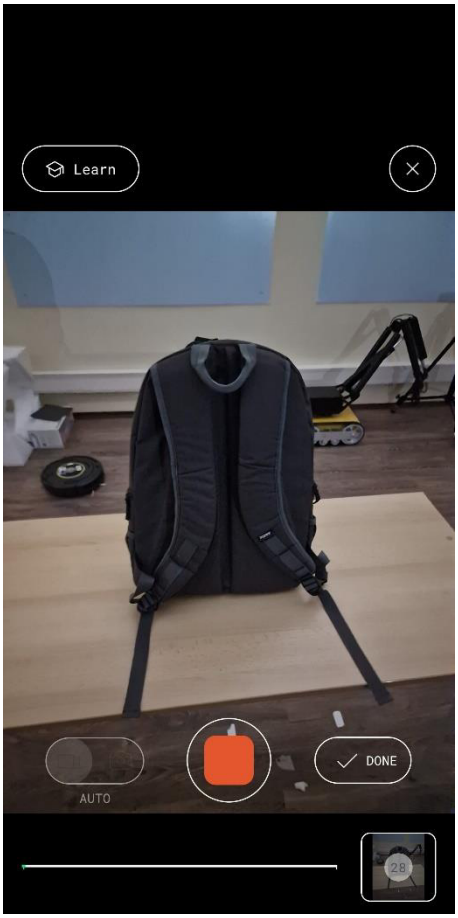
The second scan – Luma AI: 3D Capture (android)
The second scan was performed with the Luma AI: 3D Capture application. Since the use of the application does not require the presence of special sensors, such as a LIDAR scanner, we installed the application on an Android device (Samsung S22 Ultra).

During the scanning process the app artificially illuminated the half-dark environment on the device's display and did not give any error messages for low-light conditions. Rendering the final 3D model took about 30 minutes, because it uploaded the data obtained during the scanning to their own servers and created the final 3D model with the help of AI.

3. *Figure: During scanning, the Luma AI app artificially illuminates the environment on the device's display. It does not turn on the flash of the device.*

The third scan – Polycam 3D Scanner & Editor (android)
The third scan was performed with the Polycam 3D Scanner & Editor application. Because the use of this application does not require any special sensors either, like LIDAR, we installed this app on our Android device (Samsung S22 Ultra).

Just like we experienced with Luma AI, during the scanning process this app also artificially illuminated the half-dark environment on the device's display and did not give any error messages for low-light conditions. The app uploaded the gathered data to their servers and then sent back the final 3D model. Rendering the final 3D model took about 15 seconds.

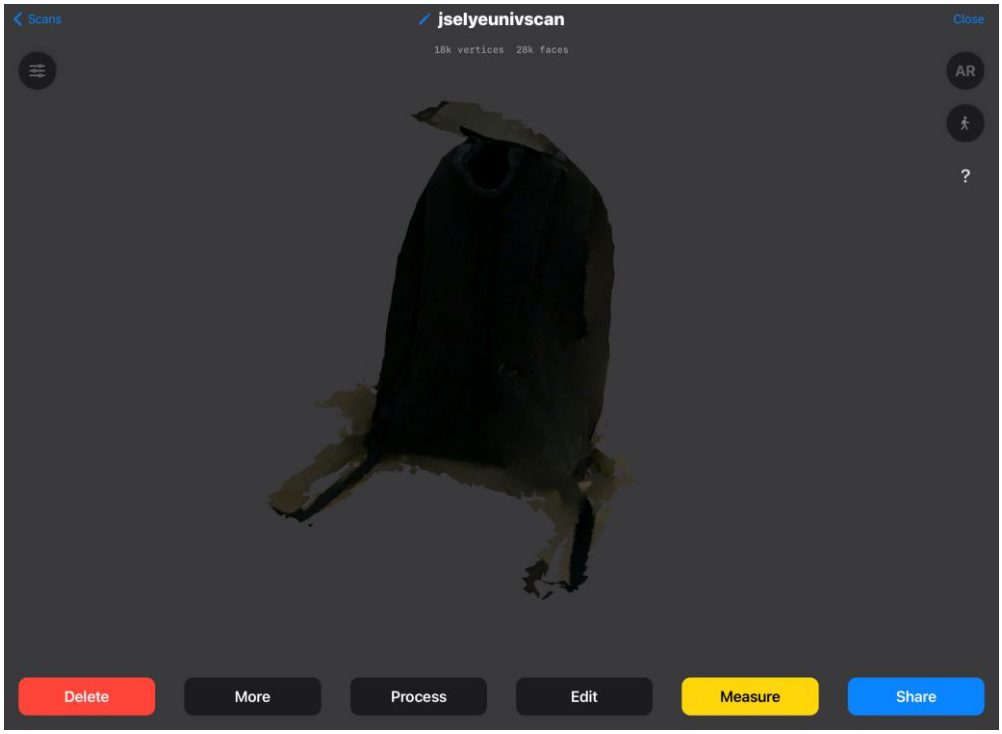


4. Figure: During scanning, the Polycam 3D Scanner app artificially illuminates the environment on the device's display. It does not turn on the flash of the device.

RESULTS

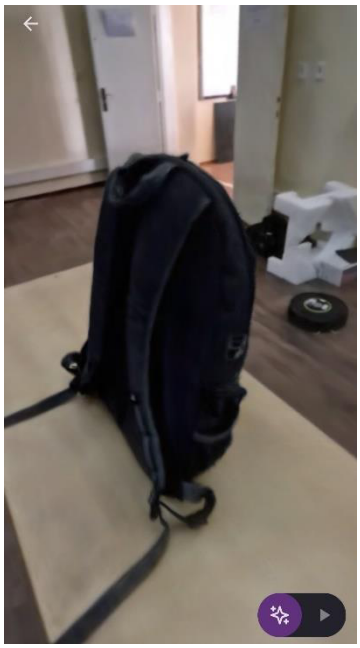
During the visual comparison of the obtained 3D models, we can see that the application using the LIDAR sensor, the 3D Scanner App, successfully completed the scanning despite the low-light conditions.

It only scanned the target object, which can be attributed to the LIDAR sensor, leaving the environment completely out of the final render. Although it defined the physical form of the object well, unfortunately the app for the most part omitted the texture and colour data from the final 3D render. Because of this, we obtained a rather poor quality result.



5. *Figure: The 3D model created by the 3D Scanner App lacks texture and colour data*

The Luma AI application performed the scan successfully even in low light conditions. The 3D model created by the app is very detailed, properly models the physical form of our object, and has sharp textures and a sufficient amount of colour data. The application also included the environment in the final render, which was sufficiently illuminated by software even in low light conditions. This is obviously due to the AI processing.



6. *Figure: The 3D model created by the Luma AI app is high quality, bright enough, almost photorealistic*

The Polycam application also successfully created the 3D model despite the low-light conditions. The resulting 3D model is even more detailed and of better quality than the model created by Luma AI. It has rich and detailed textures, we got an artificially well-lit 3D model, whose physical form is also almost perfect. Except for the table, the environment was left out of the final 3D model.

7. Figure: The 3D model created by the Polycam app is high quality, bright enough, almost photorealistic with rich texture, colour and geometric detail

CONCLUSION

By visual comparison of the obtained 3D models, we can see that the best result was produced by the Polycam application. Our hypothesis, that the best result will be produced by the 3D Scanner App using the LIDAR sensor, was not fulfilled.

It has been proven that all three applications can be used in low light conditions, their use in education is possible, but the following must be taken into account:
The 3D Scanner App may only be interesting for the presentation of LIDAR technology due to the shortcomings of the texture quality, the long rendering time must be taken into account when using the Luma AI app, and the free version of the Polycam application allows for a limited amount of scanning.

REFERENCES

Web page

Apple App Store (2024) 3D Scanner App
https://apps.apple.com/us/app/3d-scanner-app/id1419913995?platform=ipad

BuiltIn (27.11.2023) What is Photogrammetry? How Drones Contribute to Photogrammetry
https://builtin.com/software-engineering-perspectives/photogrammetry

Google Play (2024) Luma AI: 3D Capture
https://play.google.com/store/apps/details?id=ai.lumalabs.polar&hl=sk

Google Play (2024) Polycam 3D Scanner & Editor
https://play.google.com/store/apps/details?id=ai.polycam&hl=sk

ScienceDirect (2015) *Photogrammtery*
https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/photogrammetry