

Development of USTH Interactive Virtual World using Unreal Engine

Presenter: Do Duy Huy Hoang
Supervisor: Dr. Tran Giang Son

ICT Department - USTH

October 4, 2019

① Introduction

② Methodology

③ Results and Discussion

④ Conclusion and Future Works

Section 1

Introduction

Introduction to Virtual World

Definition: a virtual world is a computer-based simulated environment which may be populated by many users who can create a personal avatar for interaction

Applications of Virtual World

Today's virtual worlds are being used for many application domains such as entertainment, education and training, tourism, etc. Virtual world is even becoming better than the real world



Figure 1: Example of 3D Virtual Worlds.

Tools to build Virtual Worlds

- Unreal Engine
- SketchUp
- 3DSMax, Substance Painter, Adobe Tools



Figure 2: SketchUp and Unreal Engine.

Building a virtual world for USTH

We propose to build a 3D virtual world for USTH building. The goal is to create an **image of USTH** so that a wide range of USTH students and parents can interactively explore USTH

To gain this goal, we do the following tasks:

- *Collect* a dataset of 2D images for different views of USTH
- *Conduct* fully 3D models from collected 2D images
- *Build* a realtime and interactive 3D virtual world of USTH from constructed 3D models

Section 2

Methodology

Workflow

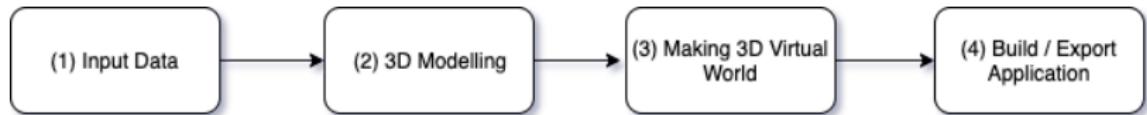


Figure 3: Overview of Work Flow.

1. Input Data



Our input data include: 2D panoramic pictures, floor plans, videos with different views of USTH

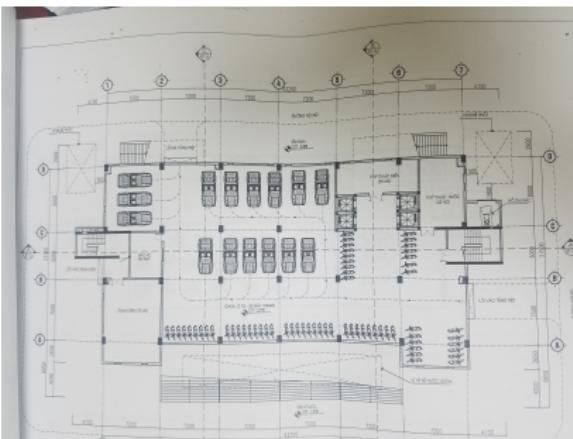
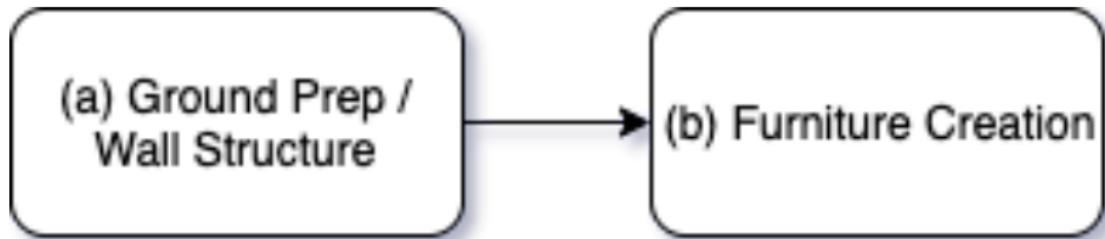


Figure 4: Examples of Input Data.

2. 3D Modelling

- 3D modeling is a process of creating a 3D representation of any surface or object by manipulating polygons, edges, and vertices in simulated 3D space.
 - 3D modeling work flow:

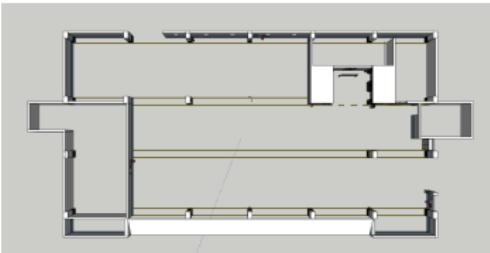
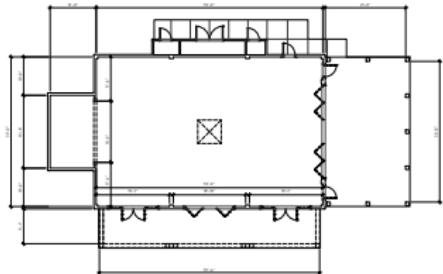
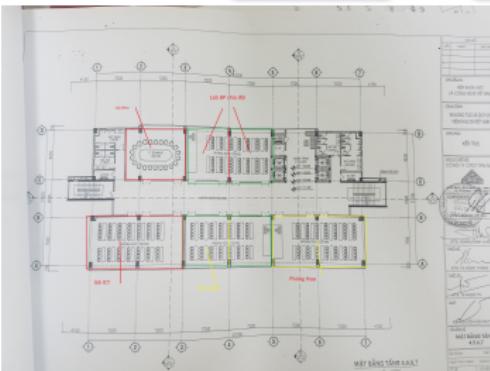


2a. Ground Prep / Wall Structure

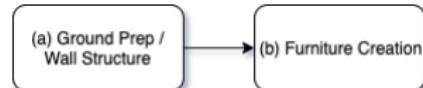
- Transfer 2D legacy floor plan images into a digital version.
- Structure walls using offset tool - allow drawing a offset of a perimeter.

(a) Ground Prep / Wall Structure

(b) Furniture Creation

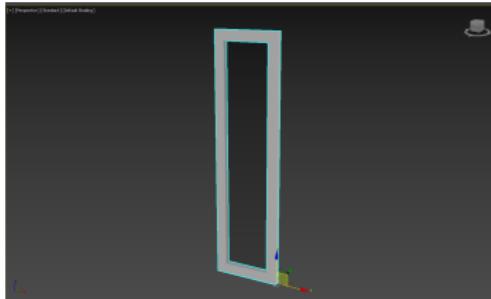
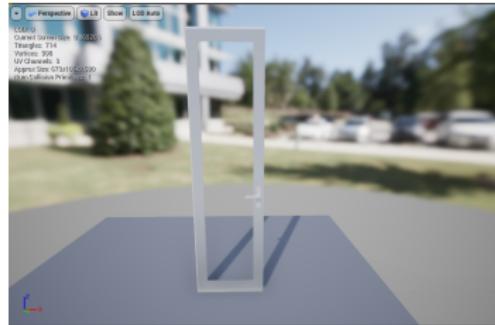


2b. Furniture Creation



We need to fix the following problems with 3DSmax to create standalone objects:

- Fix pivot, edit UV mapping of some models
- Correct the position of the texture
- To use with **Level Streaming** technique in UE4
- Avoid duplicate models



2c. 3D Model result



Figure 5: SketchUp models vs Reality

3. Making 3D Virtual world

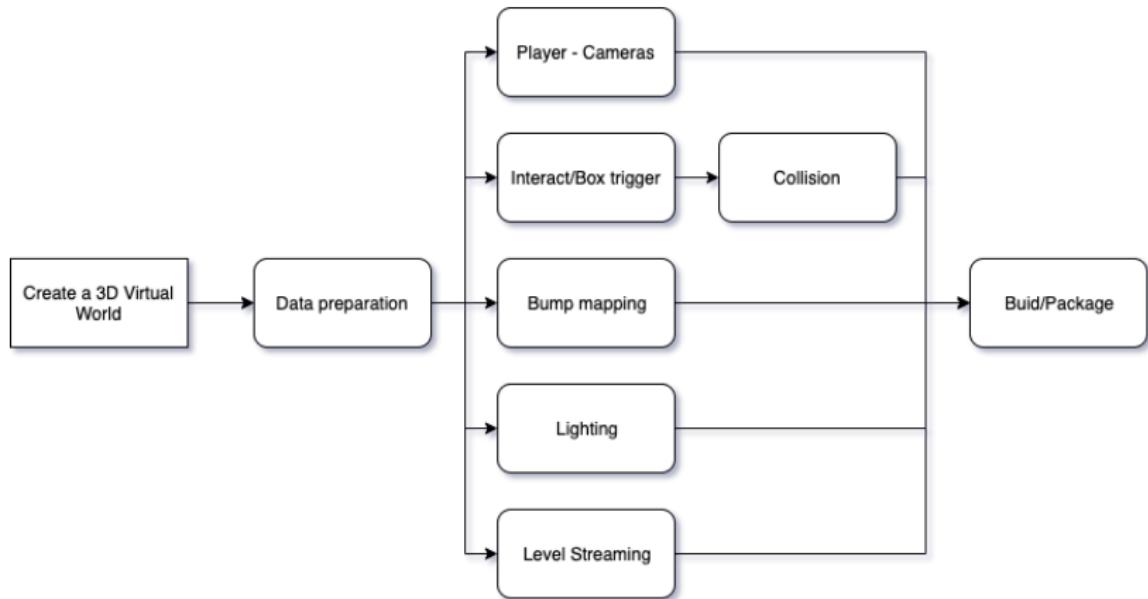


Figure 6: Unreal Engine Work flow

3a. Data preparation

- Export 3D models to *datasmith* type
- Furnitures / Standalone object will be imported manually into Unreal Engine
- Materials / Assets / Layers / Scales are same as in SketchUp, but sometimes need to tweak some values



3b. Player / Cameras

- First person view
- Camera attached into the player
- *Scene* from Sketch is shipped to Unreal Engine

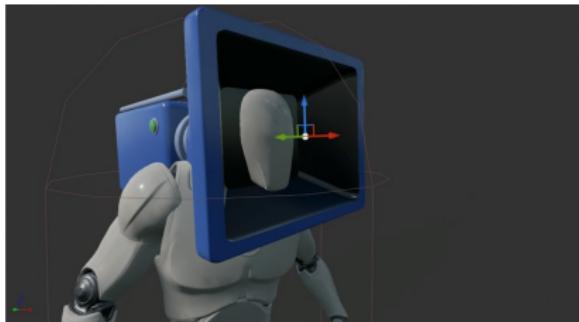
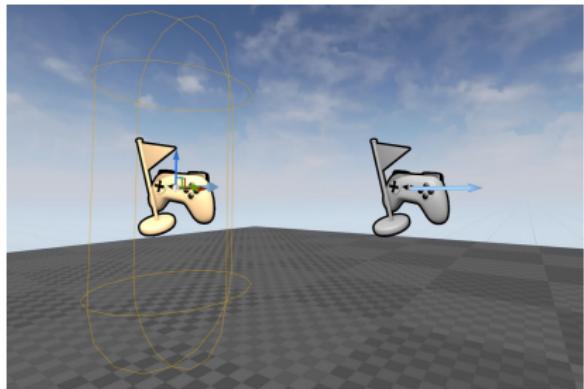


Figure 8: Player start and Cameras actor

3c. Interact / Collision / Box Trigger

- Collision used to cause an event to occur - block/overlap
- Can be used to create event



Figure 9: Box Trigger Example

3d. Bump mapping

- Same number of polygons on both models
- A normal map is an image texture mapped to the surface of a model
- Using a texture to store information

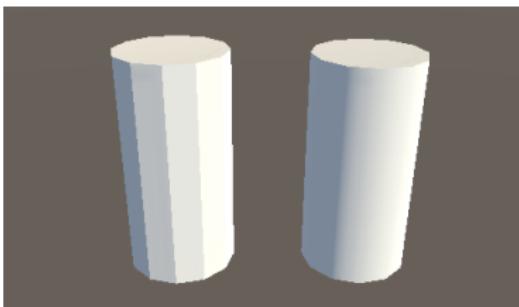


Figure 10: Left: Smooth shading on three polygons. Right:Normal mapping across three polygons / viewed as a 2D diagram

3e. Normal Map

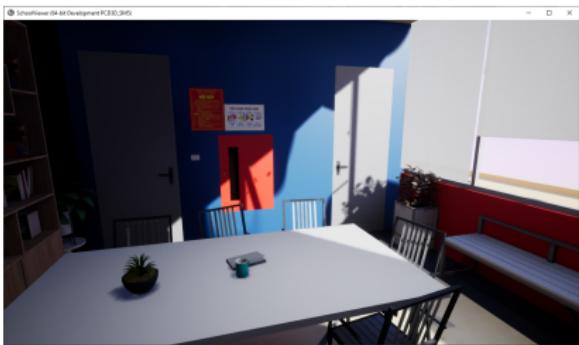
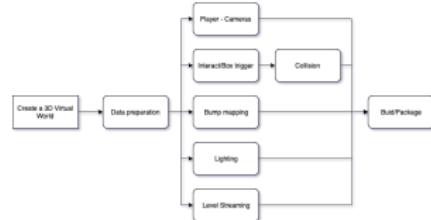


Figure 11: With/Without Normal map

3f. Level Streaming



- A quick and easy way to work on a larger game in smaller chunk
- Less resources
- Individual maps

3g. Lighting

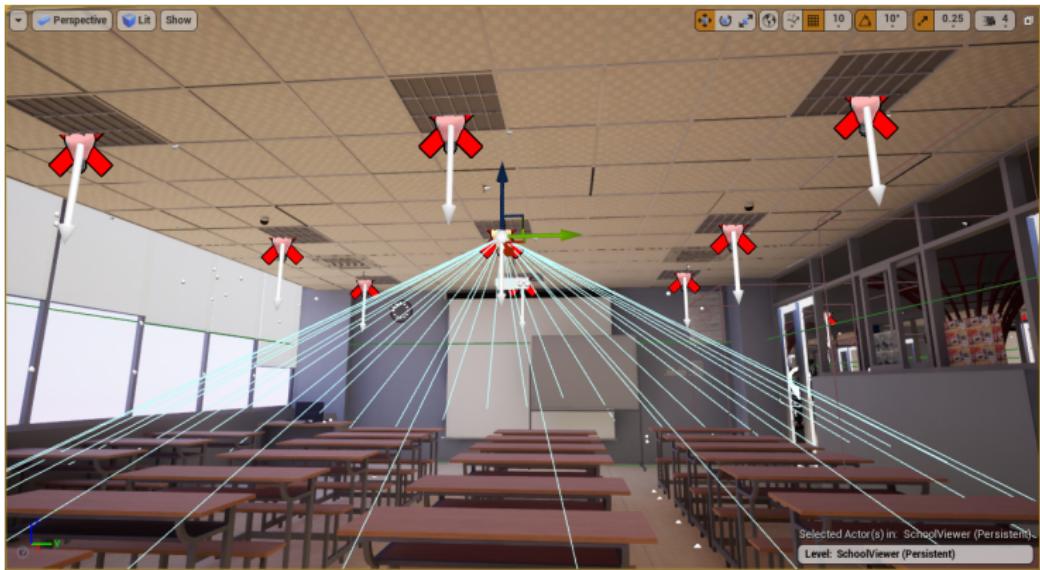
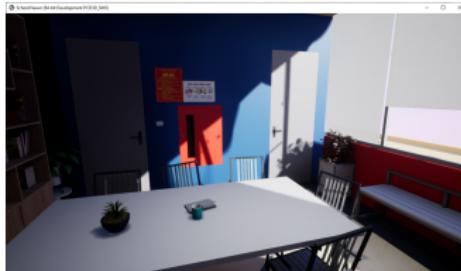
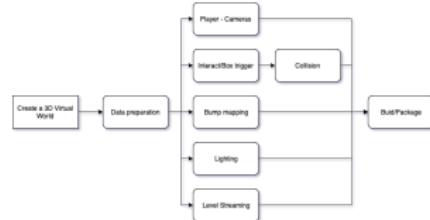


Figure 12: Lighting Example

3h. Build/Packaging

Supported platforms:

- Native Application
 - Linux
 - Window
 - MacOS
- Web Application
 - <http://scg.sontg.net/HTML5/tanghamfinal.html>



Section 3

Results and Discussion

Results



Results

Dataset of 2D images:

- **726 images, 18 videos** with different views of USTH with:
High resolution, Easily captured, Cheap, Popular

Raw 3D models of USTH

- **6 3D models, 300+ different objects and textures**
- Foundations for other researcher or developer to create others virtual world of USTH

Fully interactive virtual world of USTH

Succesfully implement 3 floors (7th floor, 4th floors and 1st floor) to create a virtual world with Unreal Engine

- Lighting
- Shading
- 30 blueprints

Section 4

Conclusion and Future Works

Conclusion and Future Work

- Better material
- Increase frame rate
- Add more interactions
- Ray Tracing
- Finish all others floors

Thank you for listening!!!