

Creating optimized 3D models for video games as a contribution to sustainable development

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Abstract

In the context of the rapid growth of the mobile gaming industry, the issue of energy efficiency and sustainable development of digital technologies is becoming particularly relevant. Modern game projects are increasingly using complex three-dimensional models with a high number of polygons and detailed textures, which provides a high level of realism, but at the same time leads to a significant load on the computing resources of mobile devices. This is reflected in increased energy consumption, accelerated wear of hardware components and a shorter device lifecycle, which, in turn, contradicts the goals of sustainable development related to responsible consumption and reducing the carbon footprint. This study is aimed at analyzing methods for optimizing 3D models in the Blender environment for subsequent use in game projects based on the Unity engine, as well as identifying their contribution to the development of the Green IT concept. Approaches such as polygon reduction, texture baking, and resource compression are considered. The aim of the study is to demonstrate that optimizing a polygonal grid can not only improve the performance of mobile applications, but also reduce energy consumption, thereby contributing to the implementation of the principles of sustainable development. The paper proposes a methodology for comparative analysis of the original and optimized models in terms of file size, frame rate, processor load and power consumption. It is expected that the results obtained will justify the need for system integration of optimization methods into the practice of mobile game development. Thus, optimization of 3D models is considered not only as a technical technique, but also as a tool to reduce the environmental impact of the gaming industry.

Keywords

3D model optimization, Blender, Unity engine, Mobile games, Polygon reduction, Green IT, Sustainable development¹

1. Introduction

In recent decades, the digital entertainment industry has experienced rapid growth, encompassing not only console and computer games, but also, primarily, the mobile segment. According to industry statistics, mobile games currently account for the largest share of the global market, attracting hundreds of millions of users every day. The video game market has been growing rapidly in recent years: its volume will increase from \$310.97 billion in 2024 to \$343.22 billion in 2025, corresponding to a compound annual growth rate (CAGR) of 10.4% [1]. The expansion of the audience is accompanied by the increasing complexity of game worlds, the growth of graphic realism, and the use of increasingly detailed three-dimensional models. Such trends open up new horizons for developers and players, but, on the other hand, create significant challenges related to computing costs and the sustainable development of digital technologies.

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Modern mobile devices are limited in terms of computing power, battery capacity, and cooling capabilities. With gamers expecting console-like quality and developers striving to keep their audience engaged with graphics, there is an increasing load on central and graphics processors. This, in turn, leads to increased energy consumption, accelerated equipment wear, and a shorter device life cycle. Therefore, enhancing the energy efficiency of games represents a critical challenge for mobile devices with limited battery capacity. An additional factor is the growth of “digital waste”: users are increasingly forced to upgrade their smartphones due to incompatibility with increasingly resource-intensive applications. Taken together, this creates a problem of unsustainable consumption that directly contradicts the Sustainable Development Goals (SDGs), among which the tasks of responsible production and consumption (SDG 12) and combating climate change (SDG 13) stand out.

3D models, which form the basis of the vast majority of games, play a special role in this context. High-polygon models with a large number of textures and complex materials provide visual realism, but at the same time place a significant load on the system. In most cases, the level of visual quality achieved in movies cannot be fully replicated within games. This is because 3D models must be optimized for real-time rendering as players navigate and interact with the environment. Processing geometry with millions of polygons and multi-layered material maps requires significant computing resources. On stationary systems, this leads to increased energy consumption and heat dissipation, and in the case of mobile devices, to accelerated battery discharge and overheating. Thus, heavy 3D models are one of the key factors shaping the energy and environmental footprint of the gaming industry.

Optimizing polygonal meshes and related resources is an effective tool for reducing hardware load. Methods such as decomposition, polygon reduction, implementation of levels of detail (LOD), and material baking can significantly reduce model weight without critical losses in visualization quality. Once computed and transferred onto the low-poly mesh, the normal map reproduces the light reflection properties of the original high-resolution model. This process allows the simplified geometry to approximate the appearance of the non-decimated version: in essence, by modifying the shading of the reduced-detail mesh, the normal map enables the low-poly model to visually resemble its high-poly counterpart [4]. For mobile games, such methods are not only a means of improving performance, but also a factor in sustainable development: reducing the size of applications facilitates their distribution, reduces the energy consumption of devices during execution, and, as a result, extends the life cycle of the equipment. High-demand computational tasks such as 3D rendering, virtual reality, and AI simulation executed in web environments impose significant workloads on a smartphone’s CPU and GPU, often forcing them to operate at maximum capacity and resulting in substantial energy consumption [5]. All of this fits into the concept of Green IT, which involves designing and using digital solutions with their environmental impact in mind.

Thus, it can be argued that the task of optimizing 3D models goes beyond purely technical or aesthetic considerations. It takes on a socio-environmental dimension, directly affecting issues of energy efficiency, rational use of resources, and sustainable development of the digital economy. At a time when the global agenda is focusing on reducing carbon footprints and increasing environmental responsibility, computer graphics optimization methods can be seen as an important component of a broader “green” game development strategy.

The purpose of this study is to demonstrate the potential of optimizing the polygonal mesh of game models as a tool for improving energy efficiency and reducing the environmental impact of the mobile gaming industry. The paper proposes to consider methods for simplifying geometry and managing levels of detail, evaluate their impact on performance and energy consumption, and discuss their contribution to the concept of Green IT. Particular attention is paid to practical scenarios for implementing optimizations in mobile projects, where the balance between visualization quality and efficiency is critical.

This work is structured as follows. The “Literature Review” section analyzes current research in the field of 3D model optimization and its connection to the concept of sustainable development. The “Methodology” section describes the research objects, the tools used, and the criteria for evaluating the effectiveness of optimization. The “Results” section provides data on the impact of various

methods on file size, frame rate, energy consumption, and visual quality. The “Discussion” section examines the interpretation of the results in the context of sustainable development goals and the concept of Green IT. Finally, the conclusion formulates the main conclusions, limitations of the study, and directions for future work.

2. Literature review

In recent years, sustainable development has become a key framework for evaluating digital technologies. The COVID-19 pandemic has accelerated digitalization for sustainability. There is growing interest among businesses and regulators in using digitalization for sustainability, but academic literature on the subject lags behind. Technologies such as AI, IoT, blockchain, big data analytics, cloud computing, 5G, remote sensing, and GIS make a significant contribution to the Sustainable Development Goals (SDGs). Each of them supports several goals. AI optimizes resources (SDGs 2, 3, 13), blockchain provides transparency (SDGs 12, 16), IoT monitors in real time (SDGs 11, 7), big data helps analyze trends (SDGs 13, 3), cloud computing scales (SDGs 9, 17), 5G improves connectivity (SDG 11, 3), and remote sensing/GIS monitors the environment (SDG 14, 15). Thus, the impact of digital technologies on sustainable development is complex and multifaceted [7].

Sustainable development in the digital environment resonates with the theme of Green IT. Green IT is the discipline that encompasses the study and implementation of methods for designing, manufacturing, operating, and disposing of computers, servers, and related subsystems, such as monitors, printers, storage units, and networking or communication devices, in a manner that ensures efficiency and effectiveness while minimizing, or ideally eliminating, adverse environmental impacts. The systematic review notes that the key factors in battery discharge are user profile (23.53% of articles – habits, usage time), mobile networks/Wi-Fi (17.65%), background applications/services (11.76%), old hardware and standby mode (11.76% each), and background activity can increase consumption by 160% in some scenarios [9]. Three main strategies for efficient energy consumption are identified [5]:

1. Reducing processor load: Optimizing interactions – reducing the frequency of scrolling/pinching events; Offloading – transferring heavy tasks, such as 3D rendering, to the server;
2. Reducing web traffic: Caching – predictive for dynamic content; Filtering – blocking ads/animations to save traffic and CPU;
3. Content adaptation: Code optimization – JS/CSS minification, removal of unused code; Display adaptation – dark themes for OLED.

A study based on life cycle assessment identified video streaming as the type of content that creates the largest carbon footprint in the atmosphere [10]. It should be differentiated between initiatives aimed at minimizing the environmental impacts of ICT and the application of technologies to enhance organizational sustainability [11].

There are numerous studies on the topic of effective smartphone energy resource management. A new approach to energy management when working with gaming applications on mobile devices has been proposed: System-level Energy-optimization for Game Applications (SEGA) [2]. However, the technique is optimized specifically for games and requires detecting them by stream names, which may not be universal for all game engines. The Co-Cap methodology is also proposed, a coordinated optimization approach where the CPU and GPU both work cooperatively. The experiment showed an improvement in energy efficiency of 10.6% (training set) and 10.0% (test set) with only a 0.5-0.7% decrease in FPS [12]. In modern games, the intensity dynamics are uneven – different scenes and levels require different amounts of resources. A hierarchical FSM modeling approach is proposed, which is quite natural for video game architecture, which is also designed hierarchically [13]. But a more down-to-earth approach may be to work directly with game asset optimization, which stands out as an approach whose goal is “to improve the energy efficiency of the game application itself” [2].

One strategy for efficient energy consumption is to offload processor-intensive tasks such as 3D object rendering. This is also critical for increasing the performance of video games. In this article, this phenomenon is examined from the perspective of optimizing polygons while maintaining the quality of the viewer's perception. The main problem with optimizing 3D models is the balance between model quality and performance, which stems from a paradoxical requirement: a 3D model must look good but have a minimal impact on computer resources. Overly detailed models overload the computer, while simplified models lose scientific accuracy [4]. Models should be detailed but contain a minimum number of polygons [3]. A balance between these conflicting requirements can be found by creating a low-poly version of the model along with baked normal maps and displacement maps, which create the illusion of unevenness and relief. This approach is particularly promising for the gaming industry, where realistic objects with dynamic levels of detail are needed. However, unlike models for films, game models must be rendered in real time. The experiment revealed that 88.9% of respondents did not notice a critical difference between a high-polygon and low-polygon model with proper optimization [3]. In other words, with a competent approach to creating a game model, we can mask the visual shortcomings of insufficient polygons by skillfully working with textures and normal maps.

Admittedly, there are limitations to this optimization method. First, normal maps do not compensate for geometric accuracy. When looking at an object from an acute angle, the effect of realism can be quite lost. So this method may not be suitable for tasks that require geometric precision from the developer. Displacement map, in turn, requires competent retopology and UV scan preparation, and errors at this stage are critical. Secondly, there is a general problem of accuracy with any geometric simplifications. If you do not control this moment, it reduces the metric reliability of the model, and it cannot be used for scientific measurements. The third is the unexplored topic. A review of the literature shows that there is a significant amount of work on optimizing 3D graphics and on Green IT. There is also a rich literature on sustainable development and digital technologies. However, there are almost no studies that directly link the methods of optimizing polygonal grids of game models with their contribution to sustainable development through reducing energy consumption, extending the life cycle of devices, and reducing e-waste. The present work is aimed at filling this gap. In addition to limitations, there are also opportunities. First, the optimization approach can be used not only in the gaming industry. It is also applicable to museums, architecture, online tours, educational VR/AR platforms i.e. in places where reusability and real-time rendering is very important. Secondly, cross-platform engines like Unity allow you to run such projects in the browser and on mobile devices. This, in turn, leads to a wider audience reach. The third is the democratization of games. With proper optimization, players with less powerful machines benefit as their devices become capable of playing games. The fourth is the concept of the "golden mean" of polygons. There is an optimal number of polygons, in which the visual quality is practically indistinguishable from highly polygonal models. In the gaming industry, such models are defined as mid-poly. Thus, improving performance by optimizing 3D models helps to work directly with the energy efficiency of the device. This method is not universal in all cases, but in most cases it helps to achieve the optimal effect.

3. Methodology

The purpose of this study is to evaluate the impact of 3D model optimization on performance and stability. Using an optimized model as an example, we want to show how to find a balance between performance and visual quality of an object. The study is applied in nature and focused on practical results. As part of this study, we used Unity Editor version 2022.3.62f1 and Blender version 3.6. An experiment was chosen as the method, as it helps to empirically reveal the research hypothesis. The original and optimized versions of the 3D model will be compared. A single 3D barrel will be created as a representative example of low-polygon assets.

The standardized process of developing 3D models in the gaming industry is called a pipeline. In our study, the pipeline is divided into several stages:

1. High poly model simulation. This version is as detailed as possible and is used to bake maps and chamfers into a low poly model. As a rule, this model contains round and smooth shapes.
2. Low poly model simulation. This version is used in the final game and is optimized to the maximum extent possible. Before baking, this model does not have smooth shapes, and all polygons on it serve to preserve the overall silhouette of the object.
3. Creating a UV map. This process helps the 3D package recognize how to apply textures to the 3D model.
4. Baking textures. Transferring detail from the high poly model to the low poly model.

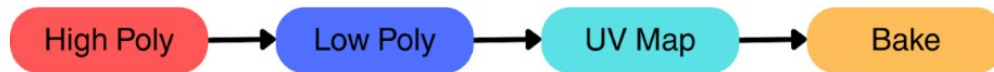


Figure 1: Pipeline for creating an optimized 3D model.

Several optimization methods will be applied to this model. First, polygon reduction using low-polygon modeling of the 3D object. This method helps reduce the number of geometric shapes, making the object “lighter” and its rendering less costly. Second, texture optimization using the atlas method. This involves combining several materials into a single texture map. Our model will have two types of materials: wooden boards and metal products. They will be baked into a single texture file. The third is baking normal maps. This method is designed to add visibility of detail and relief where they should be, without adding new geometry. All these methods together help to create a low-polygon but visually pleasing picture of a 3D object.



Figure 2: Visual comparison between the original high-polygon version, the low-polygon version, and the low-polygon version with baked textures.

The equipment used in this experiment includes several key aspects. First, the software. Blender version 3.6 was used for low poly and high poly modeling, Adobe Substance 3D Painter was used for texturing, Marmoset Toolbag was used for baking normal maps for low poly, and the Unity game engine was used for testing. Second, the hardware environment. The models were tested using an ASUS TUF Gaming A15 laptop and a Xiaomi Redmi Note 11S mobile device with the specifications listed in the Table 1.

Table 1

Devices used for testing 3D models

Device	Type	Memort	GPU	RAM	CPU
ASUS TUF Gaming A15	Desktop	512 GB	Nvidia GeForce RTX 4060/8 GB	16,0 GB	AMD Ryzen 7 7435HS
Redmi Note 11S	Mobile	128 GB	ARM Mali-G57 MC2	8 GB	Hello G16

To conduct the study, we collected a set of data reflecting the key parameters of the 3D model before and after its optimization. Data collection was carried out in two stages: first, the characteristics of the initial high-poly version of the barrel were recorded, and then the same metrics were determined for the optimized low-poly version prepared according to the pipeline described above. First of all, the geometric characteristics of the model were collected, including the number of vertices, edges, polygons, and triangles. These indicators are one of the basic ones for analysis, because they directly determine the complexity of the scene, the load on the GPU, and the overall performance when integrating the model into a game application. For ease of comparison, the values before and after optimization were recorded in the table, which makes it possible to visually show the percentage of reduction in the complexity of the polygonal grid. The next group of data was the size of the model files and texture resources. At this stage, the weight of the exported format files was measured .fbx, as well as the total size of the texture folder. This is necessary to assess the impact of optimization on the total weight of the game asset and, consequently, on the amount of memory that will be occupied in the mobile application. The third component is performance metrics collected directly in the Unity game engine. In the experiment, the average FPS value was recorded when visualizing a scene using high-poly and low-poly models, as well as the loading time of the scene and objects. For greater objectivity, the measurements were repeated several times, after which the average value was calculated. In addition, the GPU load was monitored, which allows you to indirectly assess the device's power consumption when working with each version of the model. Finally, the visual quality assessment stage was included in the study. To do this, screenshots were taken of both versions of the model in identical lighting conditions and camera position. Visual differences were recorded in a descriptive form, as well as potential distortions associated with the use of normal maps or a decrease in texture resolution. Despite the subjective nature of this analysis, it is extremely important because it allows you to correlate the technical indicators of optimization with the actual perception of the quality of the model by the end user. Thus, the data collection process included quantitative metrics (geometric parameters, file size, FPS, download time, GPU load) and qualitative observations (visual assessment). This approach provides an idea of the effectiveness of the proposed optimization method, which allows it to be linked not only to the technical aspects of game development, but also to sustainable development goals related to energy efficiency and prolonging the life cycle of devices.

An additional criterion for evaluating the developed model is its impact on sustainability. The fact is that the optimization method is designed to reduce the resource consumption of the user's hardware. This, in turn, leads to a lower load on the GPU, which helps the game application work more efficiently while maintaining quality. less GPU load leads to lower power consumption, which is one of the goals of sustainable development. Reducing the total weight of the model on the device leads to savings in traffic and memory, which prolongs its service life. This leads to the sustainability and environmental friendliness of the game process.

Table 2

Measured test indicators

Metric	Description	Tool
Geometric indicators	Number of vertices, edges, and polygons	Blender with statistics display enabled
Model file size	.fbx format and final size with textures	Windows 11 File Manager
Average FPS	Indirect energy consumption indicator	Unity Profiler
GPU load	Indirect energy consumption indicator	Unity Profiler
Visual assessment	Comparison using screenshots and detail assessment	Visual perception

There are several limitations to this study. One of the key ones is sampling. During the experiment, only one barrel model is used, which may reduce its validity. It is also worth recognizing that energy consumption metrics are taken indirectly through indicators such as FPS and GPU utilization. In addition, to show the optimization results comprehensively, scaling is required on more complex game scenes. However, this is only a pilot study and a more elaborate design of the experiment is possible in the future.

4. Results

Testing on a desktop computer confirmed a significant difference in computational efficiency between the high-polygon (HP) and low-polygon (LP) versions of the model. The number of vertices in the HP model was 2,159,592, while in the LP model it was only 1,891, which is a reduction of more than a thousand times. Similar differences are observed in the number of edges (5,756,516 vs. 5,088) and faces (3,596,994 vs. 3,216). The file size was reduced from 113,424 KB to 143 KB, which reduces storage and download speed requirements. At the same time, the average FPS remained virtually unchanged (144 FPS for HP and 147 FPS for LP), but the load on the graphics processor decreased from 3.7 ms to 2 ms, indicating a more efficient use of resources. Presumably, this is due to the small size of the game scene, which consisted only of a 3D model of a barrel. There is a hypothesis that as the number of models increases, the difference may become more significant. Thus, mesh optimization provides a radical reduction in geometric complexity and data volume while maintaining high visualization quality and stable frame rates.

Visual assessment showed that the low-poly model obtained using baked textures satisfactorily reproduces the geometric and material characteristics of the high-poly version. The main elements of the wood and metal details are preserved and visually distinguishable, despite a significant reduction in the number of polygons. The presence of normal maps and texture maps compensates for the loss of small geometric details, providing a comparable level of perception at medium and long distances. Thus, the use of Low Poly with baking can be considered as the optimal balance between visualization quality and computational load.

Table 3
Comparative test results on ASUS TUF Gaming A15

Parameters	HP	LP
Vertices	2 159 592	1 891
Edges	5 756 516	5 088
Faces	3 596 994	3 216
File size	113 424 KB	143 KB
Average FPS	144 FPS	147 FPS
GPU Load	3.7 ms	2 ms

To collect data on the mobile device, we used the built-in Unity Profiler tool, through which we measured performance data. The measurement was carried out using a USB cable that connects the mobile device to Unity Profiler running on a computer. First, we made two builds containing the HP and LP model versions. Then we configured the Unity environment and the mobile device. Once the preliminary work was done, we launched the game app versions on the mobile device and recorded the metrics in a table.



Figure 3: Comparison of high-polygon version and low-polygon version with baked textures.

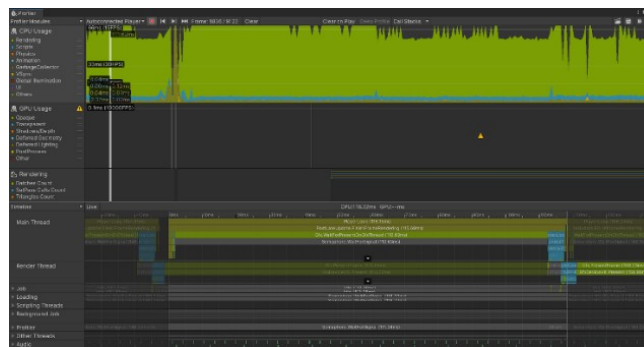


Figure 4: Measuring metrics in Unity Profiler.

Test results showed significant differences in performance between the high-polygon (HP) and low-polygon (LP) versions of the model. The LP model file size was 39.7% smaller than the HP model (107,302 KB vs. 177,825 KB), which reduces the load on the system when loading resources. The average FPS when rendering the LP model was 30 frames per second, which is significantly higher than the 18 FPS of the HP model and provides a smoother user experience. The CPU load also shows a sharp contrast: 0.96 ms for LP versus 53.03 ms for HP, confirming the effectiveness of mesh

optimization. Similarly, RAM usage was reduced by almost a third (198.2 MB vs. 297.6 MB). Taken together, these metrics indicate that the optimized model delivers significant performance improvements without critical visual losses, making it a more sustainable solution for mobile gaming applications.

Table 4

Comparative test results on Redmi Note 11S

Parameters	HP	LP
File size	177825 KB	107302 KB
Average FPS	18 FPS	30 FPS
CPU Load	53.03 ms	0.96 ms
Memory usage	297.6 MB	198.2 MB

A comparative analysis of high-polygon and low-polygon models showed that geometry optimization followed by texture baking provides a radical reduction in the number of vertices, edges, and faces (by a factor of thousands), as well as a reduction in file size by up to hundreds of times. This leads to a reduction in the use of RAM and computing resources on both desktop and mobile devices: the load on the GPU and CPU is reduced several times over, while the frame rate either increases significantly (on mobile devices) or remains stable (on PCs). Visual evaluation confirmed that when normals and texture maps are used correctly, the low-polygon model retains a comparable level of detail and shape readability. Thus, model optimization allows a balance to be achieved between visualization quality and efficient use of computing resources, which is in line with the principles of sustainable development and Green IT.

5. Discussion

Our results demonstrate that using polygonal mesh optimization and texture baking methods in Blender can significantly reduce the computational load when integrating models into the Unity engine, especially in the context of mobile games. A comparative analysis showed that low-polygon versions of models require orders of magnitude less geometric data and disk space, while providing either an increase in frame rate (on mobile devices) or maintaining stable FPS (on desktop systems). A significant reduction in CPU and GPU load, as well as a reduction in RAM consumption, indicates a more efficient use of computing resources.

In the context of SDG 7 (“Affordable and Clean Energy”), the study demonstrates that optimizing 3D models helps reduce the energy consumption of computing devices by reducing the load on the processor and graphics accelerator. Improving energy efficiency is especially important for mobile platforms, where battery savings directly affect the accessibility of technology for users with limited access to stable power sources. In addition, reducing energy consumption in conjunction with optimized use of hardware resources can be seen as a contribution to reducing energy consumption across the gaming industry. Thus, the development of optimized models not only improves application performance, but also supports the achievement of SDG 7, which aims to ensure cleaner and more affordable energy.

In the context of SDG 9 (“Industry, Innovation and Infrastructure”), the study demonstrates that the optimization of 3D models is an example of a technological solution aimed at improving the efficiency of digital infrastructure. Reducing the computational load and file resource volume allows for the development of lighter and more productive applications, which contributes to the accessibility of gaming and educational technologies even on devices with modest hardware specifications. In addition, such methods can be integrated into industrial and educational software, contributing to the formation of more sustainable and innovative digital ecosystems. Thus, the

optimization of graphic models in the gaming industry not only increases productivity but also contributes to the development of a digital infrastructure that is consistent with the principles of sustainable industrialization and innovation.

Within the framework of SDG 12 (“Responsible Consumption and Production”), the results of the study show that optimizing 3D models can significantly reduce the digital resources required for their storage and use. Reducing file sizes and the number of polygons lowers the requirements for memory, network bandwidth, and disk storage, which is in line with the principles of more efficient use of computing resources. For developers, this means the ability to create games and applications with lower storage and distribution costs, and for users, it means reduced device load and more sustainable software use. Thus, polygon mesh optimization can be seen as an example of responsible digital production that minimizes excessive consumption of computing power and contributes to the more environmentally friendly development of the industry.



Figure 5: Final render of LP model with baked textures in Blender.

From a sustainability perspective, these results confirm the importance of optimizing digital assets. The energy efficiency of gaming applications is directly related to the duration of mobile device operation without recharging and the reduction of total energy consumption by data centers and end devices. Thus, the optimization of 3D models can be viewed as part of a broader Green IT paradigm aimed at reducing the carbon footprint of the digital industry. Taken together, this indicates that technical solutions in the field of 3D graphics can not only enhance the user experience, but also contribute to sustainable development by reducing the gaming industry's impact on the environment.

6. Conclusion

Our research has shown that the use of polygonal mesh optimization and texture baking techniques in Blender for integration into Unity allows for a significant reduction in computational and resource costs without a critical loss of visualization quality. The results of the experiment, obtained on desktop and mobile devices, confirmed that low-polygon models have significantly lower memory and computational resource requirements, while providing stable frame rates and comparable visual detail. This makes this approach an effective solution for developing mobile games, where limited hardware resources are particularly critical.

From a sustainable development perspective, the proposed methodological approach demonstrates the potential to reduce energy consumption, optimize digital resources, and increase

the accessibility of technologies. The contribution of the study is directly related to SDG 7 (“Affordable and Clean Energy”), SDG 9 (Industry, Innovation and Infrastructure), and SDG 12 (Responsible Consumption and Production), as the optimization of 3D content contributes to more efficient use of resources and the development of innovative digital infrastructure. Thus, the optimization of game models can be seen not only as a technical improvement, but also as a step towards a more sustainable and environmentally responsible gaming industry.

One limitation of this study is that only one model was used, which was tested on a single mobile device and a single computer. It is difficult to scale its results to the entire gaming industry. It should also be added that energy consumption indicators are obtained from indirect sources. The applicability of the method in real games requires scaling to more complex and detailed scenes. Promising areas for future research include expanding the set of models and testing optimization on a larger number of assets and game scenes. The game scene can be tested on iOS, Android, and VR devices, and a comparison of the popular Unity and Unreal Engine game engines can be performed.

Declaration on Generative AI

The authors have not employed any Generative AI tools.

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