

030/S/RPL-KCBR/PK.03.08/10/Agustus/2023

**OPTIMASI PERFORMA GIM *VIRTUAL BIOTOPE* BERBASIS *UNITY ENGINE*  
MENGUNAKAN METODE *BASIC OPTIMIZATION***

**SKRIPSI**

Diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar  
Sarjana Komputer pada Program Studi S-1 Rekayasa Perangkat Lunak



Oleh :

Fariz Ahmad Berlian Zulfikri

NIM 1902762

**PROGRAM STUDI REKAYASA PERANGKAT LUNAK**

**KAMPUS DAERAH CIBIRU**

**UNIVERSITAS PENDIDIKAN INDONESIA**

**2023**

OPTIMASI PERFORMA GIM *VIRTUAL BIOTOPE* BERBASIS *UNITY ENGINE* MENGGUNAKAN METODE *BASIC OPTIMIZATION*

Oleh  
Fariz Ahmad Berlian Zulfikri

diajukan untuk memenuhi sebagian syarat untuk memperoleh  
gelar Sarjana Komputer Program Studi Rekayasa Perangkat Lunak

© Fariz Ahmad Berlian Zulfikri  
Universitas Pendidikan Indonesia  
Agustus 2023

Hak cipta dilindungi Undang - Undang  
Skripsi ini tidak boleh diperbanyak seluruhnya atau sebagian,  
dengan dicetak ulang, difotokopi, atau cara lainnya tanpa ijin dari penulis.

## HALAMAN PENGESAHAN

FARIZ AHMAD BERLIAN ZULFIKRI

OPTIMASI PERFORMA GIM *VIRTUAL BIOTOPE* BERBASIS *UNITY ENGINE* MENGGUNAKAN METODE *BASIC OPTIMIZATION*

Disetujui dan disahkan oleh pembimbing :

Pembimbing I

Hendriyana, S.T., M.KOM

NIP. 920190219870504101

Pembimbing II

Asyifa Imanda Septiana, S.Pd., M.Eng

NIP. 920190219920228201

Mengetahui

Ketua Program Studi Rekayasa Perangkat Lunak

Mochamad Iqbal Ardimansyah, S.T., M.Kom.

NIP. 920190219910328101

# OPTIMASI PERFORMA GIM *VIRTUAL BIOTOPE* BERBASIS *UNITY ENGINE* MENGUNAKAN METODE *BASIC OPTIMIZATION*

## ABSTRAK

Pengembangan iterasi pertama pada gim berbasis Unity bertajuk “*Virtual Biotope*” memiliki masalah pada performa. Lebih tepatnya, gim “*Virtual Biotope*” ini tidak dapat dijalankan dengan lancar, karena gim ini hanya berjalan di bawah 30 FPS. Masalah performa pada gim dapat dikatakan masalah sebagai pengalaman pemainnya. Karena itu, penelitian terhadap optimasi gim *Virtual Biotope* ini dilakukan. Upaya optimasi ini dilakukan demi menambahkan performa gim agar dapat dimainkan dengan mulus di perangkat gawai. Upaya untuk melakukan optimasi ini dilakukan dengan menggunakan metode *Basic Optimization*, atau yang dapat disebut dengan Optimasi Dasar. Optimasi dasar adalah metode optimasi yang paling umum dilakukan pada proses pengembangan gim. Ada beberapa cara untuk melakukan optimasi dasar, di antaranya ialah pengaplikasian model *low poly* dengan mengurangi jumlah poligon di dalam objek dan juga jumlah objek yang di *render* pada gim dengan menggunakan *occlusion culling*. Selain itu, animasi juga menjadi salah satu proses yang dilakukan di dalam CPU, sementara objek yang tidak terlihat oleh kamera juga menjalankan proses animasi di belakang layar. Hal tersebut dapat dikatakan tidak efektif dan merupakan pemborosan terhadap penggunaan sumber daya. Maka dari itu ada baiknya apabila mengurangi penggunaan animasi dari objek beranimasi yang tidak di *render* oleh kamera. Secara keseluruhan, proses optimasi tersebut dapat menaikkan angka rata – rata performa hingga sekitar 104 persen pada perekaman data *Unity Profiler*, dan juga peningkatan sekitar 102 persen pada perangkat gawai yang diuji. Hasil tersebut menunjukkan bahwa metode optimasi tersebut dapat dibilang sangat efisien dalam peningkatan performa gim.

**Kata Kunci:** Optimasi, Gim, Performa, *Profiler*, Unity

**PERFORMANCE OPTIMIZATION OF UNITY ENGINE-BASED GAME  
VIRTUAL BIOTOPE USING BASIC OPTIMIZATION METHOD**

**ABSTRACT**

*The first iteration development in Unity-based game titled "Virtual Biotope" had performance issues. For the context, this game can only run at less than 30 FPS. Performance issues in games can be seen as problems affecting the player's experience. As a result, research was conducted on optimizing the Virtual Biotope game. This optimization effort was made to improve the game's performance so that it can be played smoothly on various devices. The optimization was carried out using the method of Basic Optimization. Basic optimization is the most common method used in the game development process. There are several ways to perform basic optimization, including reducing the number of polygons by applying low poly into models and using occlusion culling to reduce objects rendered in the game. Additionally, animations are one of the processes that take place on the CPU, while objects that are not visible by the camera also run animation processes behind the screen. That is inefficient in terms of resource usage. Because of that, it is beneficial to reduce unnecessary animation processes of animated objects that are not rendered in camera. Overall, the optimization process was able to increase the average performance by about 104 percent in the Unity Profiler data recording, and there was also an improvement of about 102 percent on the tested mobile devices. These results indicate that the optimization method proved to be very efficient in enhancing the game's performance.*

**Keywords:** *Optimization, Game, Performance, Profiler, Unity.*

## DAFTAR ISI

HALAMAN PENGESAHAN .....	ii
LEMBAR PERNYATAAN.....	iii
UCAPAN TERIMA KASIH .....	iv
ABSTRAK.....	vi
<i>ABSTRACT</i> .....	vii
DAFTAR ISI.....	viii
DAFTAR GAMBAR .....	x
DAFTAR TABEL .....	xii
BAB I PENDAHULUAN.....	1
1.1. Latar Belakang .....	1
1.2. Rumusan Masalah .....	2
1.3. Tujuan Penelitian.....	3
1.4. Manfaat Penelitian.....	3
1.5. Batasan Masalah.....	3
1.6. Sistematika Penulisan.....	4
BAB II TINJAUAN PUSTAKA .....	6
2.1. Penelitian Terkait.....	6
2.2. <i>Video Game (Gim)</i> .....	8
2.3. <i>Unity Engine</i> .....	8
2.3.1. Unity Profiler.....	9
2.4. <i>Rendering</i> .....	9
2.5. <i>Frame Rate / Frames per Second (FPS)</i> .....	10
2.6. <i>Frame Time</i> .....	11
2.7. <i>Spikes</i> .....	12
2.8. <i>Central Processing Unit (CPU)</i> .....	13
BAB III METODOLOGI PENELITIAN.....	14
3.1. Desain Penelitian.....	14
3.1.1. <i>Research Clarification</i> .....	15
3.1.2. <i>Descriptive Study 1</i> .....	15
3.1.3. <i>Perspective Study</i> .....	15
3.1.4. <i>Descriptive Study 2</i> .....	15

Fariz Ahmad Berlian Zulfikri, 2023

**OPTIMASI PERFORMA GIM VIRTUAL BIOTOPE BERBASIS UNITY ENGINE MENGGUNAKAN METODE BASIC OPTIMIZATION**

Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

3.2.	Alat dan Bahan.....	16
3.3.	Skenario Pengujian.....	16
BAB IV	TEMUAN DAN PEMBAHASAN .....	19
4.1.	Analisa Gim Yang Belum Di-optimasi pada Laptop.....	19
4.2.	Proses Optimasi.....	21
4.2.1.	Pengaplikasian <i>Low Poly</i> Terhadap Model .....	21
4.2.2.	Pengaplikasian <i>Occlusion Culling</i> .....	23
4.2.3.	Pengaplikasian <i>Disable Object</i> Terhadap Objek Burung Yang Terlalu Jauh.....	28
4.3.	Evaluasi Optimasi Pada <i>Unity Profiler</i> di Laptop.....	30
4.3.1.	Evaluasi <i>Low Poly</i> Terhadap Model.....	30
4.3.2.	Evaluasi <i>Occlusion Culling</i> .....	35
4.3.3.	Evaluasi <i>Disable Object</i> Terhadap Objek Burung Yang Terlalu Jauh.....	38
4.3.4.	Evaluasi Optimasi Akhir .....	41
4.4.	Evaluasi Optimasi Pada Perangkat Gawai .....	44
4.5.	Temuan lainnya .....	45
BAB V	PENUTUP .....	47
DAFTAR PUSTAKA.....		49
Lampiran 1 Data Sebelum Optimasi.....		53
Lampiran 2 Data Setelah Optimasi.....		73

## DAFTAR PUSTAKA

- Anwari, S. P. (2018, Juli 8). Terancam punah, lima jenis burung di kampung Blekok, Bandung, ini pun semakin tergusur. *Tribun Jabar*.
- Bernal-Merino, M. Á. (2007). Challenges in the translation of video game. *Tradumàtica*, 0.
- Blessing, L. T. M., dan Chakrabarti, A. (2009). *DRM, a Design Research Methodology*. London: Springer London.
- Both, D. (2020, Juli 23). The central processing unit (CPU): Its components and functionality.
- Calculator Academy Team. (2022, Oktober 19). Frame rate calculator.
- Caradonna, G., Lionetti, S., Tarantino, E., dan Verdoscia, C. (2018). A comparison of low-poly algorithms for sharing 3D models on the web. *New Advanced GNSS and 3D Spatial Techniques: Applications to Civil and Environmental Engineering, Geophysics, Architecture, Archeology and Cultural Heritage*, 237–244.
- Cole, T. J., dan Altman, D. G. (2017). Statistics Notes: What is a percentage difference? *BMJ*, j3663.
- Djaouti, D., Alvarez, J., Jessel, J.-P., Methel, G., dan Molinier, P. (2008). A gameplay definition through videogame classification. *International Journal of Computer Games Technology*, 2008, 1–7.
- Dong, Y., dan Peng, C. (2019). Real-time large crowd rendering with efficient character and instance management on gpu. *International Journal of Computer Games Technology*, 2019, 1–15.
- Esposito, N. (2005). *A short and simple definition of what a videogame is*.
- Filho, G., Fonteles Furtado, P., Leite, F., dan Neves Filho, H. (2018). *Unity: Criando jogos e outras aplicações multi-plataforma*.



- Gamage, C., Pinto, V., Xue, C., Stephenson, M., Zhang, P., dan Renz, J. (2021). Novelty generation framework for AI agents in Angry Birds style physics games. *2021 IEEE Conference on Games (CoG)*, 1–8.
- Gapo, B. (2022, Oktober 1). What is a good fps for gaming?
- Gillis, A. S. (2019, Februari). Spike testing.
- Haas, J. K. (2014). *A history of the Unity Game Engine*.
- Huhti, J. (2019). *The effect of high monitor refresh rate on game experience*.
- Jiang, H., Sun, D., Jampani, V., Yang, M.-H., Learned-Miller, E., dan Kautz, J. (2018). Super slomo: High quality estimation of multiple intermediate frames for video interpolation. *Proceedings of the IEEE conference on computer vision and pattern recognition*, 9000–9008.
- Johnson, D. (2021, Maret 5). What is a CPU? A guide to the “brain” of your computer or phone, including how it works.
- Joseph, D., dan Knuttila, L. (2014). Single-player/multiplayer. *The Routledge Companion to Video Game Studies*.
- Juliani, A., Berges, V.-P., Teng, E., Cohen, A., Harper, J., Elion, C., ... Lange, D. (2018). *Unity: A General Platform for Intelligent Agents*.
- Koulaxidis, G., dan Xinogalos, S. (2022). Improving mobile game performance with Basic Optimization techniques in unity. *Modelling*, 3, 201–223.
- Liu, S., Kuwahara, A., Scovell, J. J., dan Claypool, M. (2023). The Effects of Frame Rate Variation on Game Player Quality of Experience. *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–10. New York, NY, USA: ACM.
- Mackin, A., Zhang, F., dan Bull, D. R. (2019). A Study of High Frame Rate Video Formats. *IEEE Transactions on Multimedia*, 21, 1499–1512.
- Martinez, L., Gimenes, M., dan Lambert, E. (2022). Entertainment video games for academic learning: A systematic review. *Journal of Educational Computing Research*, 60, 1083–1109.

- Nusrat, F., Hassan, F., Zhong, H., dan Wang, X. (2021). How developers optimize virtual reality applications: A study of optimization commits in open source Unity projects. *2021 IEEE/ACM 43rd International Conference on Software Engineering (ICSE)*, 473–485.
- Okita, A. (2014). *Learning C# programming with Unity 3D*. CRC press.
- Owens, B. (2013, Oktober 28). Forward rendering vs. deferred rendering.
- Pantazopoulos, I., dan Tzafestas, S. (2002). Occlusion Culling Algorithms: A Comprehensive Survey. *Journal of Intelligent and Robotic Systems*, 35, 123–156.
- Pavlovic, D. (2020, Juli 23). Video game genres: Everything you need to know.
- Peever, N., Johnson, D., dan Gardner, J. (2012). Personality & video game genre preferences. *Proceedings of the 8th australasian conference on interactive entertainment: Playing the system*, 1–3.
- PS, G. G. (2015). Platform comparison between games console, mobile games and PC games. *Sisforma*, 2, 23–26.
- Roach, J. (2022, Oktober 27). What is frame time, and why is it so important in games?
- Salamah, A., Abdo, A., dan Abdo, M. (2017). *Street War*.
- Seitzler, T. M. (1990). Robot servoing from video rate updates using the APA512 real time machine vision processor. Dalam B. G. Batchelor (Ed.), *Intelligent Robots and Computer Vision VIII: Systems and Applications* (Vol. 1193, hlm. 315 – 325). SPIE.
- Singh, N. P., Sharma, B., dan Sharma, A. (2022). Performance analysis and optimization techniques in Unity 3D. *2022 3rd International Conference on Smart Electronics and Communication (ICOSEC)*, 245–252. IEEE.
- Šmíd, A. (2017). Comparison of unity and unreal engine. *Czech Technical University in Prague*, 41–61.
- Strydom, M. (2023, Juli 22). 9 common reasons why your GPU utilization spikes.

- Taylor, T. L. (2009). *Play between worlds: Exploring online game culture*. MIT press.
- Tree, A. (2023, Juni 27). What are the most common causes of CPU spikes?
- Turpeinen, M. (2020). A performance comparison for 3D crowd rendering using an Object-Oriented system and Unity DOTS with GPU instancing on mobile devices. Dalam *DEGREE PROJECT COMPUTER SCIENCE AND ENGINEERING*. Stockholm.
- Unity Manual. (2017, Juli 12). Modeling characters for optimal performance.
- Unity Manual. (2023a, Juli 14). Draw call batching.
- Unity Manual. (2023b, Juli 14). Occlusion Culling.
- Unity Manual. (2023c, Juli 14). Profiler overview.
- Unity Manual. (2023d, Juli 21). Unity - Manual: Platform Development.
- Vaughan, T. (2014). *Multimedia: Making it work*. McGraw-Hill Education Group.
- Watson, A. (2020). Deep learning techniques for super-resolution in video games. *arXiv preprint arXiv:2012.09810*.
- White, M., dan Langenheim, N. (2014). Urban street tree modelling using high polygon 3D models with photometric daylight systems. *Our common future in urban morphology. Porto, Portugal, FEUP*, 256–267.
- Wingfield, N. (2016, Juli 13). Unity Technologies, Maker of Pokémon Go Engine, Swells in Value.