

Virtual Reality Based Immersion Systems

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Abstract— Virtual reality (VR) is a high-end human computer interface that strives to immerse the designers and users completely in a virtual interactive environment for a simulation of real world. In order to meet the requirements of market competition, VR technologies can not only reduce effectively the time and cost, but also optimize complex products in the design process. Virtual reality is a rapidly developing computer interface that strives to immerse the user completely within an experimental simulation, thereby enhancing the overall impact and providing a much more intuitive link between the computer and the human participants. Virtual reality has been applied successfully to hundreds of scenarios in diverse areas including prototyping, manufacturing, scientific visualization, engineering and education. This paper discusses the applications of virtual reality and specifically focuses its features in Construction Industry.

Keywords- Virtual Reality, Oculus Rift Dk2, Construction

I. INTRODUCTION

With the fast development of computer technology, Virtual reality (VR) is a rapidly developing computer interface that allows the users and designers to step through the computer screen into a three-dimensional (3D) world. The users with stereo glasses can look at, move around and interact with these worlds as if they were in the real world. VR is also a new media for information and knowledge acquisition, and representing concepts of ideas in ways not previously possible. With the advance of computer technology, VR systems could contribute efficiently in various applications. Virtual manufacturing (VM) is one of the applications of applying VR technology in manufacturing applications. VM becomes an important characteristic of the advanced manufacturing technology in 21 century. Virtual reality is used in many military, scientific, and industrial applications, ranging from training astronauts to designing automobiles

II. DESIGN AND APPLICATIONS

1. Military Simulator
2. Medical Simulator.
3. Construction Simulator.

4. Media Simulator.

5. Educational Training Simulator

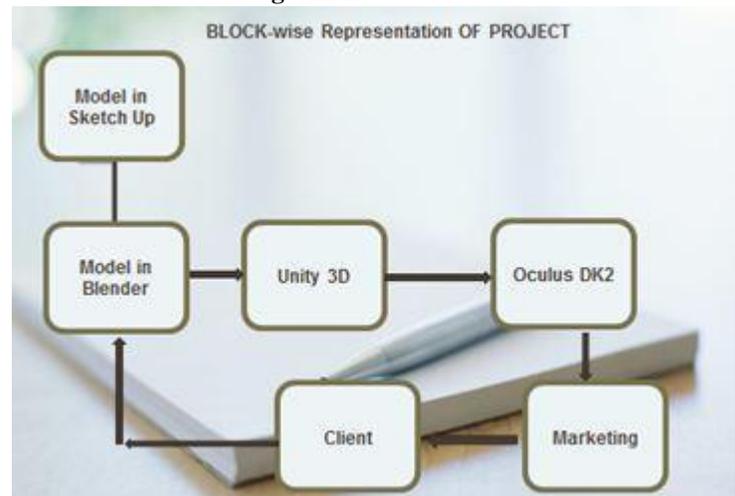


Fig 1. Block wise Representation

The process for creating the virtual world is as follows:

- (A) Modeling and Texturing the Building
- (B) Environment Creation,
- (C) Interactive Scripting, and
- (D) Hardware Integration

In order to model and texture map the building, Blender and Sketch-up modeling software's were chosen, but any modeling software will suffice. To create the environment, Unity3D was chosen. This piece of the project involves terrain creation and interactive object creation that will be used further into development. The Interactive Scripting element of the project is done in C# and JavaScript, to be integrated with Unity3D, linked to each object the scripting is to involve. The hardware incorporation includes utilizing the SDKs included with the Oculus Rift Developer Kit 2.

III. SIMULATIONS AND RESULTS

The tools that we used so far include Blender, Sketch-up, Unity and Oculus Dk2.

(A) Modeling:

The modeling process is one of the most time consuming pieces of the design process, so it is of utmost importance that the process is started correctly, to reduce any rework in the future. That being said, it is also one of the most rewarding parts of the design process. In order to get a model of a building, one must first have floor plans of the building. The software package Blender and Sketch up were chosen for its ability to import PDF files as lines, which streamlines the process if one were to have digital copies of the floor plans. Once imported onto the plane and scaled accordingly, one must create surfaces from the outlines of walls, beams, and columns for each floor of the building. After each surface has been created, it is a simple task to select all surfaces, and extrude a solid object from the surface a length vertically that represents the height of the walls on that floor. Rinsing and repeating for each floor applicable, one now has an accurate representation of the building. Adding stairs, floors, and ceilings is now a trivial matter, and doors will be looked at in the interactive object section of this paper. Following is one of the examples of model that we created in Sketch up, as shown in Fig 2.



Fig 2. Model in Sketch up

(B) Environment Creation(Blending):

The Environment Creation process is done primarily in Unity3D, a physics engine used primarily for video game creation, so in order to create a tour within Unity, one must go about it with a game-like routine. First there must be a terrain for our object to lie on, otherwise exiting the building would lead to an infinite fall to nothing. The next step to the process is to import the project from Sketch up to Unity, which is easily done by saving the project in Unity as a .fbx file, with textures included in the save file. Once saved, the file can be added to the assets in the Unity project, and can be added to the scene, making sure to activate the "Import Mesh Colliders" box on the assets menu, to assure the user will not be able to walk through the walls created. The texture files must also be present as assets in the same directory as the file, otherwise Unity will not be able to link the

correct textures to the file on inclusion to the scene. Once the files have been added to the scene, a character must be made to be able to take the tour. Unity has a standard asset for first person characters and third person characters, so the best choice would be the first person standard asset. Once imported into the scene, a person would be able to use the WASD keys to move and the Space key to jump within the project. There are other small additions to the scene that could be considered just for the sake of world building, such as light probes for illumination, and skyboxes for a non-gray sky and atmospheric effect, but they require no further explanation, as they are rather straight-forward to implement. Following are the examples of Environments created using Blender, as shown in Fig 3 and 4.

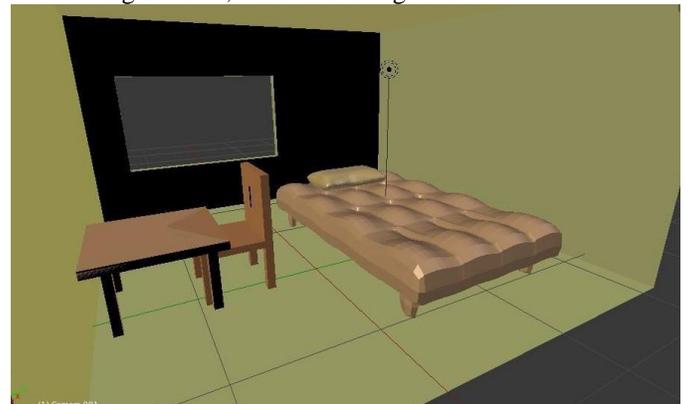


Fig 3. Model in Blender

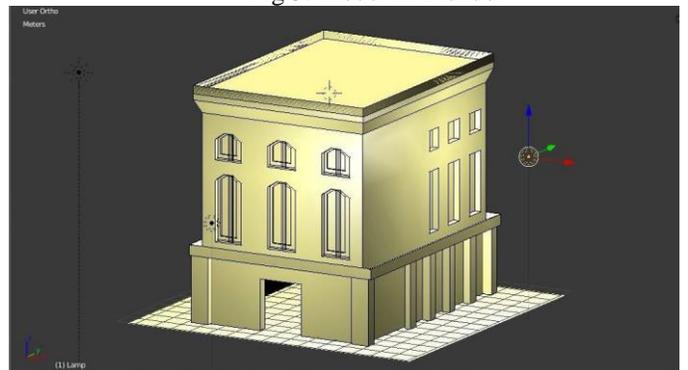


Fig 4. Model in Blender

(C) Scripting:

Interactive Scripting is to be added in order to create more than a static representation of a building. This interaction includes work with doors and light fixtures, with plans to expand to elevators and whiteboards. In order to create interactivity in Unity with doors and lights, one must first create a mesh collider that is a bit larger than the object to be interacted with. Once the collider is created and added as a child element to the object needing interaction, there will be a script added in either C# or Java that checks to see whether the character object is within the mesh collider, and if a designated keystroke has been pressed. Once both of these criteria have been met, the object goes through a rotation about an axis (in the door case, a 90 degree rotation

about its perceived hinge, and in the light switch case, a 45 degree rotation as well as a light probe being Disabled/enabled). Future directive involving elevators would move the elevator object and character up a story based on similar parameters and with smooth movement as seen with the door scripting. Here are the examples of Final development in Unity:



Fig 5. Environment in Unity 3d



Fig 6. Unity 3d Application Running

(D) Hardware Integration

Hardware integration part was one of the main and challenging part of this project. As all other things like modeling, scripting and blending demands only the good awareness of that specific software and consistent commitment for creating specific environments. But when comes to its integration with real time hardware, here comes your skills of software fiddling, debugging, troubleshooting and updated knowledge. That's why it is opt to be the challenging part of the project. At first we faced certain issues like low power, off HMD and optimum Graphic card selection, related to our device Dk2 but gradually with the burning of midnight oil we came over all these problems. We used several online active forums like Developers forum of official Oculus Rift. We posted our queries and got professional assistance through that. The most challenging part that I must highlight here was the know how of exact SDK plus selection of optimum graphic card. One should sort out these domains at first before starting the VR development. There are specified requirements that comes with the device, for its stable execution. One Must fulfill all those specs and then start VR development with the latest possible SDK installed with you. So that this way

you address all the issues like lesser frame rates, bad graphics, less immersion etc.

IV. CONCLUSIONS:

New advances in computerized modeling, visualization, Simulation and product data management are making Virtual Reality (VR) a viable alternative to traditional product Realization and manufacturing. VR can be a powerful tool for Testing and evaluating new products and ideas. Its applications in manufacturing, Military, Medical and Construction enable companies to reduce design and production costs, ensure product quality and slash the time needed to go from product concept to production. VR technology has been applied to solve clients' real-world problems, and has increased profitability, reduced time to market, and increased worker safety. Design and processes can be defined, modeled and verified before they can be actually implemented. VR offers the engineer's new ways to not only visualize their problems, but also to interact with environment to solve the problems effectively and efficiently. It is important to realize that VR is not merely for visualization purposes, instead, offers improved methods of interaction and visualization, where it can be applied in real engineering problems.

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