

PERFORMANCE ANALYSIS OF 3 DIMENSION MODELS OF 12 SHIO PETS IN THE TWELVE METAVERSE GAME

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Abstrak

Metaverse adalah alam semesta pasca-realitas, lingkungan multi pengguna dan persisten yang menggabungkan realitas fisik dengan virtualisasi digital. Dengan kecanggihan tersebut, Metaverse menggabungkan banyak teknologi baru yang memadukan dunia maya dan kenyataan. Salah satu teknologi yang memadukan dunia maya dan kenyataan yang berkembang pesat hingga mempengaruhi perekonomian dunia saat ini yaitu Video game. Salah satu video game yang menggunakan teknologi berbasis metaverse adalah game Twelve Metaverse. Game tersebut memiliki daya tarik bagi pengguna khususnya pada asset. Namun pada game Twelve Metaverse terdapat kendala dalam performa game, salah satu penyebabnya adalah kurang optimalnya game asset. Di mana user mengalami lag ketika interaksi antar karakter dalam kondisi jumlah spawn yang banyak tanpa angka pasti. Dengan permasalahan tersebut, perlu untuk mengetahui kualitas performa game dengan mencari jumlah maksimal spawn pada avatar 3 dimensi 12 Shio pet sesuai standar optimal 50-60 FPS dalam satu scene. Analisa performansi berdasarkan metode penelitian kuantitatif dan kualitatif. Pengujian dilakukan dengan menggunakan unity engine profiler yang tersedia di Unity3D. Hasil observasi, evaluasi, dan analisis performansi dari 12 Shio pet, 12 Shio pet bersama karakter manusia, 12 Shio pet bersama karakter manusia dan environment pada game Twelve Metaverse sudah efisien.

Kata Kunci: performa game, model 3 dimensi, game mobile, unity engine profiler, game metaverse.

Abstract

The Metaverse is a post-reality universe, a multi-user and persistent environment that combines physical reality with digital virtualization. With this sophistication, Metaverse combines many new technologies that combine virtual worlds and reality. One technology that combines the virtual world and reality that is developing rapidly to influence the world economy today is video games. One video game that uses metaverse based technology is the Twelve Metaverse game. This game has an attraction for users, especially assets. But in the Twelve Metaverse game there are problems with game performance, one of the causes is less than optimal game assets. Where users experience lag when interacting between characters in conditions of a large number of spawns without a definite number. With these problems, it is necessary to determine the quality of game performance by looking for the maximum number of spawns on 3-dimensional avatars of 12 Shio pets according to the optimal standard of 50-60 FPS in one scene. Performance analysis based on quantitative and qualitative research methods. Testing was carried out using the Unity Engine Profiler available in *Unity3D*. The results of observation, evaluation, and performance analysis of 12 Shio pets, 12 Shio pets with human characters, 12 Shio pets with human characters and environment in the Twelve Metaverse game are efficient.

Keywords: game performance, 3 dimensional models, mobile games, unity engine profiler, metaverse games.

1. INTRODUCTION

In this modern, sophisticated era, people are competing to buy or create technology with the aim of helping their work, activities, and the birth of the metaverse (Sopiandi & Susanti, 2022). Additionally, Mark Zuckerberg announced in October 2021 that Facebook would change its name to Meta and make significant investments in the development of Metaverse technology (Damar 2021).

According to (Mystakidis 2022), The metaverse is a post-reality universe, a persistent, multi-user environment that combines physical reality with digital virtualization (Mystakidis, 2022). With this sophistication, the metaverse combines many new technologies that combine virtual worlds and reality (Ren et al., 2023). One technology that combines the virtual world and reality that is developing rapidly to influence the world economy today is video games (Febrianta et al., 2021).

An example of a video game that uses metaverse-based technology is the game Twelve Metaverse. This game has an attraction for users, especially the assets available in it. However, in the Twelve Metaverse game there are problems with game performance, one of the causes is less than optimal game assets. Where users experience lag when interacting between characters in conditions of a large number of spawns without a definite number.

With these problems, it is necessary to determine the quality of the game's performance by looking for the maximum number of spawns on 3-dimensional avatars of 12 Shio pets according to the optimal standard of 50-60 FPS (Koulaxidis & Xinogalos, 2022). Optimal game quality can be observed in terms of the performance produced (output) when controlled by the user (input). Games that are not optimized properly can result in frame rates, freezes, crashes, input lag, long loading times, engine breakdowns, and even excessive battery consumption (Aversa & Dickinson, 2019).

In the Twelve Metaverse game there is visual media in the form of objects based on 3-dimensional models. These 3-dimensional model objects are produced through several digital stages such as modeling, texturing, materials and others. One of the digital stages discussed is modeling. Of course, when creating an object 3-dimensions requires knowledge and technique to produce a good and correct 3-dimensional model. There are modeling techniques that can be applied to produce a 3-dimensional model, such as Low Poly modeling techniques and High Poly modeling techniques (Tania et al., 2022).

Based on the theories above, we are increasingly interested in exploring more deeply the performance quality of 3D objects in the Twelve Metaverse game. This research analyzes a 3-dimensional model in the form of 12 Shio pets which has been designed using *blender* software. Then the game assets were imported into *Unity* software as a game development platform, resulting in a Twelve Metaverse game. Therefore, in this final research assignment the title is "Performance Analysis of 3-dimensional models of

12 Shio pets in the Twelve Metaverse game".

2. RESEARCH METHOD

2.1 Research Method Design

This research was conducted based on identified problems. By measuring the game performance of each 3-dimensional model of the 12 Shio pet avatars to prove the aim of this research. This research utilizes qualitative and quantitative methods by measuring game performance according to optimal standards. Therefore, the steps are carried out as in the following image.

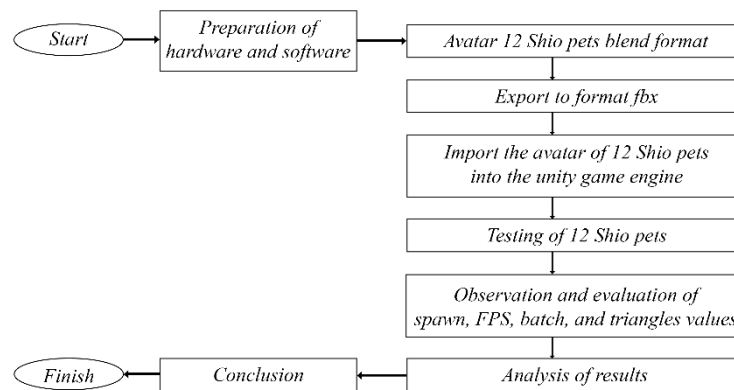


Figure 1. Testing framework
[Source: Author Documentation, 2024]

Unity game engine is a platform to start the process of observing and evaluating game performance on the 3-dimensional avatars model of the 12 Shio pets in the Twelve Metaverse game. There is a *Unity Profiler* feature which was created to make it easier to optimize performance by reducing statistical reports about performance usage in *Unity3D* while it is in progress (Riwinoto & Tan, 2021). Therefore, *unity profiler* is a tool to start the process of monitoring and evaluating game engine performance (Koulaxidis & Xinogalos, 2022).

Data collection was carried out by inputting a 3-dimensional model in *fbx* format into the *unity game engine*. Spawn is the process of appearing items, which can be characters or other objects in the game (Putra, 2023). Because 2 players are the minimum and 50 players in 1 scene is decided as the maximum limit (Aaltonen, 2022), so testing from a minimum of 50 spawns. If the number 50 is still normal, then test up to 1.000 spawns or more. Then you can see the spawn number which directs the number of batches and triangles with a standard of 50-60 FPS in accordance with the objectives of this research. The *unity game engine* stages are carried out through monitoring and sampling values from spawn, FPS (frame per second), batch, and triangles.

2.1.1 Frame per Second (FPS)

FPS is one of the most common metrics for evaluating the performance of video games, because it affects the end user's game performance as well. For the optimized version it ranges between 50 and 60 FPS when the game is played by the user, while 20 and 30 FPS causes the game to lag (Koulaxidis & Xinogalos, 2022).

2.1.2 Batches

Batching is a method of combining the same objects into one, so that the CPU will more easily recognize the object without analyzing the reading of a new object. GPU Instancing is a process that makes the GPU read objects so that it does not burden the CPU to read the texture of the object (Riwinoto & Tan, 2021).




2.1.3 Triangles/Polygons









Every 3-dimensional model used in game development consists of triangles/polygons (Koulaxidis & Xinogalos, 2022). In making object modeling 3-dimensions with a large number of polygons is called a high poly modeling technique and vice versa, if it is an object 3-dimensions having a small number of polygons is called a low poly modeling technique (Meilin Mongilala, Tulenan, and Sugiarso 2019).

The maximum number of low poly vertices is 12,000 so that modeling animated objects is simple (Laila Zanitra & Nurma Sari, 2022). The more polygons we find in an object, the more realistic the representation. One way to optimize a video game model is to use as few polygons as possible to represent it (Koulaxidis & Xinogalos, 2022).

Following are the 3-dimensional model avatars of the 12 Shio pets in the Twelve Metaverse game with the number of triangles.

Table 1. Avatar of 12 Shio pets
[Source: Author Documentation, 2024]

No	Avatar of Shio pet	No	Avatar of Shio pet	No	Avatar of Shio pet
1	 Figure 2. Buffalo Triangles: 6.084	2	 Figure 3. Dog Triangles: 7.154	3	 Figure 4. Dragon Triangles: 4.038

4	 Figure 5. Goat Triangles: 3.318	5	 Figure 6. Horse Triangles: 5.028	6	 Figure 7. Monkey Triangles: 8.994
7	 Figure 8. Pig Triangles: 8.456	8	 Figure 9. Rabbit Triangles: 7.318	9	 Figure 10. Rat Triangles: 8.078
10	 Figure 11. Rooster Triangles: 2.478	11	 Figure 12. Snake Triangles: 1.666	12	 Figure 13. Tiger Triangles: 8.102

Twelve Metaverse game are available on *Google play store*, which can be installed by users via mobile devices.

<https://play.google.com/store/apps/details?id=com.DefaultCompany.Twelve>

2.2 Testing Media

Before the testing process, prepare an adequate device to start the process of testing the performance of the 3-dimensional 12 Shio pet avatars model in the Twelve Metaverse game. This test was carried out for mobile games, so there is no need to use a PC high end. The following are the devices and specifications used.

Table 2. Device specifications
[Source: Author Documentation, 2024]

Device Name	LAPTOP-3RBM4FE1 ASUS ROG <i>Strix</i> G513QM
Processor	AMD Ryzen 9 5900HX
RAM	16.0GB

This research uses a laptop as a testing tool, observing, evaluating, and analyzing performance12 Shio pets in the Twelve Metaverse game. By using a personal laptop, researchers can carry out tests anytime and anywhere.

3. RESULTS AND ANALYSIS

3.1 Testing

Game that has been observed, evaluated, and analyzed is the Twelve Metaverse game, using the *Unity Engine Profiler* and operating on a mobile platform. The purpose of this analysis is to find the maximum number of 3-dimensional avatars of 12 Shio pets in the Twelve Metaverse game according to the standard of 50-60 FPS in one scene. The following is the testing media for the 12 Shio pets in the game in the *Unity Engine Profiler*.

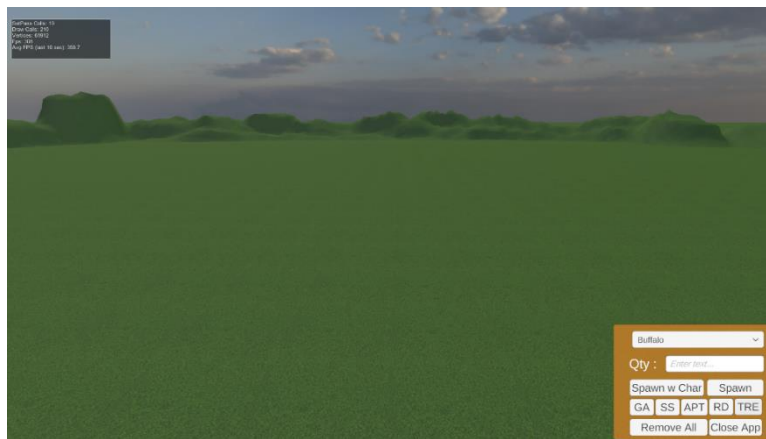


Figure 14. *Unity engine profiler*
[Source: Author Documentation, 2024]

The test media as shown in figure 14 has gone through the export and import process from *blend* format to *fbx* format in the *unity game engine* on the avatars 3-dimensions 12 Shio pets. Then there are 2 types of control buttons available, as in Figure 15.

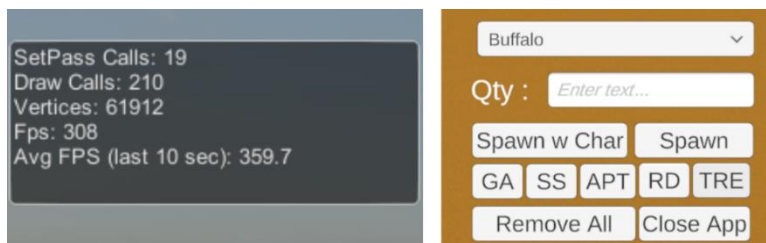


Figure 15. Engine statistics information and engine test control buttons
[Source: Author Documentation, 2024]

The orange test engine control button located at the bottom right is useful for setting the Shio pet, quantity, character, spawn, environment, remove spawn, and close application. Meanwhile, the black statistical information located at the top left is useful

for providing information on batch values, vertices, and Avg FPS. The following is a 3D model profiling of the game in *Unity3D*.

3.1.1 Testing of the Shio pet

Testing begins with collecting triangles data from 12 Shio pets. Then this test is carried out on the 2 Shio pets which have the highest and lowest number of triangles. The following is a table of the 12 Shio pets with the number of triangles.

Table 3. Number of triangles and color code for the highest and lowest Shio pets
[Source: Author Documentation, 2024]

3D Objects	Triangles	Information
Land	18.667	-
Monkey	8.994	highest
Pig	8.456	-
Tiger	8.102	-
Rat	8.078	-
Rabbit	7.318	-
Dog	7.154	-
Buffalo	6.084	-
Horse	5.028	-
Dragon	4.038	-
Goats	3.318	-
Rooster	2.478	-
Snake	1.666	lowest

The reason of testing between the Shio pets with the highest and lowest number of triangles is to make it easier to understand and more efficient in time. Apart from that, the test results between the 2 Shio pets are enough to draw the conclusion that the other 10 Shio pets also have a value of 1.000-1.200 spawn with 50-60 FPS. The following is a visualization in Unity3D of testing the Monkey and Snake Shio pets.

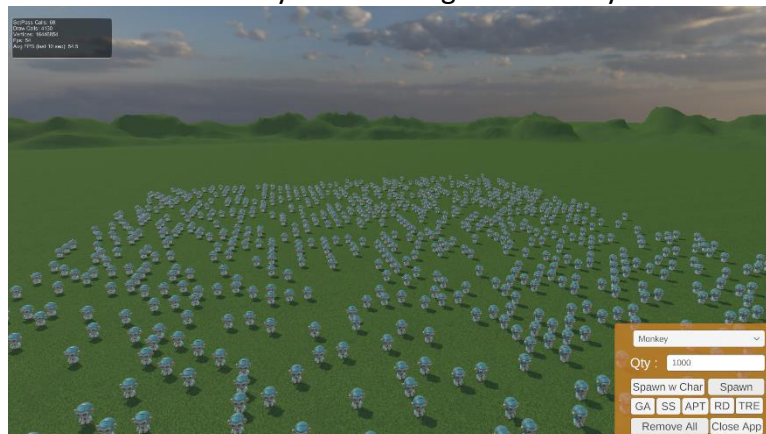


Figure 16. Testing of Monkey Shio pets
[Source: Author Documentation, 2024]

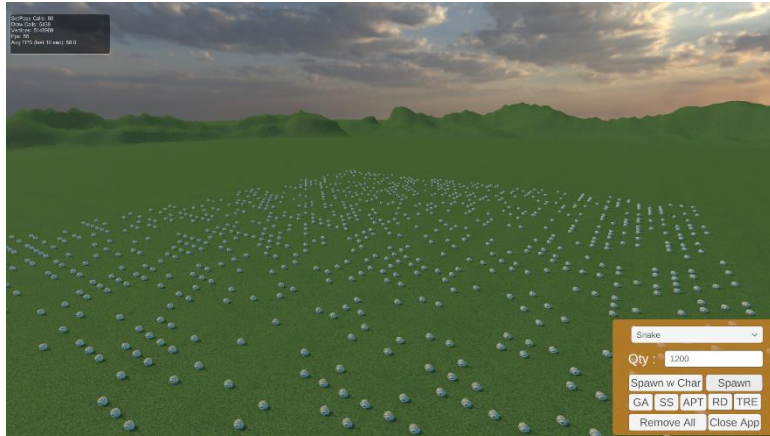


Figure 17. Testing of Snake Shio pets
 [Source: Author Documentation, 2024]

Based on the test results between the 2 Shio pets, if the Shio pet with 8.994 triangles is the highest, it produces 1.000 spawns and 54 FPS which is considered standard, namely 50-60 FPS in video games. Then the Shio pet with 1.666 triangles as the lowest produces 1.200 spawns and 58 FPS which is also considered standard. So, a Shio pet with a number between 8.994-1.666 triangles will definitely produce a value of more than 1.000-1.200 spawns with standard FPS too. Following are the test results on Monkey and Snake as Shio pets.

Table 4. Testing 2 Shio pets as the highest and the lowest
 [Source: Author Documentation, 2024]

Spawn	FPS		Batches		Triangles	
	Monkey	Snake	Monkey	Snake	Monkey	Snake
50	349	361	390	393	309.262	80.910
100	272	293	605	604	579.347	147.216
200	194	215	972	1.038	1.093.225	294.408
400	117	140	1.753	1.792	2.174.216	524.815
600	77	89	2.702	2.702	3.557.423	817.785
800	61	80	3.367	4.061	4.417.649	1.297.073
1.000	54	68	4.130	4.413	5.482.284	1.366.209
1.200	45	58	4.972	5.439	6.673.225	1.716.303
1.400	39	48	5.914	7.419	8.015.915	2467.837

■ = Monkey Shio pet ■ =Snake Shio pet

To make it easier to find the comparison between the 2 Shio pets, there are several graphs in accordance with the table above. These graphs contain information on spawn numbers, FPS, batch, and triangles. The following are graphs of test results between the 2 Shio pets.

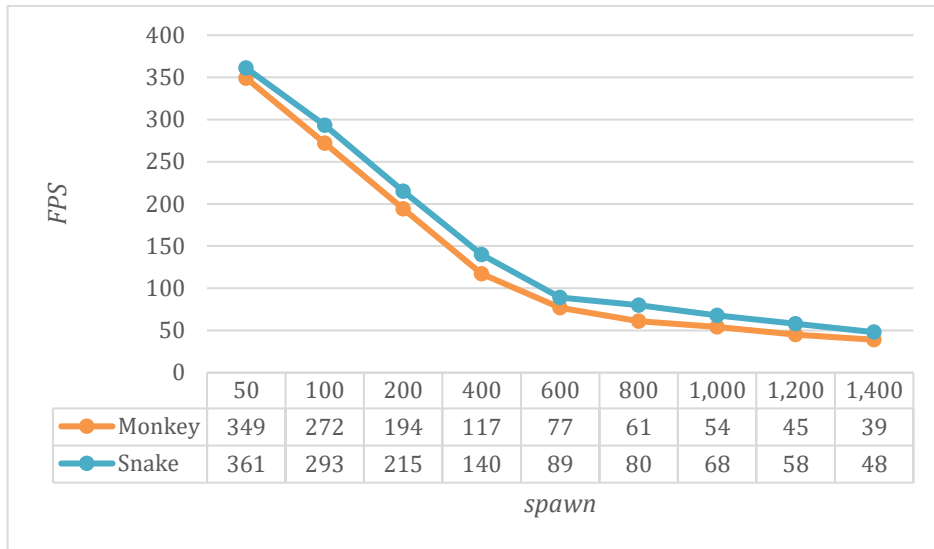


Figure 18. Graph 2 Shio pets of spawn and FPS values
 [Source: Author Documentation, 2024]

The blue line shows the test results on the Snake Shio pet which produced 1,200 spawns with 58 FPS. Meanwhile, the orange line shows the test results on the Monkey Shio pet which produced 1,000 spawns with 54 FPS. Both test results show 1,000 spawns on Monkey and 1,200 spawns on Snake as the maximum player limit in one scene, considering that what is needed is 50-60 FPS in one scene.

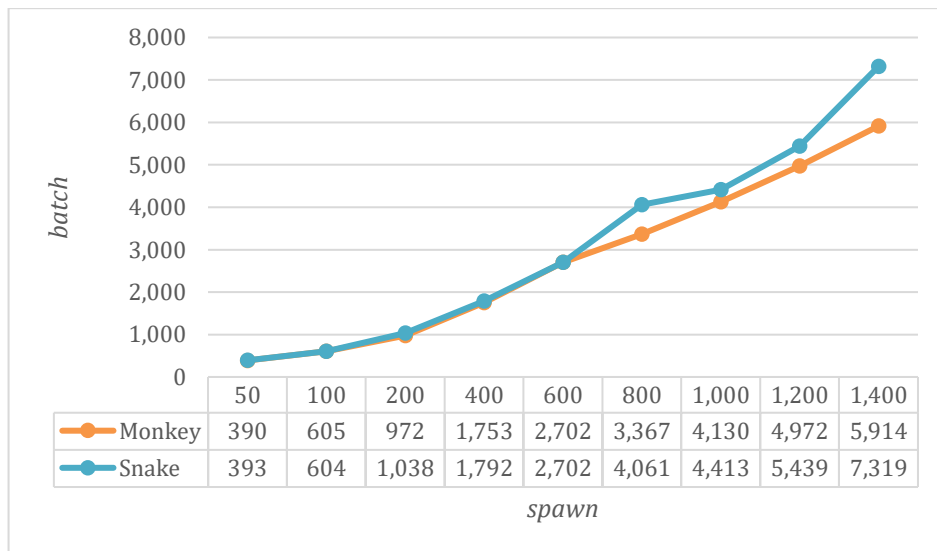


Figure 19. Graph 2 Shio pets of spawn and batch values
 [Source: Author Documentation, 2024]

The blue line shows the test results on the Snake Shio pet which produced 1,200 spawns with 5,439 batches. Meanwhile, the orange line shows the test results on the Monkey Shio pet which produced 1,000 spawns with 4,130 batches.

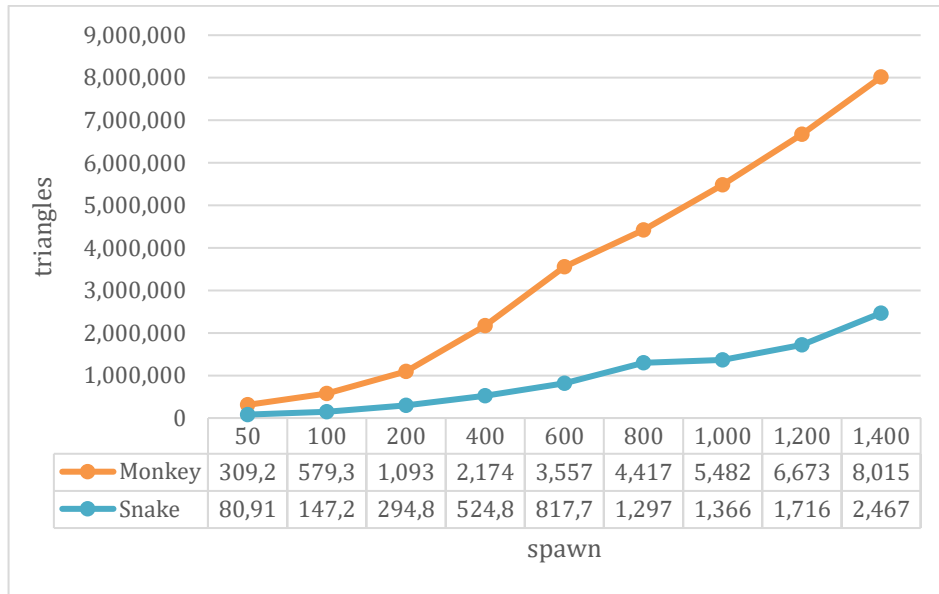


Figure 20. Graph 2 Shio pets of spawn and triangles values
 [Source: Author Documentation, 2024]

Then, the blue line shows the test results on the Snake Shio pet which produced 1.000 spawns with 5.482.284 triangles. Meanwhile, the orange line shows the test results on the Monkey Shio pet which produced 1.200 spawns with 1.716.303 triangles. Of course, the visualization above also represents the test results of the 10 Shio pets between the highest and lowest triangles.

3.1.2 Testing of the Shio pet with human character

The next test was carried out on Monkey, Snake side by side with human characters. The aim is to find the cause of an increase in batches and triangles as well as a decrease in FPS when testing in the Unity Engine Profiler. The following is the number of triangles on the 3D object tested.

Table 5. Number of triangles human character
 [Source: Author Documentation, 2024]

3D Objects	Triangles
Land	18.667
Monkey	8.994
Snake	1.666
Human character	4.500

If these numbers are not translated into each 3-dimensional object, errors may occur in the analysis results. So, to find out the correct calculation of the analysis results, this test must describe each number of triangles in land, Monkey, Snake, and human character as in the table above.

When testing was carried out, there was an excess number of batches and triangles as well as a decrease in FPS on information in the Unity Engine Profiler. Because the Twelve Metaverse game has a human character as the main character played by players and the 12 Shio pets are always side by side with human characters in every scene in the game. So, it is important to test the Shio pet with the human character. The following is a visualization in *Unity3D* of the Monkey and Snake Shio pet side by side with human characters.



Figure 21. Testing of Monkey Shio pets with human characters
[Source: Author Documentation, 2024]



Figure 22. Testing Snake Shio pets with human characters
[Source: Author Documentation, 2024]

Test results on the Unity Game Engine show that the Shio pet Monkey with human characters produces 500 spawns and 54 FPS. Meanwhile, the Shio pet Snake with human characters produces 600 spawns and 50 FPS. Following are the test results in the form of spawn, FPS, batch, and triangles values for Monkey and Snake as Shio pets.

Table 6. Testing 2 Shio pets as the highest and the lowest signs with human character
 [Source: Author Documentation, 2024]

Spawn	FPS		Batches		Triangles	
	Monkey	Snake	Monkey	Snake	Monkey	Snake
50	274	275	1.044	1.021	605.091	378.496
100	204	194	1.916	1.833	1.206754	726.492
200	119	124	3.676	3.711	2.435.318	1.545.082
300	82	97	5.311	5.455	3.559.252	2.297.657
400	69	71	7.129	6.883	4.806.239	2.911.758
500	54	59	8.552	8.905	5.765.009	3.796.760
600	44	50	11.289	10.760	7.676.084	4.601.143

■ = Monkey Shio pet with human character
■ = Snake Shio pet with human character

With the table above, it will be even easier to visualize in graphic form to find out the comparison between 2 Shio pets that are side by side. The graph also contains information on the number of spawns, SFPS, batches, and triangles. Below are some graphs of test results between 2 Shio pets that are side by side.

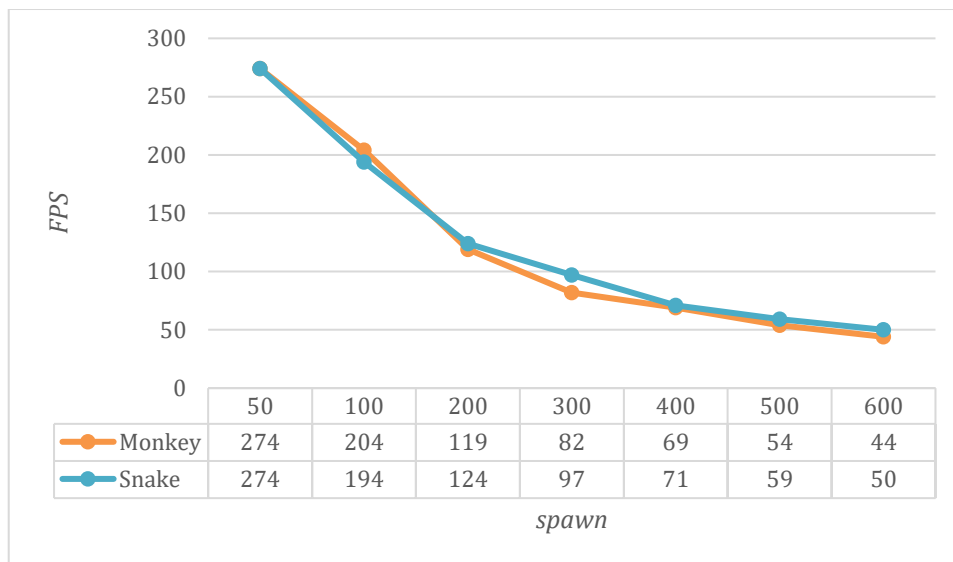


Figure 23. Graph 2 Shio pets with human character of spawn and FPS values
 [Source: Author Documentation, 2024]

The blue line shows the test results on the Monkey Shio pet with the human character producing 500 spawns with 54 FPS. Meanwhile, the orange line shows the test results on the Snake Shio pet with the human character producing 600 spawns with 50 FPS. Both results show 500 spawns on Monkey and 600 spawns on Snake with human characters as the maximum player limit in one scene, considering that what is needed is 50-60 FPS in one scene.

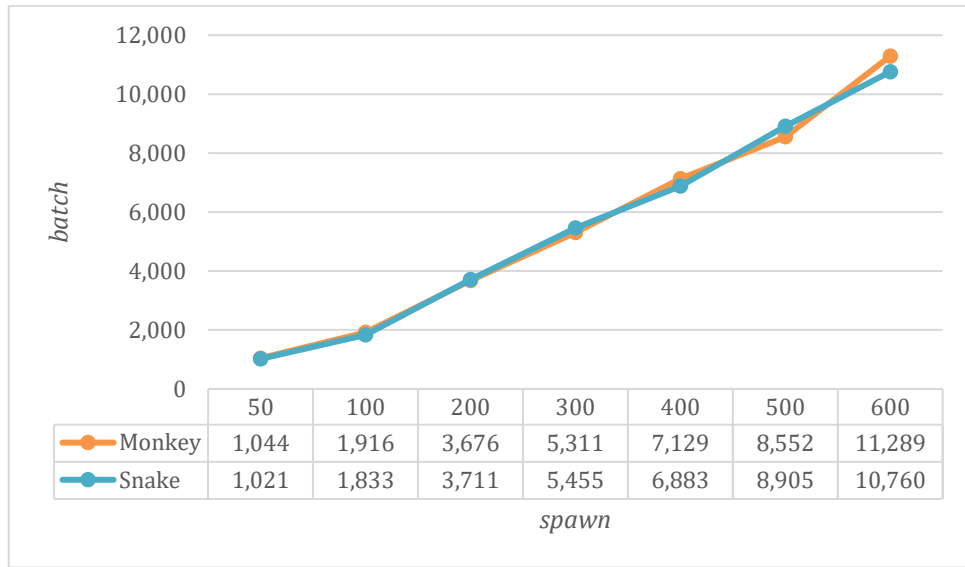


Figure 24. Graph 2 Shio pets with human characters of spawn and batch values
 [Source: Author Documentation, 2024]

The blue line shows the test results on the Monkey Shio pet which produced 500 spawns and 8.552 batches. Meanwhile, the orange line shows the test results on the Snake Shio pet which produced 600 spawns and 10.760 batches.

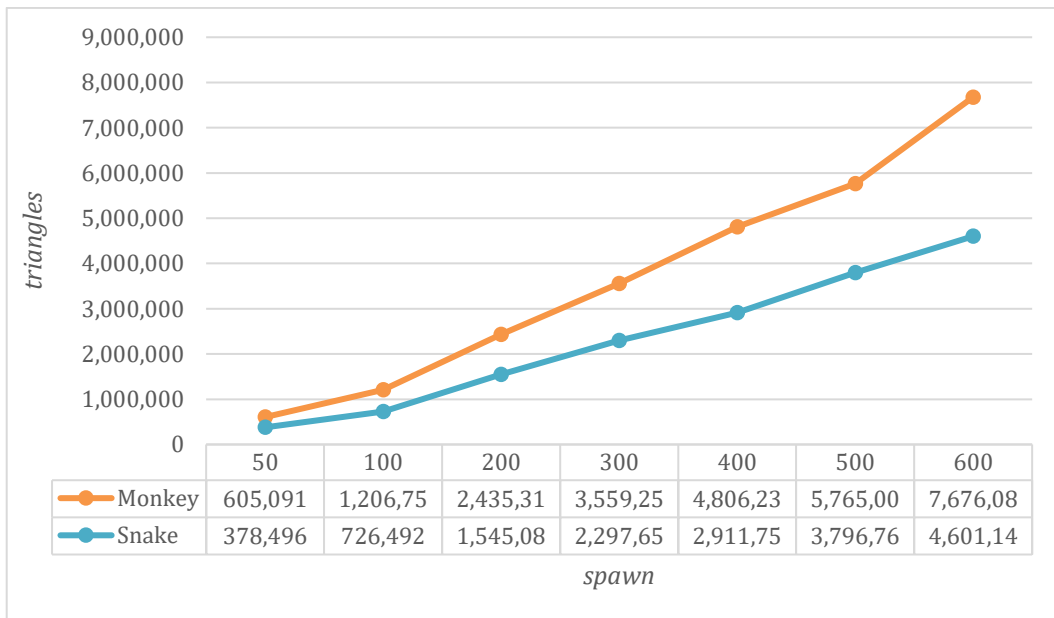


Figure 25. Graph 2 Shio pets with human characters of spawn and triangles values
 [Source: Author Documentation, 2024]

Then, the blue line shows the test results on the Monkey Shio pet which produced 500 spawns with 5.765.009 triangles. Meanwhile, the orange line shows the test results on the Snake Shio pet which produced 600 spawns with 4.601.143 triangles.

Of course, the visualization above also represents the test results of the 10 Shio pets between the highest and lowest triangles with human characters.

3.1.3 Testing of the Shio pet with human character and environment

The final test is testing Monkey Shio pet and Snake Shio pet side by side with human characters and several environments. The aim is also to find the cause of why there is an increase in batches and triangles as well as a decrease in FPS when testing in the Unity Engine Profiler. The following is a description of the number of triangles in the 3D objects tested.

Table 7. Number of environment triangles
[Source: Author Documentation, 2024]

3D Objects	Triangles
Land	18.667
Monkey	8.994
Snake	1.666
Human character	4.500
GA (gathering area)	15.333
SS (skyscrapers)	22.333
Apt (apartment)	69.666
RD (roads)	4.333
Tre (tree)	23.333

Apart from it being important to test the Shio pet with the human character, analyzing the Shio pet with the human character and environment is also the same. Because in the Twelve Metaverse game, the environment is a background that contains buildings to fill the maps in the game. So, the role of the Shio pet with human character and the environment are interrelated.

Therefore, testing the triangles, spawn, batch, and FPS values was also carried out on the Shio pet next to human character and environment. The following is a visualization in *Unity3D* of the Monkey Shio pet and Snake Shio pet side by side with human character and the environment.

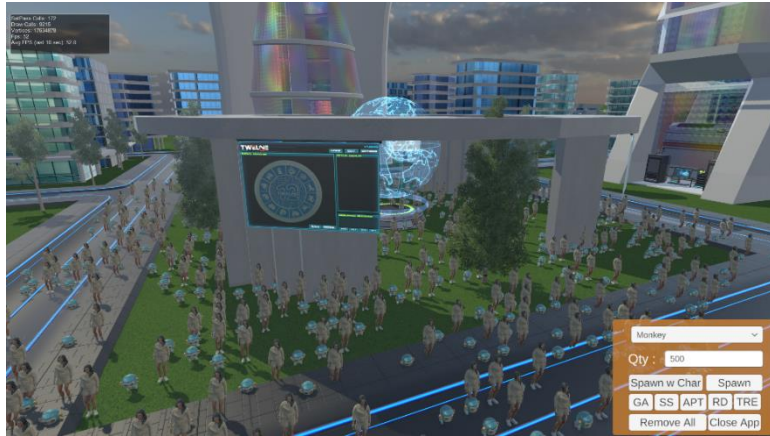


Figure 26. Testing of Monkey Shio pet with human character and environment
 [Source: Author Documentation, 2024]

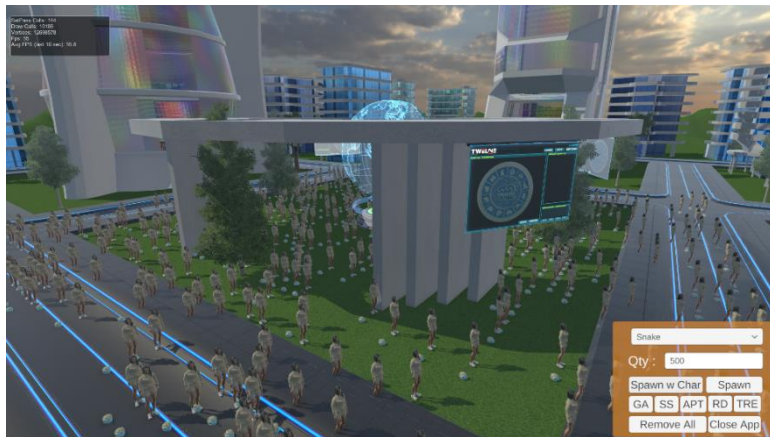


Figure 27. Testing of Snake Shio pet with human character and environment
 [Source: Author Documentation, 2024]

This test produced the highest number of batches and triangles with 500 spawns compared to the previous one. One factor is that there are more 3-dimensional objects than in the previous test. Of course, the number of spawns given to more objects also affects the FPS value in a video game. Following are the test results on Monkey and Snake side by side with human characters and the environment.

Table 8. Testing 2 Shio pets as the highest and the lowest signs with human character and environment
 [Source: Author Documentation, 2024]

Spawn	FPS		Batches		Triangles	
50	217	221	1.734	1.705	785.383	525.100
100	157	167	2.729	2.571	1.450.208	903.188
200	103	114	4.332	4.394	2.576.790	1.698.792
300	79	86	6.700	6.326	4.185.116	2.543.354
400	63	68	8.069	8.670	5.164.933	3.565.124
500	53	56	9.215	10.198	5.878.292	4.232.859
600	44	47	11.195	12.179	7.233.167	5.090.710

■ = Monkey Shio pet with human character and environment
■ = Snake Shio pet with human character and environment

Of course, there are several graphs that show the test results between the 2 Shio pets with human characters and the environments according to the table above. Below are several graphs containing test results for spawn, FPS, batch, and triangles values on 2 Shio pets with human characters and environments.

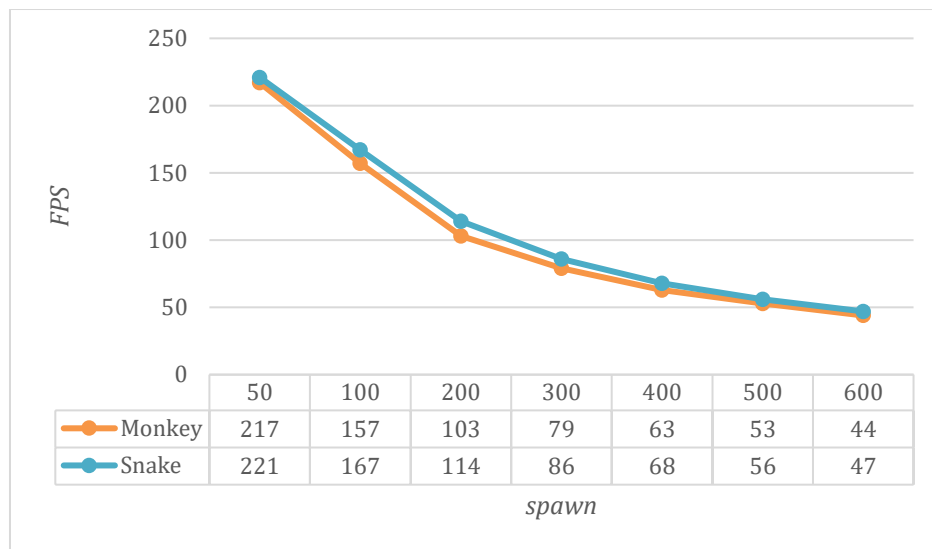


Figure 28. Graph 2 Shio pets with human characters and environment of spawn and FPS values
 [Source: Author Documentation, 2024]

The blue line shows the test results on the Monkey Shio pet with the human characters and environments producing 500 spawns with 53 FPS. Meanwhile, the orange line shows the test results on the Snake Shio pet with the human characters and environments, producing 500 spawns with 56 FPS. Both test results show 500 spawns on Monkey and 500 spawns on Snake with human characters and environments as the maximum player limit in one scene, considering that what is needed is 50-60 FPS in one scene.

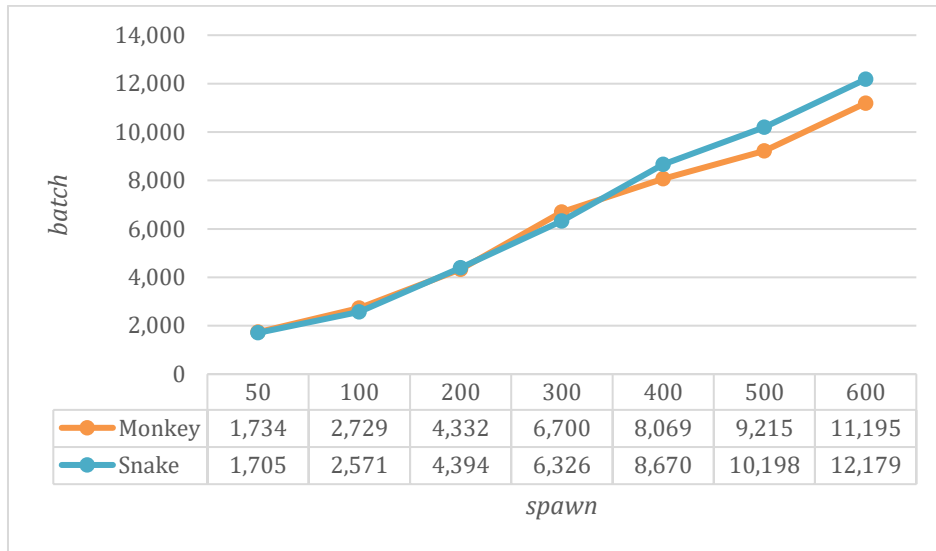


Figure 29. Graph 2 Shio pets with human characters and environments of spawn and batch values
[Source: Author Documentation, 2024]

The blue line shows the test results on the Monkey Shio pet which produced 500 spawns and 9.215 batches. Meanwhile, the orange line shows the test results on the Snake Shio pet which produced 500 spawns and 10.198 batches.

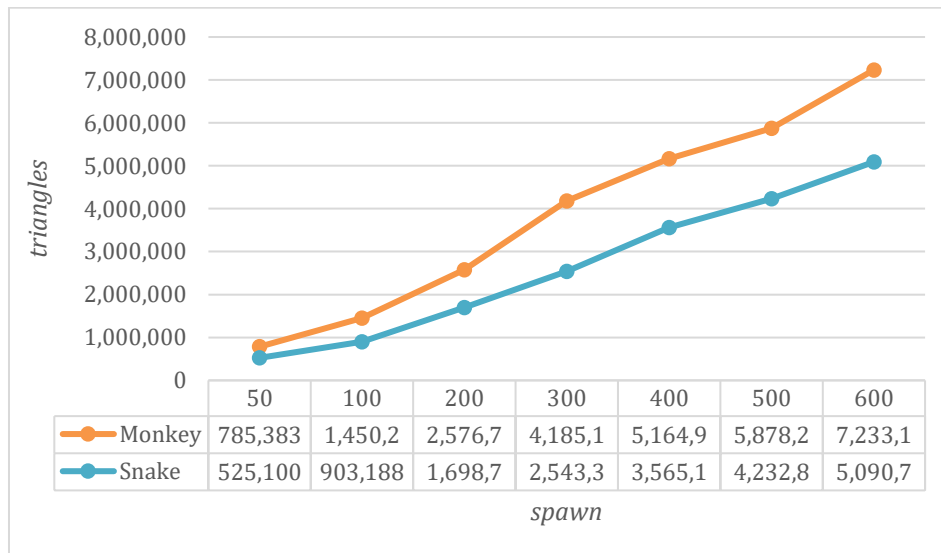


Figure 30. Graph 2 Shio pets with human characters and environments of spawn and triangles values
[Source: Author Documentation, 2024]

Then, the blue line shows the test results on the Monkey Shio pet which produced 500 spawns with 5.878.292 triangles. Meanwhile, the orange line shows the test results on the Snake Shio pet which produced 500 spawns with 4.232.859 triangles. Of course, the visualization above also represents the test results of the 10 Shio pets

between the highest and lowest triangles with human characters and the environments.

In this report, it only provides a visualization of the test results between Monkey and Snake with human characters and the environments. For the other 10 Shio pets, research has also been carried out in the form of observation, evaluation, and analysis of game performance in accordance with the objectives of this research. All analysis results on the other 10 Shio pets, signs produce numbers between the results of the two Shio pets Monkey and Snake according to the explanation and testing above.

3.2 Analysis of Results

Game that has been analyzed is the Twelve Metaverse game, using *Unity3D* and operating on a mobile platform. The data in tables 4-9 are taken from 12 Shio pets, human characters, and the environments using *blender* triangles, *unity* vertices, *unity* triangles, batch, spawn, and Avg FPS statistics in *Unity3D*. It is necessary to observe, evaluate, and analyze the performance of the 12 Shio pets with human characters and the environments in the Twelve Metaverse game because it affects the performance results of spawn, triangles, FPS, and batch values.

Where the results of the game performance analysis for Monkey Shio pet are different from Monkey Shio pet with human characters, as well as for Monkey Shio pet with human characters and environments. If used with the same spawn value for the 3 types of tests, there will be an increase in triangles and a decrease in FPS. That is not the right way to find spawn and batch values according to the 50-60 FPS standard. The following is a table of the results of the 3 types of tests that have been carried out.

Table 9. Results of observation, evaluation, and performance analysis on 3 types of 3D object testing
[Source: Author Documentation, 2024]

3D Objects	Spawn	FPS	Batches	Triangles
Monkey Shio pet	1.000	54	4.130	5.482.284
Snake Shio pet	1.200	58	5.439	1.716.303
Monkey Shio pet with human character	500	54	8.552	5.765.009
Snake Shio pet with human character	600	50	10.760	4.601.143
Monkey Shio pet with human character and environment	500	53	9.215	5.878.292
Snake Shio pet with human character and environment	500	56	10.198	4.232.859

From the results observation, evaluation, and game performance analysis on 3 types of 3D object testing through measuring Spawn, FPS, batch, triangles values based on quantitative and qualitative research methods, can be analyzed as follows:

- 1) There is an increase in batch and triangles values if the spawn value is large, and vice versa.
- 2) There will be a decrease in the FPS value if the spawn value is large and this will cause lag.
- 3) The results of observation, evaluation, and analysis of game performance on the Monkey and Snake Shio pets show that 12 Shio pets can be given 1.000-1.200

spawns and produce 54-58 FPS in one scene. Apart from that, 12 Shio pets can also produce 4.130-5.439 batches and 5.482.284-1.716.303 triangles.

- 4) In the game performance of Monkey with the human character and Snake Shio pet with the human character, it shows that 12 Shio pets can be given 500-600 spawns and produce 50-54 FPS in one scene. Apart from that, 12 Shio pets with human characters can also produce 10.760-8.552 batches and 4.601.143-5.765.009 triangles.
- 5) In the game performance of the Monkey Shio pet with human character and environments as well as the Snake Shio pet with human character and environments, it shows that 12 Shio pets can be given 500 spawns and produce 53-56 FPS in one scene. Apart from that, 12 Shio pets with human character and environments can also produce 9.215-10.198 batches and 4.232.859-5.878.292 triangles.

Rendering and scripting performance causes a decrease in FPS in the game, if on 12 Shio pets more than 1.200 spawns, on 12 Shio pets with human characters more than 600 spawns, on 12 Shio pets with human characters and environments more than 500 spawns. If you play a game, the result will be broken, because the normal FPS rate is at least 24 FPS, which is in accordance with the human eye seeing movement smoothly without breaking (Riwinoto & Tan, 2021).

4. CONCLUSION

From the tests that have been carried out, the export and import process from *Blender* to the *Unity Game Engine* on the avatars 3-dimensions 12 Shio pet game Twelve Metaverse produces a test container with a good process. Therefore, from the research above it can be concluded that the performance of the 12 Shio pets, 12 Shio pets with human character, 12 Shio pets with human character and environments in the Twelve Metaverse game is efficient. The aim of this research is to find the maximum number of avatars 3-dimensions 12 Shio pets are optimal according to the standard of 50-60 FPS in one scene.

The game performance results for 12 Shio pets can produce 1.000-1.200 spawns with a value of 54-58 FPS. For 12 Shio pets with human characters can produce 500-600 spawns with a value of 50-54 FPS in one scene. For 12 Shio pets with human characters and environments can produce 500 spawns with a value of 53-56 FPS in one scene.

For tests with game performance that exceeds the analysis results above, it is recommended to carry out further research to reduce rendering and scripting computations in Twelve Metaverse games. The goal is to avoid lag in video game scenes with a larger spawn number than the test above.

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