Connectivity pattern analysis for virtual simulation design, based on high-performance game analysis

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Abstract

In the learning and training processes, simulation is taking a lot of strength due to the ease and recurrence that it allows us, managing to perform it repeatedly until reaching the necessary skills. We find simulation in different applications Such as doctors, in engineering, where what is tried is to reproduce the experimentation environment in a similar way, that is why we find today a number of applications, tools, programming languages, dedicated development environments to be able to implement simulation environments. The present work proposes a method to be able to analyze the connectivity patterns to be able to recommend the use and applications of the different types of networks, making an analysis of these connections in the realization of video games, in the study various video games that we can find were evaluated In the market, these video games have a particularity that within their simulation structure requires a high calculation capacity, so it is recommended so that it can be installed against a good capacity of memory, storage, processor and a powerful graphic processor, who is in charge of the rendering of the scenarios, game analysis and the greater amount of calculation necessary to carry out the game, games such as Valorant, Fornite and League of Legends were evaluated, games that require high computational capacity, added to a good connectivity of network, WIFI connections were evaluated in the 2.4GHz 5GHz bands and by RJ45 connector, the results show that before a constant speed of the same network the 5GHz connection is the connection where the games have a better performance, in second place is the connection by RJ45 or better known as a network cable connection and finally in third place is the WIFI connection to 2.4 GHz, these results can help the design of applications related to virtual simulation independent of the simulation engine.

Keywords 1

Simulation, WIFI, videogames, Network, performance.

1. Introduction

In the simulation environment, we find many applications and with it many tools dedicated to developing programs and solutions based on simulation, where processes, tasks, scenarios, work situations are simulated, even how the human body reacts, each of them has a purpose, in the search for this purpose we find many requirements for these tasks such as calculation capacity, amount of memory and connectivity to be able to share resources between the different components of the simulation system, doing a search in the bibliography we can find works related to simulation, medical where the intention is to be able to present to the students scenarios similar to the human body, where they are dedicated to training the students, before the students interact with people, in the development of these simulators, electronic and mechanical processes are integrated , electric and virtual reality, reproducing scene rivers and situations of real medical cases [1] [2] [3]. The rotation in the doctors is important because it allows to interact as much as possible with the majority of the

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cases that are related to the medical specialties, in this scenario the simulators represent an alternative to be able to interact with many situations and cases where the specialists are tried from the health area [4]. In this simulation environment, there are many systems that work as integrated systems made up of components where each of them fulfills a specific task, we can indicate in this scenario the simulation engines, the modules in charge of signal acquisition, mechanical modules, each one of them needs computational resources, in its integration a network connectivity is used to share resources in this way to optimize and integrate all the modules, thanks to this connectivity this integration is possible and therefore complex simulation systems [5] [6]. In the development of simulation systems, the central part is made up of the simulation engines, where mathematical calculation models, predictive models, structure models are executed where it receives signals from the sensors and performs the necessary calculation to activate the actuators [7] [8]. The use of virtual reality, virtual stage design programs as well as artificial intelligence, are causing a change in the concept of simulation-based systems design, as well as the combination of them, the result from the computational point of view, is the increase and the need for computational capacity to be able to perform these tasks, in this work an analysis performed with video games is presented where computational capacity is required in order to test the different connectivity alternatives in order to have the best response the performance of the games based on the analysis of the frames per second and the connection speed between the computer and the router that provides connectivity. [9] [10].

2. Materials and Methods

In the analysis of simulation systems, we find many architectures dedicated to providing solutions, among them we can indicate the centralized ones where servers are used where they are responsible for most of the calculation, we have other architectures such as distributed ones where we try to distribute resources, these Two architectures have common processes, the need to be able to connect with the different components of the system through a network where information can be shared. Figure 1 presents the proposed methodology to analyze the best network that can be configured with the intention of being used as a basis for systems that develop simulation.

Figure 1: Block diagram of the proposed methodology.

2.1. Analysis of available networks

The first component of the methodology is based on the connectivity that a network connection and internet access can provide us, for the purposes of the evaluation we will carry out three evaluations based on a standard 100 Mbps internet connection, where we will make the connections based on three connections:

- WIFI connection in the 2.4 GHz band.
- WIFI connection in the 5GHz band.
- Direct cable connection with the RJ45 connector.

2.2. Types of virtual simulation mechanisms

In the simulation environment, we have many tools, each one dedicated to a particular task, one of the areas where these tools have been developed and thanks to them we can have solutions based on hardware such as software, are video games These have allowed an evolution in the different tools,

below we present a list of the different tools that we can use for the design of simulated systems, we will comment on the tools most used in the environment of video game development, such as UNITY UNREAL ENGINE , LabView dedicated to the simulation of electronic circuits and industrial control systems and matlab, for the design of engineering prototypes.

Figure 2: Development environment of the UNREAL ENGINE tool.

In figure 2, the development environment of the UNREAL ENGINE tool is presented, dedicated to the design of video games, virtual environments, scenarios, objects, as well as the programming to be able to interact between the different objects, the result of this interaction is developed video game.

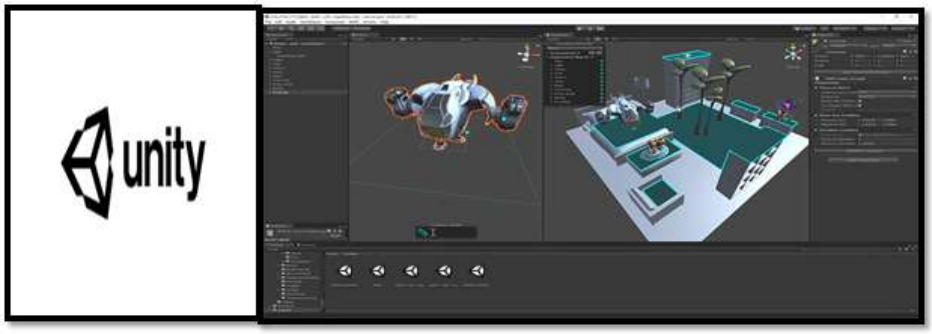

Figure 3: Development environment of the UNITY tool.

In figure 3, it is presented in the development environment of the UNITY tool, where in a similar way to the UNREAL ENGINE tool, virtual objects can be designed, such as virtual scenarios, machinery, this tool is widely used in architectural and structural design of civil works. Between both tools a considerable computational capacity is necessary, because you need to perform calculations to obtain the texturing and give the 3D appearance, it is this aspect that requires available memory capacity and a graphic processor, which will allow the rendering to be carried out in the least possible time, if we do not have a graphic processor, all the necessary calculation will be carried out by the system processor, for design purposes an internet connection is required to update and download source code and design tolos.

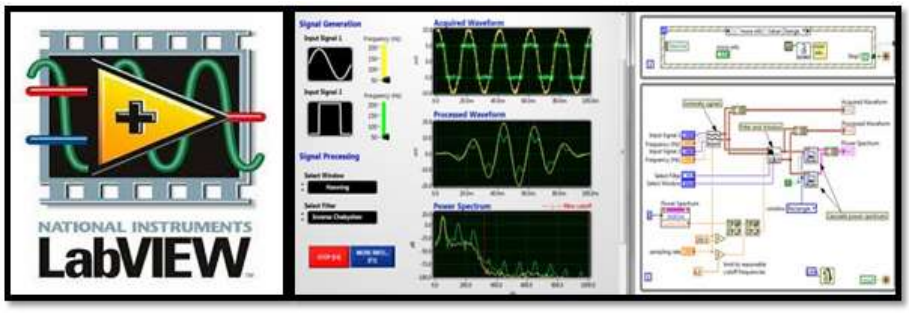

Figure 4: LabView tool development environment.

In figure 4, the development environment of the LabView tool is presented, this allows similar systems based on industrial automation, where signal analysis is performed, control, it can be connected with different data acquisition cards for data capture, and different actuators, it is recommended for electronic and electrical simulation, connecting through UDP network protocols such as TCP among others, making a modular simulation between the different components of the simulation system.

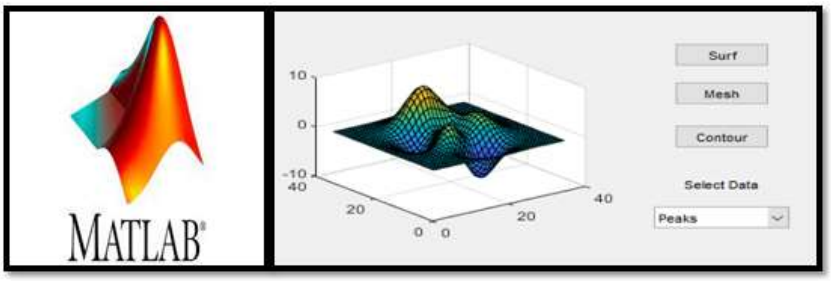

Figure 5: MATLAB tool development environment.

In figure 5, the development environment of the Matlab tool is presented, this tool is used for numerical simulation, in simulation related to the processing of images and tests of computational algorithms. It can also be used in conjunction with the LabView tool.

2.3. Evaluation of connectivity tests applied to video games

The evaluation of connectivity is carried out based on the evaluation when the video games Valorant, Fornite and League of Legends are being played, where the maximum number of frames that the video game can develop and the connection between the computer and the device is measured. Communication measuring connectivity based on the evaluation of a ping and measuring the response time in milliseconds.

Next we present the interpretation of these two values in the realization of the video game:

- **Frames per Second**, indicates the response speed of the game, you want this value to be the maximum possible, this value depends on the connection with the network and the resolution of the equipment to render the scenarios.
- **Connectivity**, Indicates the connectivity speed, the higher the connectivity the game's realism improves, indicating that there is no packet loss.

In the video game you have to take into account the maximum resolution, in many cases an attempt was made to balance the load, if the maximum resolution is configured for texturing, a higher network speed is required, in most cases when you do not have a Good network connection lowers the texturing resolution, these values are noticeable when, in the development of the game, a gap between the movement carried out and the response on the screen is not perceived.

3. Results

The results that are presented are related to the verification of the frames per second that the game develops and the delay time in the communication of the computer with the network device. The analysis is carried out based on the Valorant, Fornite and Leage of Legends games, in the following network connections, with cable and RJ45 connector, WIFI in the 2.4 GHz band and the 5GHz band.

Figure 6: Fornite game environment.

FORNITE case: in connection with RJ45 cable
Frames per Second: 71FPS
Connectivity: 91ms

FORNITE case: in connection with WIFI in the 5GHz Band
Frames per Second: 82FPS
Connectivity: 92ms

FORNITE case: in connection with WIFI in the 2.4GHz Band
Frames per Second: 53FPS
Connectivity: 100ms

In the case of the Fornite game, it can be noted that the best performance is presented in the WIFI connection in the 5GHz band, with a performance of 82 FPS and a connection of 92ms, better performance compared to the WIFI connection at 2.4 GHz and the cable connection, this result is obtained by maintaining the same internet connection in all three cases.

Figure 7: Ambiente del juego Valorant.

VALORANT case: in connection with an RJ45 cable
Frames per Second: 95 FPS
Connectivity: 50ms

VALORANT case: in connection with WIFI in the 5GHz Band
Frames per Second: 135FPS
Connectivity: 46ms

VALORANT case: in connection with WIFI in the 2.4GHz Band
Frames per Second: 85FPS
Connectivity: 47ms

In the valorrant game, there are similar results with the FORNITE game, the connectivity values and frames per second vary, but with similar results, having the connection through WIFI in the 5GHz band as the best performance, with 135 FPS and with a connection delay of 46 ms.

Figure 8: Ambiente del juego League of Legends.

LEAGUE OF LEGENDS case: in connection with RJ45 cable
Frames per Second: 59 FPS
Connectivity: 46ms

LEAGUE OF LEGENDS case: in connection with WIFI in the 5GHz Band
Frames per Second: 104FPS
Connectivity: 46ms

LEAGUE OF LEGENDS case: in connection with WIFI in the 2.4GHz Band
Frames per Second: 80FPS
Connectivity: 46ms

In the case of the League of Legends game, the results that show the performance of the game, the connection through WIFI in the 5GHz band, presents a resolution of 104 FPS with a connection delay of 46ms, being the best performance compared to WIFI connection at 2.4GHz and by wiring.

4. Conclusions

At the end of the present investigation and having evaluated the performance of three online games, where a large capacity of resources is required so that the game can develop without problems, among the necessary resources we can mention the processing capacity to generate the rendering and texturing of the scenario, these processes are very important in the development of the game because it allows to give it a realism and avoid the delay of the game with respect to the movement that is carried out, also the connectivity, because as it is a game in lines, it has to connect with the server In such a way as it is played in a group, the scenarios have to be shared and therefore connectivity and internet access are required in order not to perceive the delay in the game, the results of evaluating three games Fornite, Valorant and League of Legends In wired connections, WIFI in the 5GHZ and 2.4 GHZ band, they present different results due to the nature of the game, eg The connection that resolves the highest frames per second and the shortest response time with the communications equipment is the 5GHz WIFI connection, which shows that this connection is recommended over the conventional wiring that we find in home connections.

We can indicate that having performed the analysis of the connectivity of these three online games and require various computational resources such as processing capacity and connectivity. We recommend using the 5GHz WIFI connection for the development of simulation applications, managing to share resources, information and messages between the simulation modules, making the applications run smoothly, spending more time on the design of simulation components instead of looking for connection alternatives. It is recommended to work with the tools described for the development of simulation applications such as those that include the design of virtual scenarios such as UNITY and UNREAL ENGINE or applications dedicated to programming such as LABVIEW and MATLAB.

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