Software Requirements 1.1

Group 61: iCreate - Generative Design in Virtual Reality

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Abstract

The functionality of the virtual reality program iCreate is described in this document. This document is aimed at specifying requirements of the iCreate software to be developed, along with user characteristics, constraints, and terminology of the program. The product functions, assumptions and dependencies are also detailed within the document. Documentation and a detailed development plan for iCreate are also provided.

PARTICIPANTS

The ICreate - Generative Design in Virtual Reality senior software engineering project consists of the following team members:

Raffaele de Amicis, *Mentor*

Rhea Mae Edwards | Nabeel Shariff | Hannah Solorzano

The following persons are associated with Intel Corporation in regards to Hardware, Software and Development Environments in relations to the project:

Mike Premi, *Co-Mentor*

The following persons are guidance mentors as a part of the senior software engineering project course for the students:

Kevin McGrath, *Instructor* | **Behnam Saeedi,** *Teaching Assistant* | **Kirsten Winters,** *Instructor*

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1 INTRODUCTION

1.1 Purpose

The purpose of this user requirements document is to provide a detailed description of the “iCreate” virtual reality (VR) application. This document will illustrate the functions and features of the applications. Additionally, it will explain the interface and system constraints.

This document is intended to be proposed to Raffaele de Amicis for its approval and a reference for developing the first version of the system for the development team.

1.2 Scope

The iCreate software is a virtual reality application that allows users to construct complex architectural designs in VR using simple sketches, gestures, and parameters defined by the user. The application will be available to download for systems that can support VR headsets.

VR users can provide parameters for a base 3D object that will be used to build the user’s complex design. This objective of modifying the base object, can be done either by manually providing the parameters or by altering the object via gestures or virtual sketches. Moreover, both the base objects and the complex designs can be saved for quick access in the future.

Furthermore, the software will need a computer that is capable of running virtual reality applications. The application will also use the proprietary VR software for the respective headset being used.

1.3 Glossary

Table 1
Terms and Definitions

Terms	Definitions
VR	Virtual Reality
User	Someone who interacts with the iCreate virtual reality application.
3D	3-dimensional
Parameters	The measurements for objects defined by the user.
Input	Stimulus provided by user.
Output	Feedback from the software based on the user’s input.
Virtual Space	A 3D area in virtual reality in which the user can move around and interact with objects.
GPU	Graphics processing unit responsible for quick handling and rendering graphics on a computer.
Generative Design	A form finding process that mimics nature’s evolutionary approach to design[2].
Render	The process of creating 3D objects and environments.

1.4 References

[1] IEEE Software Engineering Standards Committee, “IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications”, October 20, 1998.

[2] Autodesk, "Generative Design at Airbus | Customer Stories | Autodesk," Autodesk, [Online].
Available: https://www.autodesk.com/customer-stories/airbus. [Accessed 31 October 2017].

2 OVERALL DESCRIPTION

2.1 Product Perspective

The VR application will utilize a virtual reality headset with input from the user via a controller or gesture recognition software. The VR headset will be used to look around in virtual space while the controllers or gesture recognition software will be used by the user to draw sketches.

The VR application will need to utilize the GPU in a computer to both run the VR application and render 3D objects in the virtual space. Additionally, the 3D modeling will be based on generative design techniques, and the assembly of the complex 3D designs will utilize mathematical equations and algorithms to derive the appropriate structure of the design.

2.2 Product Functions

Using the VR application, the user will be able to select and spawn 3D shapes from a provided library and will then be able to adjust the dimensions of the shape. The interface will allow the user to distort or scale the shape to the desired size. Once the shape is finalized, the user sketches a trajectory that represents the curve of the architecture in which they are trying to create. The program will then generate several more of the selected shapes to best fit the curve, forming the structure. If the user wishes, they will be able to store the modified shape and final generated structure in a library for later use.

2.3 User Characteristics

There are two main types of users that interact with iCreate: Professional designers and normal users. Each of the types use the system differently, thus, each have their own requirements.

- The professional designers will utilize iCreate for professional designs and projects. They will need access to a wide array of curves and precise transformation and design techniques that will enable them to produce state of the art designs.
- The game designers and students will use iCreate either for entertainment, such as creating simulated environments, or for education, like learning design techniques and concepts.

2.4 Constraints

Firstly, the software constraints for the VR application pertain to the functions that generate complex 3D structures from simple 3D objects. For example, when the user creates a 3D shape and trajectory/path, if the object is larger than the path, or if there are too many objects to fit the path, then the program will not be able to properly generate a complex structure.

Secondly, the with regards to hardware constraints, the VR application is created specifically for the HTC Vive using the Unity 3D game engine. A VR headset and a computer capable of running VR software are required to use the VR application. As VR programs are graphics intensive, for iCreate to run successfully, the minimum processor is a Intel Core i5-4590 or AMD FX 8350 (equivalent or better), a NVIDIA GTX 970 or AMD Radeon R9 290

2.5 Assumptions and Dependencies

- Users have to have enough computing and graphics power to handle VR software and applications.
- The application must be used with a VR headset.
- The VR application must allow users to spawn and modify 3D objects.

3 SPECIFIC REQUIREMENTS

This section contains all the functional and quality requirements of the system. It gives a detailed description of the system and all its features.

3.1 External Interface Requirements

3.1.1 User Interfaces

The interface will need to functionally allow the user to spawn a 3D object, then modify it via either a controller or gesture input. Additionally, the user will be able to save to a library for later use or load their creations to create complex structures. Finally, the application will display a way to transform the 3D objects by allowing the user to scale or resize the object.

3.1.2 Hardware Interfaces

The VR application will be able to run on a VR headset (preferably a HTC Vive) and a computer that can run VR software.

The minimum CPU and GPU requirements to successfully run the VR application are:

- Minimum CPU requirements: Intel Core i5-4590 or AMD FX 8350 (equivalent or better)
- Minimum GPU requirements: NVIDIA GTX 970 or AMD Radeon R9 290 (equivalent or better)

3.1.3 Software Interfaces

The VR application will be usable on a Windows operating system capable of running the VR headset's respective proprietary software.

3.2 Functional Requirements

3.2.1 iCreate VR Environment

The iCreate software will allow the user to:

- Move around in VR.
- Instantiate a simple 3d object.
- Generate multiple instances of the 3d object.

3.2.2 iCreate Object Library

The iCreate software will allow the user to:

- Obtain 3D objects from the application's library.

3.2.3 iCreate Curves

The iCreate software will allow the user to:

- To draw a 3D curve.
- Draw a trajectory in the form of a curve.
- Create a B-Spline curve.
- Create a Bezier curve.
- Create a ellipse curve.
- Create a circle curve.

- Create a hyperbola curve.
- Create a parabola curve.
- Use the curve to indicate how the user would like to displace multiple instances of the initial object.

3.2.4 iCreate Transformation and Translation

The iCreate software will allow the user to:

- Extrude the object.
- Resize the object.
- Indicate how they would like to rotate objects across a curve.
- Indicate how they would like to translate objects across a curve.
- Indicate how they would like to scale objects across a curve.
- The 3D objects that make up a complex structure must be connected with each other.

3.2.5 iCreate Save and Load

The iCreate software will allow the user to:

- Import geometry from a .fbx extension file format.
- Import a 3D object.
- Save a 3D object.
- Save structures.
- Save the entirety of the project as a whole.

3.2.6 iCreate Stretch Goals

After the completion of the iCreate program, the developers plan to use a robot to take the design created in the VR space, and recreate it in real life.

- The robot will be provided by the Oregon State University Robotics Club.
- An application programming interface (API) library will be used to allow the robot to read and apply the design.

3.3 Performance Requirements

The iCreate program should be able to run on a computer with at least an Intel Core i5-4590 or AMD FX 8350 (equivalent or better), a NVIDIA GTX 970 or AMD Radeon R9 290 (equivalent or better) graphics card, at least 4GB of RAM, at at least 30 frames per second.

The requirements to run iCreate will also depend on the user and the scale or intricacy of the architectural structure that is designed as a larger, more complex structure will require more processing power and a stronger graphics card.

3.4 Design Constraints

The VR program will have to run on a HTC Vive VR headset, and be able to support both controller and gesture input through Leap Motion and Lighthouse Tracking Technology. The user interface must be able to allow the user to spawn and transform 3D objects, and save and load previous creations.

3.5 Gantt Chart