Real-time object scanning and manipulation in the CAVE

Islam Akef Ebeid
Emerging Analytics Center
Department of Information Science
University of Arkansas at Little Rock
iaebeid@ualr.edu

Figure 1. A simple mesh created using MeshLab [6] of a scanned small object (Personally Taken)

Figure 2. Manipulating objects inside the CAVE [1] environment (Emerging Analytics Center website)

ABSTRACT

Since the introduction of the CAVE in 1993 [1], there hasn't been much work done on rendering scanned small objects in real time. I am proposing real time application inside the CAVE environment that would allow scanning small objects on a custom made turntable using a Real Sense [4] camera that would capture the objects information creating a mesh file (OBJ) that would be rendered instantly inside the CAVE allowing the user to manipulate the object using a Leap Motion Sensor [5]. The proposed work might open the way for some other endeavors and future work especially in the field of engineering and design.

Keywords

Virtual Reality, Real-time Graphics

1. INTRODUCTION

A lot of work has been done in the area of 3D scanning through high resolution depth cameras specially generating meshes from objects being recognized as iso-surfaces through using the famous Marching Cube algorithm or other algorithms that has been adopted in the recent years by projects like MeshLab. Recently an idea has been introduced to capture scanned objects based on light field rendering through creating billboard rendered images inside the VR environment in real-time [3], this method is computationally cheap and efficient however due to the lack of resources it will be hard to implement in the current project. This work does not intend to explore the problems in the field of 3D scanning is surfaces but rather to explore and introduce other ways to capture objects and render them in real-time inside cluster based VR environments like the CAVE.

Thanks to Intel's Real Sense [4] provided SDK it is made easy to scan a relatively small object and generating an OBJ file that can be parsed and rendered using OpenGL. Integrating this real-time render inside the CAVE using a C++ library called VR-Juggler [2] which provides a stereo synchronized windowing system that operates on cluster based systems like the CAVE which usually run on quad buffered graphics cards giving a smooth and consistent frame rate and viewport for stereo images.

VR-Juggler already allows introducing inputs that can either be tracked using the cameras that are already introduced in the system, however introducing Leap Motion in the CAVE might be a first but will throw a whole set of challenges that I will have to face in order to get the system smoothly running.

My pipeline starts with placing an object on a turntable that is positioned adjacent to the CAVE and by running the program a message will appear directing the user inside the CAVE that an object is currently being scanned, the object will appear instantly inside the environment where a Leap Motion sensor is introduced inside the CAVE, then user will be able to manipulate the object in the virtual space.

Figure 3. Operating Scenario

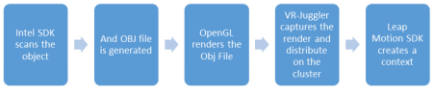

Figure 4. Program's Pipeline

2. CONCEPT & PLAN

2.1 Scenario & Use Case

- A user picks a relatively small object similar to the object shown in Figure 1.
- The user sets the object on the turntable situated right beside the CAVE.
- The user starts the program on the master node which controls the cluster running.
- The user steps into the CAVE with the 3D glasses on
- The object appears in the middle of the user's field of view
- The user introduces his hands in the field of the Leap Motion sensor setup in front of him inside the CAVE
- The user starts manipulating the object

2.2 Development Tools & Equipment

Software tools will include Microsoft Visual Studio C++ compiler, using OpenGL native DLLs, using VR-Juggler [2] library, using Leap Motion SDK, using Intel Real Sense SDK. Equipment will include Leap Motion Sensor, Intel Real Sense Camera, and the CAVE environment.

2.3 Timeline

- **Monday September 14th**: Project Proposal Due
- **Thursday October 1st:** Testing a developed program that generates a relatively accurate mesh file for a scanned object
- **Thursday October 15th:** Finish custom building a reliable turntable with an adequate scanning speed & provide a status report.
- **Sunday November 1st**: Finish building a VR-Juggler based OpenGL Obj file renderer in the CAVE
- **Sunday November 15th** : Testing the necessary Leap Motion Interaction in the CAVE with a sample OpenGL program
- **Monday November 30th:** Integrating and testing all systems components and providing final report and presentation.

3. ACKNOWLEDGMENTS

Thanks to Dr. Carolina Cruz-Neira for advising and allowing us to use equipment provided by the Emerging Analytics Center at the University of Arkansas at Little Rock.

4. REFERENCES

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