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VIRTUAL REALITY IN THE CREATION OF A TOOL TO SUPPORT PLANNING OF PHYSICAL SECURITY AT NUCLEAR FACILITIES

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ABSTRACT

In recent years was observed the importance of improving the physical security of nuclear facilities, mainly due to the increasing advancement of brazilian nuclear program. The present work aims to develop a tool that allows the visualization and planning of action strategies in a virtual environment, in order to improve this security. To this end, was created a virtual model of the Instituto de Engenharia Nuclear (IEN), which is located on Ilha do Fundão – Rio de Janeiro – Brazil. This environment is a three-dimensional model, with representations close to reality, where virtual characters (avatars) can move and interact in real time. In this virtual world, it was developed a dynamic weather system, where is possible to change between day and night, and climate changes such as: rain, storms, snow, among other features. Furthermore, the tool has a surveillance system using virtual cameras, allowing the monitoring of the environment. This way, making possible to simulate strategies approach, allowing an evaluation of the procedures performed, as well as assisting in the training of security installations subject to radiation.

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1. INTRODUCTION

With the approaching of the major events hosted in Rio de Janeiro - Brazil has intensified concern against attacks that may compromise the physical security of nuclear facilities, this treats the risk of nuclear radioactive material be used in malicious acts against civil society / country's military. The International Atomic Energy Agency (IAEA) have considered this as a priority the enhancement security and training of security personnel.

The Virtual Reality (VR), also known as virtual environment allows recreating representations close to reality for an individual, enabling real-time interaction. This technology can be applied in several areas [6], such as training, simulations, virtual experiments and every day are discovered new uses of this technology. Thus, using the RV is possible to perform the training of multiple different emergency scenarios, not possessing the real environment risks.

This work consists of the development a specific tool for the nuclear area, employing Virtual Reality techniques. This tool allows the improvement of virtual environments of nuclear facilities in order to provide a more realistic environment for the safety of these facilities can be tested and operations can be trained, including rates estimated radiation. More specifically, the work aims the training of security personnel regarding theft and attacks on nuclear facilities and the development of an evaluation system and assistance in the process of evacuating people during emergencies.

2. METHODOLOGY

The system was developed using the programs Autodesk 3ds Max and Unity 3D, through these was created a virtual model of the Instituto de Engenharia Nuclear (IEN) located in Ilha do Fundão - Rio de Janeiro - Brazil. With the use of 3ds Max was possible to model the three-dimensional buildings present in the institute, and with Unity 3D to create the virtual world where the simulations occur.

The follow will describe the tools used to develop this work.

2.1. Autodesk 3ds Max

The first program to be described is 3ds Max, which is developed by Autodesk, and the version used for the realization of this work was the 2013. 3ds Max is a three-dimensional modeling software that offers a complete solution for modeling, animation, simulation and rendering for 3D games, movies and animated graphics that enable artists and designers to quickly increase your productivity [5].

Making use of 3ds Max, the external structure of the buildings of the Instituto de Engenharia Nuclear (IEN) could be modeled in three dimensions, following their respective actual measurements (height, width and length). The figure below shows the building of the Divisão de Confiabilidade Humana (DICH) being built using this tool.

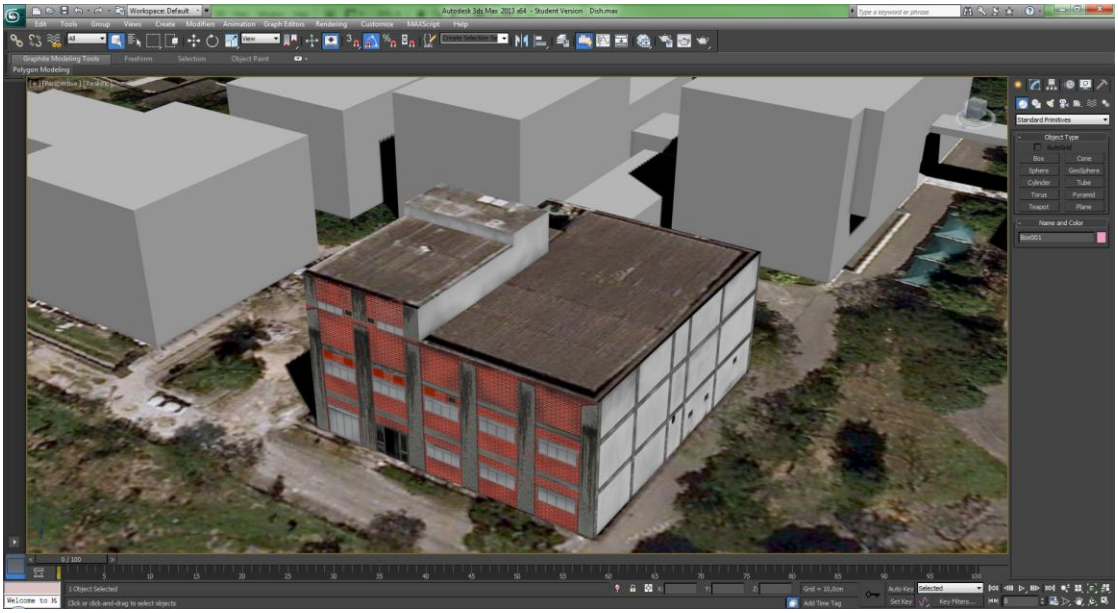

Figure 1: Modeling a building using 3ds Max.

2.2. Unity 3D

Unity is a game development ecosystem: a powerful rendering engine fully integrated with a complete set of intuitive tools and rapid workflows to create interactive 3D content; easy multiplatform publishing; thousands of quality, ready-made assets in the Asset Store and a knowledge-sharing Community [2]. Beyond all this, the Unity provides three options to work with C #, JavaScript or Boo.

Unity's Asset Store is home to a growing library of free and commercial assets created both by Unity Technologies and also members of the community. A wide variety of assets is available, covering everything from textures, models and animations to whole project examples, tutorials and Editor extensions. The assets are accessed from a simple interface built into the Unity Editor and are downloaded and imported directly into your project [4].

The software made possible to develop a virtual model of the Instituto de Engenharia Nuclear (IEN), creating the external environment around the buildings. With Unity virtual cameras are positioned, which are used in the monitoring of the environment.

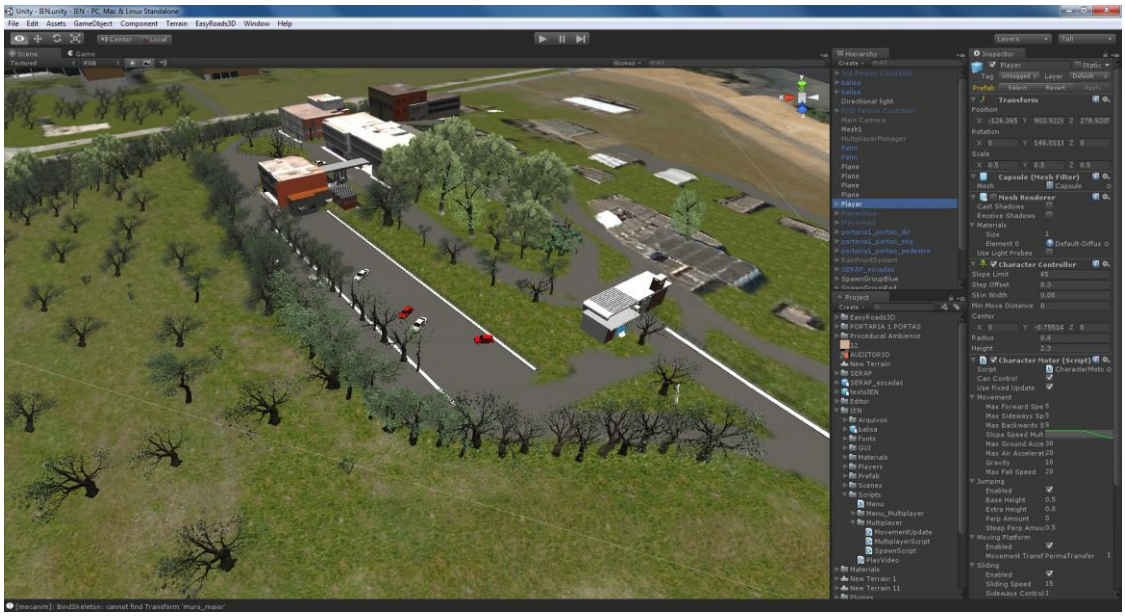

Figure 2: Virtual model of the IEN.

2.2.1. C#

C # (pronounced "C sharp") is a programming language designed for building a variety of applications that run on the. NET Framework. C # is a simple, powerful, safe and typed object-oriented. The various innovations in C # allow rapid development of applications, while retaining the expressiveness and elegance of C-style languages [3].

Just like Java, C # uses the syntax of C + + as a base. This means that elements such as declaring variables, methods and control structures (if, loops) are very similar to C + + [8]. In addition to the origin in C + +, C # has several features in common with Java.

The above features make the C # language easy to learn and use, robust and good performance [7]. Together with other features of the architecture. NET, C # is the ideal language for creating a new category of programs that take advantage of the opportunities brought by the Internet.

With C #, modifications were implemented in the core of the game, in order to make the simulation more realistic. Among the changes made in the game are the speed of movement of the avatar and the cylinder Collision (cylinder that defines space as possible between virtual people), which were modified in order to become closer to human standards.

2.2.2. UniStorm

The UniStorm is one of several scripts available in the Unity Asset Store, and an incredibly powerful dynamic day and night weather system that creates realistic storms and weather at AAA quality, all at a blazing fast frame rate [1].

UniStorm is programmed in both C# and JavaScript and features many weather types, weather types include: mostly clear, partly cloud, mostly cloudy, foggy, snowy, falling

leaves, rainy, and lighting and thunder storms with heavy rain, all randomly generated, a 24 hour day and night system, an advanced in-game time system, sun, moon, and stars system, a moon phase system, sunrises and sunsets, sun effects the clouds, easy to use custom editor that allows you to control every component and color of the sky, easy to use pull down menus to pick the weather, starting time and moon phases [1].

The C # language using the UniStorm allowed the development of a system time, where you can choose the length of day in the simulation and change between day and night. Besides choosing between types of weather, mentioned earlier.

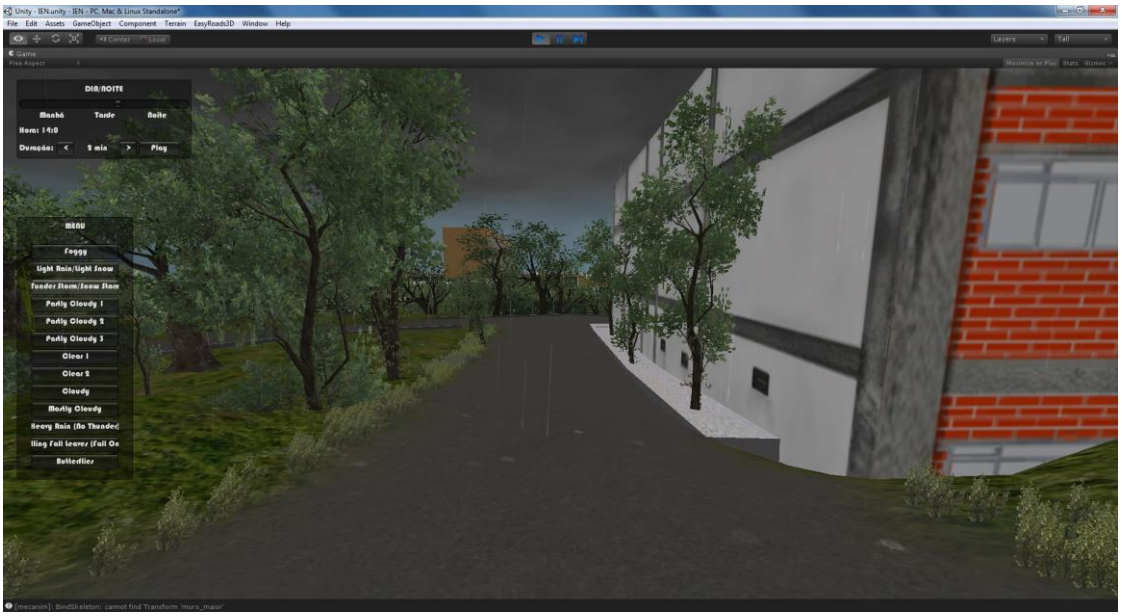

Figure 3: System time.

2.2.3. Ultimate FPS Camera

The Ultimate FPS Camera, also found in the Unity Asset Store, is responsible for feeding player movements (mouse, input, walking, jumping) into the camera using realtime spring physics, sinus bob and procedural noise shaking [9]. The system uses hundreds of parameters to manipulate the camera, allowing for a vast range of complex, realtime-generated behaviors.

In short, this system is specialized in handling camera and weapon motion resulting from player movement and firing, such as weapon swaying, recoil, fall, impact and explosion knockback. The Ultimate FPS Camera combining with traditional animation can result in super-lifelike motion rivaling the best AAA games out there [9].

3. RESULTS

The figures below show the virtual environment, allowing the visualization and planning strategies. The Figures 4 and 5 show, respectively, the gatehouse of the Instituto de

Engenharia Nuclear alternating between day and night, while Fig. 6 shows the building of the Divisão de Confiabilidade Humana (DICH) during the simulation.

Figure 4: Ordinance during day.

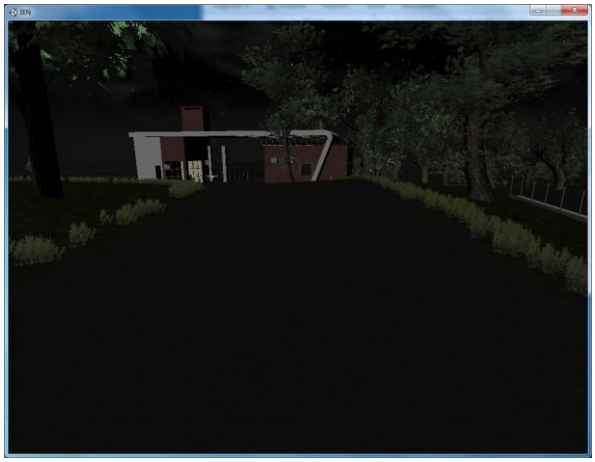

Figure 5: Ordinance overnight.

Figure 6: Building of the DICH.

4. CONCLUSIONS

This study showed the feasibility of using virtual reality for the development of a tool for improving the physical security of nuclear facilities. Once the security planning of these facilities is an extremely complex task, but absolutely necessary. With this tool you can visualize and plan action strategies, without interrupting the operation of the facility. Can be used as well for training and simulations security, and provide an assessment and assistance in the process of withdrawing people. Future improvements, such as modeling the internal buildings and environment around the IEN will make this tool more efficient.

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