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CHOOSING A 3D SCANNER FOR THE TASKS OF THE DESIGNER

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Abstract. The modern development of 3D scanning technologies allows us to recreate the visible reality in the virtual world. For example, designers can experiment with digitised clothes in various graphic editors, changing their colour, material texture, etc. This allows them to review design options without wasting time on implementing the next iteration of the product, making their work easier.

In general, 3D scanners can be divided into two types of scanning: contact and non-contact. The article reviews the well-known common methods of active and passive non-contact scanning. Their disadvantages and advantages are briefly described.

***Methodology.** Based on systematisation and generalisation, comparative analysis of 3D scanner types, and information and research approaches.*

***The results.** The feasibility of using a smartphone as a modern tool for designers has been proven not only for photogrammetry today, but also opens up prospects for active scanning in the future. This is due to the constant improvement of smartphone cameras, the increase in their computing power and the introduction of new technologies, such as LiDAR / Time of Flight scanners in some models.*

The article lists the types of active and passive devices for three-dimensional scanning and describes the principles of their operation. The article provides a graphical representation of the layout of the working elements of active and passive 3D scanners. Based on the analysis of research, recommendations on the use of the device for scanning are given.

***Scientific novelty.** The scanning methods are analyzed, the methods disadvantages and advantages are shown.*

***Practical significance.** 3D scanning technologies are analysed, recommendations for selection are given.*

Keywords: design, 3D scanning, 3D scanning methods, 3D scanning method classification, hardware.

INTRODUCTION

There are a large number of devices and corresponding software for scanning objects used in various life spheres. For example, in medicine, when scanning the jaw in dentistry, when planning operations by plastic and neurosurgeons; in architecture, for digitising historical monuments, their reconstruction, and space planning; in forensics, for digitising crime scenes [24; 25], identifying people; in engineering, for reverse engineering [20]; in the entertainment industry, for motion capture [8; 19]

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for films, animations, and games. The type of device is chosen according to the task to be performed.

The modern development of 3D scanning technologies allows us to recreate the visible reality in the virtual world. For example, designers can experiment with digitised clothes in various graphic editors, changing their colour, material texture, etc. This allows them to review design options without wasting time on implementing the next iteration of the product, making their work easier.

ANALYSIS OF PREVIOUS STUDIES

3D scanning has become an indispensable tool for research, medical, architectural, commercial tasks and the development of design solutions. In their paper [22], the researchers proposed the use of adaptive laser 3D scanning to recreate the geometry of facade decor and subsequent restoration of the object. The authors of the article [21] substantiated the use of scanning of transport infrastructure objects for collecting and further processing information.

Studies by foreign scientists [3] have argued that it is possible to use less expensive and easier-to-use systems to perform tasks for which accuracy is not a key factor. In their article, a team of scientists proposed an alternative to the stationary and widely used 3dMDface system – the iPhone and the Bellus3D application with a standard deviation of up to 2 mm compared to the reference data of the standard system. The authors of article [13] conducted a comparative analysis of the characteristics of the devices and found that the use of iPhone and Bellus3D has a difference in measurements of up to 3 mm compared to the standard and a limited scope of application in medicine (orthodontic examination and evaluation). The researchers [6] proved that implements a proven 3D scanning method to create models of a designer chair and custom racing steering wheel. The results showed the potential of inexpensive, simple and accurate digitization at an early stage of product development and design.

OBJECTIVE

Consider the types of 3D scanners by technology and justify the choice in accordance with the tasks.

RESEARCH RESULTS AND THEIR DISCUSSION

It is known [2] that a 3D scanner is a device for building digital three-dimensional models based on the analysis of a real-world object or environment to collect data on its shape and, if possible, colour. 3D scanners differ by type (Fig. 1).

Contact 3D scanners digitise fixed objects by physically repeatedly touching the object's surface. They have a number of significant limitations, which makes them suitable for scanning only objects for reverse engineering/copying products [1].

Non-contact 3D scanners are devices used to create three-dimensional models of objects without physical contact with them. They are divided into passive and active.

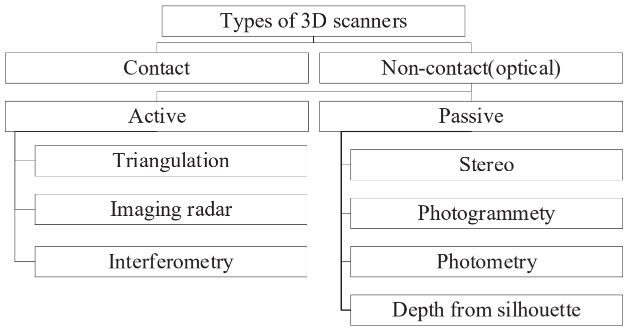

Fig. 1. Types of 3D scanners

Passive devices use ambient light and one (Fig. 2 a) or more cameras (Fig. 2 b) together with the necessary software to create objects digital models. These devices have a low cost, low accuracy, but low scanning quality. They include stereoscopic and photometric 3D scanners, and silhouette scanners.

A stereoscopic 3D scanner [12] uses two cameras or sensors to collect depth information and create a three-dimensional objects or scene's image. Scanning with this device is based on the principle of binocular vision, similar to how human eyes perceive depth by comparing images from both eyes. A typical stereoscopic 3D scanner typically consists of two cameras or other sensors that are positioned at a fixed distance from each other and simultaneously capture images with slight deviations in viewpoints. The images captured by the cameras are processed and analysed to create a 3D model, identifying differences between the two images.

Photometric 3D scanning [4], also known as photometric stereoscopy, is a technology that uses multiple 2D images of an object. It is photographed from several viewpoints under different light sources or at different lighting angles. Changes in lighting create different shadows and highlights on the object's surface, which are captured in a series of images that are then used to calculate the surface normal vectors at each point on the object using photometric

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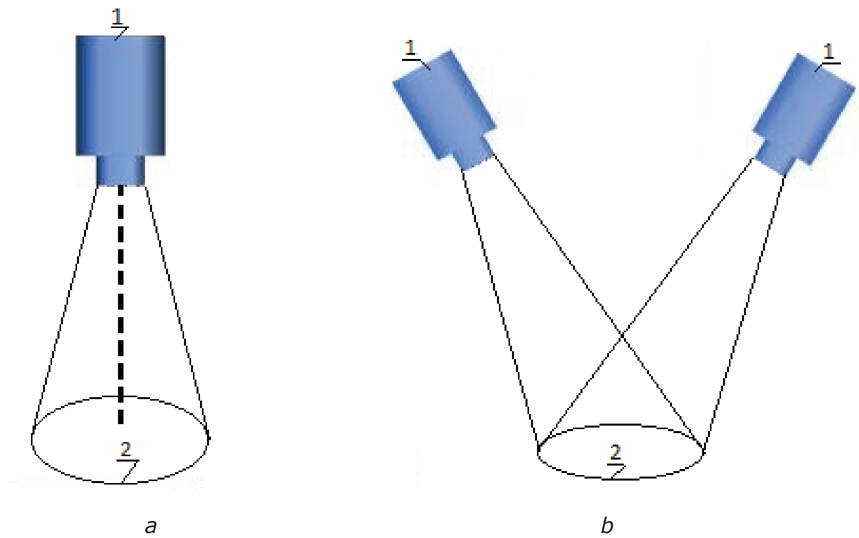


Fig. 2. Graphical representation of the location of working elements of passive 3D scanners: 1 – camera, 2 – object

stereoscopy algorithms. Normal vectors are vectors perpendicular to the surface at each point. Knowing their direction, you can recreate the three-dimensional shape of an object. The accuracy and resolution of the resulting 3D model depends on the number of images and the quality of the lighting.

Photogrammetric 3D scanning [11] is a technology that allows to obtain a object's three-dimensional model from its photographs. It is photographed from several viewpoints and at different angles. The resulting images are then processed by the appropriate software, which processes them in two ways:

− obtaining metadata from the photo (geolocation and tilt angle) and determining the object's geometry, knowing the capture points.

− determining the geometry using image processing algorithms.

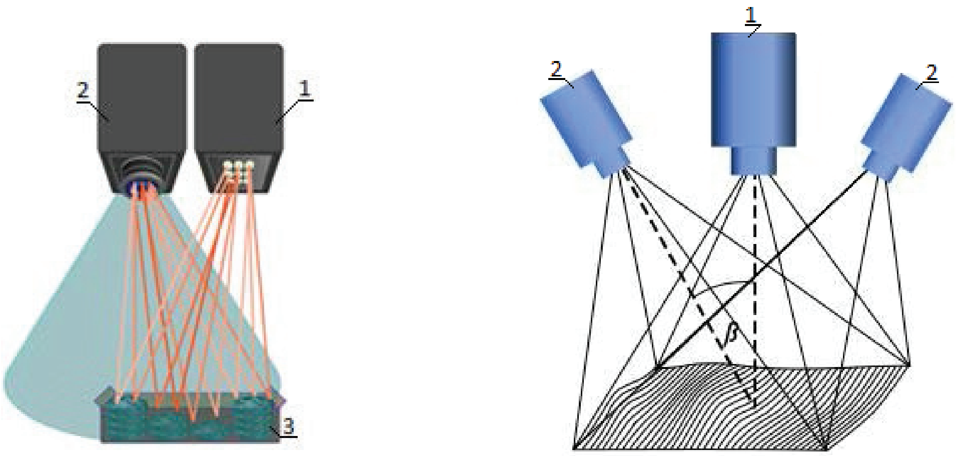
The accuracy and resolution of the resulting 3D model depends on the number of images, their quality and the light quality.

Silhouette scanning [9] is a technology that captures the shape and contours of an object based on the analysis of its silhouette or outline. Unlike other scanning methods that reproduce the full surface geometry of an object, silhouette scanning focuses on capturing the external shape and edges of an object. To capture the silhouette of an object, the scanner places it between a light source and a camera. The light is projected onto the object, and the camera records the shadow or silhouette of the object on the background surface. By analysing the captured silhouette, the contour and shape of the object is determined. The data collected from different angles can be combined to create a complete three-dimensional representation of the object's external surface.

Active 3D scanners, unlike passive ones, are equipped with projectors that irradiate an object with structured light in the form of lines or squares with different levels of illumination, or lasers that emit light in the form of lines. The cameras record the curvature of the lines and squares, and the software interprets the resulting images of the curvature into a model of the object. Active scanners include laser and projector 3D scanners.

3D laser scanning uses laser light to obtain information about the geometry and surface details of objects. A scanner (Fig. 3, a) emits laser beams onto the surface of an object and measures the time it takes for the light to reflect and return to the sensor, which allows the distance from the sensor to each point on the object's surface to be calculated. Such devices typically consist of a laser source, a scanning mechanism to direct the beam, and a sensor to receive the reflected light. The laser beam is projected onto the object, and as the scanner moves or the object rotates, several points on the surface are measured. They form a point cloud - a set of 3D coordinates that represent the shape of the object [10]. By combining the coordinates of different points from several viewpoints, the laser scanner creates a comprehensive 3D model of the object, recording its geometry and surface features with high accuracy.

Another type of active scanning is projector scanning (Fig. 3, b), which uses a projector to display patterns or light on the surface of an object. The scanner reads the deformation of these patterns as they wrap around the shape



a **b**

Fig. 3. Graphical representation of the location of the working elements of an active laser 3D scanner (a): 1 – infrared light source; 2 – ToF sensor; 3 – scanned object; projector 3D scanner (b): 4 – projector, 5 – camera

of the object and reproduces a 3D image of the object's surface. The patterns can be in the form of grids, stripes, or other complex images. A camera or sensor placed at an angle from the projector records deformed light patterns. The software uses the collected information to triangulate the 3D coordinates of each point on the object's surface. By combining several sets of patterns and corresponding camera images from different angles, the scanner creates a detailed 3D model of the object [23, p. 18].

Commercially available devices or systems are expensive, but the modern smartphones development is making 3D scanning more affordable. All models on the market have main cameras, which allows them to be used for photogrammetry. However, the smartphones share using Time of Flight (ToF) and LiDAR technologies is growing every year, which will make it possible to use more accurate laser scanning.

Android devices can perform 3D scanning using various methods. It is worth noting that not all smartphones have built-in sensors or cameras suitable for high-quality 3D scanning. Typically, apps available on the Google Play Store allow you to use your smartphone's built-in cameras to create 3D models with low accuracy. Some apps offer the use of structured light technology or other digitisation techniques to increase the accuracy of 3D model scanning. Smartphones that have additional sensors, such as depth sensors or additional cameras, can produce 3D models with high detail. Some models of Samsung Galaxy, Xiaomi, and other smartphones have a ToF sensor [14–17].

A well-known type of ToF sensor is used in some smartphones to measure the distance to objects by determining the time it takes for a laser beam or infrared light to reflect and return to the sensor from an object.

ToF technology is similar to LiDAR technology, but uses infrared light instead of a laser beam. The ToF sensor is usually located next to the cameras on the back of the smartphone or in a special additional camera.

Main advantages of the ToF sensor:

– high accuracy of measuring the distance to objects in their wide range (from several centimetres to several metres), which improves the quality of 3D scanning and the realism of projections in AR applications;

– high speed of operation, which allows you to speed up scanning, recognise gestures in real time;

– compactness and cost-effectiveness, which is manifested in the production of small and light form factors for easy integration into various battery-powered devices and systems.

On iOS mobile devices, such as the iPhone X or later, 3D scanning can be performed using apps and sensors, including LiDAR [5; 7; 16] and TrueDepth using a NIR (Near Infrared) sensor with infrared LEDs to create a point cloud of the face that stores the 3D coordinates of surface points. This allows for the creation of detailed 3D facial models used, for example, for device unlocking, animation and AR applications.

3D surface scanning is also the most common LiDAR technology. The sensor measures the distance to an object and creates accurate maps based on point clouds of the surface.

This technology is also used to scan rooms, architectural details or other objects that require high accuracy.

Texture light scanners scan white objects with high accuracy, but do not work well with black objects. Photogrammetric scanners have the opposite problem, and white objects will have poor quality when scanned with them.

For high-precision industrial scanning, active laser or structured light scanners are recommended. For architectural and landscape projects, LiDAR systems are effective. For creating 3D models of medium-sized objects, photogrammetry using a smartphone or digital camera is suitable.

When choosing a smartphone for passive scanning, you should give preference to models with high-quality cameras, while only smartphones with built-in LiDAR or ToF sensors are suitable for active scanning.

Using the right device and scanning method will allow designers to efficiently create accurate 3D models for a variety of projects, from industrial design to architectural visualisation.

CONCLUSIONS

The feasibility of using a smartphone as a modern tool for designers has been proven not only for photogrammetry today, but also opens up prospects for active scanning in the future. This is due to the constant improvement of smartphone cameras, the increase in their computing power and the introduction of new technologies, such as LiDAR/ToF scanners in some models.

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BIBLIOGRAPHY

[1] 3D scanning technologies and the 3D scanning process. ANIWAA. The marketplace for additive manufacturing hardware. URL: https://www.aniwaa.com/guide/3d-scanners/3d-scanning-technologies-and-the-3d-scanning-process/ (Дата звернення: 12.08.2023).

[2] 3D scanning. Wikipedia. URL: https://en.wikipedia.org/wiki/3D_scanning (Дата звернення: 07.08.2023).

[3] Andrews J., Alwafi A., Bichu Y. M., Pliska B. T., Mostafa N., Zou B. Validation of three-dimensional facial imaging captured with smartphone-based photogrammetry application in comparison to stereophotogrammetry system. *Heliyon*. Elsevier, 2023, Vol. 9, ISSUE 5, E15834. DOI: 10.1016/j.heliyon.2023.e15834. 3

[4] Bieryt P. Digitizing Materials With Photometric Stereo and ArtEngine. 80 LVL. URL: https://80.lv/articles/digitizing-materials-with-photometric-stereo-and-artengine/ (Дата звернення: 20.12.2023).

[5] Exciting Ways to Use LiDAR on iPhone. *Make Use Of.* URL: https://www.makeuseof.com/iphone-lidar-uses/ (Дата звернення: 29.11.2023).

[6] Kohtala S., Erichsen J.F., Wullum O.P., Steinert M. Photogrammetry-based 3D scanning for supporting design activities and testing in early stage product development. *Procedia CIRP*, 2021, Vol. 100. p. 762–767. DOI: 10.1016/j.procir.2021.05.047. URL: https://www.sciencedirect.com/science/article/pii/S2212827121005096.

[7] LiDAR. Wikipedia. URL: https://en.wikipedia.org/wiki/Lidar (Дата звернення: 28.11.2023).

[8] Motion capture. *Wikipedia*. URL: https://en.wikipedia.org/wiki/Motion_capture (Дата звернення: 12.09.2023).

[9] Olsson K. Shape from Silhouette Scanner: Master's Degree Project. *Linköping University*. Linköping. 2002. URL: https://www.diva-portal.org/smash/get/diva2:18671/FULLTEXT01.pdf (Дата звернення: 28.10.2023).

[10] Point cloud. *Wikipedia*. URL: https://en.wikipedia.org/wiki/Point_cloud (Дата звернення: 20.10.2023).

[11] Shashi M., Jain K. Use of photogrammetry in 3d modeling and visualization of buildings. *ARPN Journal of Engineering and Applied Sciences*. 2007, Vol. 2, P. 37–40. URL: https://www.researchgate.net/publication/255651498_Use_of_photogrammetry_in_3D_modeling_and_visualization_of_buildings.

[12] Sun C., Beare R., Cheong K., Jung B., Kim M. Stereoscopic flatbed scanner. *Journal of Electronic Imaging*. 2009. Vol. 18, Issue 1. URL: https://www.spiedigitallibrary.org/journals/journal-of-electronic-imaging/volume-18/issue-01/013002/Stereoscopic-flatbed-scanner/10.1117/1.3059582.full#_=_ (Дата звернення: 06.12.2023).

[13] Thurzo A., Strunga M., Havlínová R., Reháková K., Urban R., Surovková J., Kurilová V. Smartphone-Based Facial Scanning as a Viable Tool for Facially Driven Orthodontics? *Sensors.* 2022, 22, 7752. DOI: 10.3390/s22207752

[14] Time of flight. Wikipedia. URL: https://en.wikipedia.org/wiki/Time_of_flight (Дата звернення:.11.2023).

[15] Time-of-flight: what you need to know about these new means of computer vision. *AVSYSEM*. URL: https://www.avsystem.com/blog/time-of-flight/ (Дата звернення: 29.11.2023).

[16] ToF vs. LiDAR: What's the Difference? Make Use Of. URL: https://www.makeuseof.com/tof-and-lidar-difference/ (Дата звернення: 28.11.2023).

[17] What Is a Time of Flight Sensor and How Does ToF Work? *Make Use Of.* URL: https://www.makeuseof.com/what-is-time-of-flight-sensor-how-does-tof-work/ (Дата звернення: 24.11.2023).

Kuzmenko V. V., Ostapenko N. V. (2024). Choosing a 3D scanner for the tasks of the designer.
Theory and practice of design. Culture and art. 4(34). P. 344–351,
doi: https://doi.org/10.32782/2415-8151.2024.34.37

[18] What Is Structured Light Scanning? *Medit*. URL: https://blog.medit.com/medit/what-is-structured-light-scanning (Дата звернення: 22.10.2023).

[19] Zhu Y. Application of Motion Capture Technology in 3D Animation Creation. *Proceedings of the 3rd International Conference on Culture, Education and Economic Development of Modern Society (ICCESE 2019).* Wuhan: Business University Wuhan, 2019. P. 452–456. DOI: 10.2991/iccese-19.2019.101

[20] Долгополов Д. Зворотний інжиніринг засобами цифрового 3d-моделювання. *Актуальні проблеми математики, фізики і технологій : зб. наук. пр. Вінницький державний педагогічний університет імені Михайла Коцюбинського*. Вінниця: ТОВ «Меркьюрі-Поділля», 2020, Вип. 17. С. 37–41.

[21] Дорожко Є., Трегуб М., Янкін О., Онищенко О. Особливості побудови цифрової 3d-моделі місцевості об'єктів транспортної інфраструктури за результатами вимірювань мобільним лазерним сканером. *Вісник ХНАДУ*. Харків: ХНАДУ, 2023, Том 1 № 102. С. 56. DOI: 10.30977/BUL.2219-5548.2023.102.1.56.

[22] Дорошенко Ю., Нещадим В. Сценарій комплексного 3d-моделювання рельєфної поверхні елементу фасадного декору за даними лазерного сканування. Теорія та практика дизайну. Київ: НАУ, 2022, Вип. 25. С. 58–65. DOI: 10.18372/2415-8151.25.16779

[23] Контактні і безконтактні 3d сканери. *Studfile*. URL: https://studfile.net/preview/5200484/page:6/ (Дата звернення: 12.10.2023).

[24] Терешкевич А.І. Застосування методу 3d-сканування об'єктів в експертній службі МВС України. *Криміналістичний вісник*, Київ: ДНДЕКЦ МВС України. 2014. № 2 (22), С. 158–160.

[25] Шехавцов Р. М. Можливості використання технологій 3D сканування під час розслідування злочинів. *Вісник Луганського державного університету внутрішніх справ імені Е.О. Дідоренка.* 2010. № 3. С. 247–251.

REFERENCES

[1] 3D scanning technologies and the 3D scanning process. *ANIWAA. The marketplace for additive manufacturing hardware*. Retrieved from: https://www.aniwaa.com/guide/3d-scanners/3d-scanning-technologies-and-the-3d-scanning-process/ (Date of access: 12.08.2023). [in English].

[2] 3D scanning. *Wikipedia*. Retrieved from: https://en.wikipedia.org/wiki/3D_scanning (Date of access: 07.08.2023). [in English].

[3] Andrews, J., Alwafi, A., Bichu, Y. M., Pliska, B. T., Mostafa, N., & Zou, B. (2023). Validation of three-dimensional facial imaging captured with smartphone-based photogrammetry application in comparison to stereophotogrammetry system. *Heliyon*. Vol. 9, ISSUE 5, E15834. DOI: 10.1016/j.heliyon.2023.e15834. [in English].

[4] Bieryt, P.(2021). Digitizing Materials With Photometric Stereo and ArtEngine. *80 LVL*. Retrieved from: https://80.lv/articles/digitizing-materials-with-photometric-stereo-and-artengine/ (Date of access: 20.12.2023). [in English].

[5] Exciting Ways to Use LiDAR on iPhone. *Make Use Of.* Retrieved from: https://www.makeuseof.com/iphone-lidar-uses/ (Date of access: 29.11.2023).

[6] Kohtala, S., Erichsen, J.F., Wullum, O.P., & Steinert, M. (2021). Photogrammetry-based 3D scanning for supporting design activities and testing in early stage product development. *Procedia CIRP*, Volume 100, P. 762–767. DOI: 10.1016/j.procir.2021.05.047. Retrieved from: https://www.sciencedirect.com/science/article/pii/S2212827121005096. [in English].

[7] LiDAR. *Wikipedia*. Retrieved from: https://en.wikipedia.org/wiki/Lidar (Date of access: 28.11.2017). [in English].

[8] Motion capture. *Wikipedia*. Retrieved from: https://en.wikipedia.org/wiki/Motion_capture (Date of access: 12.09.2023). [in English].

[9] Olsson, K. (2002). Shape from Silhouette Scanner: Master's Degree Project. *Linköping University.* Linköping. Retrieved from: https://www.diva-portal.org/smash/get/diva2:18671/FULLTEXT01.pdf (Date of access: 28.10.2023). [in English].

[10] Point cloud. *Wikipedia*. Retrieved from: https://en.wikipedia.org/wiki/Point_cloud (Date of access: 20.10.2023). [in English].

[11] Shashi, M., & Jain, K. (2007). Use of photogrammetry in 3d modeling and visualization of buildings. *ARPN Journal of Engineering and Applied Sciences*, Vol. 2, P. 37–40. Retrieved from: https://www.researchgate.net/publication/255651498_Use_of_photogrammetry_in_3D_modeling_and_visualization_of_buildings. (Date of access: 16.01.2024) [in English].

[12] Sun, C., Beare, R., Cheong, K., Jung, B., & Kim, M. (2009). Stereoscopic flatbed scanner. *Journal of Electronic Imaging*. Vol. 18, Issue 1. Retrieved from: https://www.spiedigitallibrary.org/journals/journal-of-electronic-imaging/volume-18/issue-01/013002/Stereoscopic-flatbed-scanner/10.1117/1.3059582.full#_=_ (Date of access: 06.12.2023) [in English].

[13] Thurzo, A., Strunga, M., Havlínová, R., Reháková, K., Urban, R., Surovková, J., & Kurilová, V. (2022). Smartphone-Based Facial Scanning as a Viable Tool for Facially Driven Orthodontics? *Sensors.* Vol. 22, 7752. DOI: 10.3390/s22207752 [in English].

[14] Time of flight. *Wikipedia*. Retrieved from: https://en.wikipedia.org/wiki/Time_of_flight (Date of access: 11.2023) [in English].

[15] Time-of-flight: what you need to know about these new means of computer vision. *AVSYSEM*. Retrieved from: https://www.avsystem.com/blog/time-of-flight/ (Date of access: 29.11.2023) [in English].

[16] ToF vs. LiDAR: What's the Difference? *Make Use Of.* Retrieved from: https://www.makeuseof.com/tof-and-lidar-difference/ (Date of access: 28.11.2017) [in English].

[17] What Is a Time of Flight Sensor and How Does ToF Work? *Make Use Of.* Retrieved from: https://www.makeuseof.com/what-is-time-of-flight-sensor-how-does-tof-work/ (Date of access: 24.11.2023) [in English].

[18] What Is Structured Light Scanning? *Medit*. Retrieved from: https://blog.medit.com/medit/what-is-structured-light-scanning (Date of access: 22.10.2023) [in English].

[19] Zhu, Y. (2019). Application of Motion Capture Technology in 3D Animation Creation. *Proceedings of the 3rd International Conference on Culture, Education and Economic Development of Modern Society (ICCESE 2019)* Wuhan Business University Wuhan, China, P. 452–456. DOI: 10.2991/iccese-19.2019.101 [in English].

[20] Dolhopolov, D. (2020). Zvorotnyy inzhynirynh zasobamy tsyfrovoho 3d-modelyuvannya. [Reverse engineering by means of digital 3d modeling]. *Aktual'ni problemy matematyky, fizyky i tekhnolohiy : zbirnyk naukovykh prats'.* [Actual problems of mathematics, physics and technologies: a collection of scientific papers]. Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University. Vinnitsa. Vol. 17, P. 37–41 [in Ukrainian].

[21] Dorozhko ,Ye., Trehub, M., Yankin, O., & Onyshchenko, O. (2023). Osoblyvosti pobudovy tsyfrovoi 3d-modeli mistsevosti ob'iektiv transportnoi infrastruktury za rezultatamy vymiriuvan mobilnym lazernym skanerom [Features of building a digital 3D model of the location of transportation infrastructure objects according to the results of measurements by a mobile laser scanner]. *Bulletin of Kharkov National Automobile and Highway University. Kharkov: KhNAHU, P. 56.* DOI: 10.30977/BUL.2219-5548.2023.102.1.56 [in Ukrainian].

[22] Doroshenko, Yu., & Neshchadym, V. (2022). Stsenarii kompleksnoho 3d-modeliuvannia reliefnoi poverkhni elementu fasadnoho dekoru za danymy lazernoho skanuvannia [The scenario of obtaining initial information about the embossed surface of the facade decor element using laser scanning]. *Theory and practice of design*. Kyiv: NAU, Vol. 25, P. 58–65. DOI: 10.18372/2415-8151.25.16779 [in Ukrainian].

[23] Kontaktni i bezkontaktni 3d skanery. [Contact and non-contact 3D-scanners]. *Studfile*. Retrieved from: https://studfile.net/preview/5200484/page:6/ (Date of access: 12.10.2017) [in Ukrainian].

[24] Tereshkevych, A.I. (2014). Zastosuvannya metodu 3d-skanuvannya ob'yektiv v ekspertniy sluzhbi MVS Ukrayiny. [Application of the method of 3d scanning of objects in the expert service of the Ministry of Internal Affairs of Ukraine]. *Kryminalistychnyy visnyk, Kyiv: DNDEKTS MVS Ukrayiny.* Vol. 2, Issue 22, P. 158–160 [in Ukrainian].

[25] Shekhavtsov, R. M. (2010). Mozhlyvosti vykorystannya tekhnolohiy 3D skanuvannya pid chas rozsliduvannya zlochyniv. [Possibilities of using 3D scanning technologies during the investigation of crimes]. *Visnyk Luhans'koho derzhavnoho universytetu vnutrishnikh sprav imeni E.O. Didorenka.*№ 3, P. 247–251 [in Ukrainian].

АНОТАЦІЯ

Кузьменко В. В., Остапенко Н. В. Вибір 3D-сканера для завдань дизайнера

Сучасний розвиток технологій 3D-сканування дозволяє відтворювати видиму реальність у віртуальному світі. Наприклад, дизайнери можуть експериментувати з оцифрованим одягом у різних графічних редакторах, змінюючи його колір, текстуру матеріалу тощо. Це дозволяє їм переглядати варіанти дизайну, не витрачаючи час на реалізацію наступної ітерації продукту, що полегшує їхню роботу.

Відомо, що 3D-сканер – це пристрій для побудови цифрових тривимірних моделей на основі аналізу реального об'єкта або середовища для збору даних про його форму і, якщо можливо, колір. Загалом, 3D-сканери можна розподілити на два типи сканування: контактне та безконтактне. В статті розглянуто відомі розповсюджені методи активного та пасивного безконтактного сканування. Коротко описано їх недоліки та переваги.

Методологія. *Ґрунтується на систематизації та узагальненні, порівняльному аналізі типів 3D-сканерів, інформаційно-дослідницьких підходах.*

Результати. *Доцільність використання смартфона як сучасного інструменту для дизайнерів доведена не тільки для фотограмметрії сьогодні, але й відкриває перспективи для активного сканування в майбутньому. Це пов'язано з постійним вдосконаленням камер смартфонів, збільшенням їх обчислювальних потужностей і впровадженням нових технологій, таких як LiDAR / Time of Flight сканерів у деяких моделях.*

У статті перераховані типи активних і пасивних пристроїв для тривимірного сканування та описані принципи їх роботи. Наведено графічне зображення компонування робочих елементів активних і пасивних 3D-сканерів. На основі *аналізу досліджень надано рекомендації щодо використання пристрою для сканування.*

Наукова новизна. *Проаналізовано методи сканування, показано недоліки та переваги методів.*

Практична значущість. *Проаналізовано технології 3D-сканування, надано рекомендації щодо вибору.*

Ключові слова: дизайн, 3D-сканування, методи 3D-сканування, класифікація методів 3D-сканування, апаратне забезпечення.

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