

# **Requirements Document for Better Graphics For A Robotics Grasping GUI**

**Shady Robots**

**Group 12**

**Justin Bibler**

**Matthew Huang**

**Daniel Goh**

**CS461: Senior Software Engineering Project**

**Fall 2016**

**November 12, 2016**

# Requirements Document for Better Graphics For A Robotics Grasping GUI

## Shady Robots

Group 12

Justin Bibler

Matthew Huang

Daniel Goh

CS461: Senior Software Engineering Project

Fall 2016

November 12, 2016

**Abstract:** Our customer is using a simulation to create visuals that are used for online data collection. This simulation is using outdated libraries which result in outdated graphics. We, as the supplier, define the requirements necessary to accomplish our customer's request. The request being to update the simulation's graphics with warm cool shaders, shadows and silhouettes.

**Keywords:** OpenInventor, OpenGL, OpenRave, shaders, warm cool shaders, silhouettes, shadows, robotic simulation, geometry, visualization, render, vertex lines, software requirements specification, system requirements specifications

## **INTRODUCTION**

Currently, our client is using visualizations, of a robot hand grasping objects, to collect data online. These visualizations are created from a simulation program (OpenRave); the data collected is used to create a model of the human grasp. However, the current graphics in the simulation are outdated. It is hard to see and understand the shapes and contact points represented in the scene. Because of this, users aren't confident in giving proper responses to the simulation. Thus, the graphics need to be updated to allow meaningful data to be collected.

## **PARTICIPANTS**

Cindy Grimm, Matthew Huang, Daniel Goh and Justin Bibler

# Contents

<b>1 Overview</b>	<b>4</b>
<b>2 References</b>	<b>4</b>
<b>3 Definitions</b>	<b>4</b>
<b>4 Specific requirements</b>	<b>5</b>
4.1 External interface requirements . . . . .	5
4.1.1 User interfaces . . . . .	5
4.1.2 Hardware interfaces . . . . .	5
4.1.3 Software interfaces . . . . .	5
4.1.4 Communication interfaces . . . . .	5
4.2 System features . . . . .	5
4.2.1 System Feature 1: Warm cool shading . . . . .	5
4.2.1.1 Introduction/Purpose of feature . . . . .	5
4.2.1.2 Stimulus/Response sequence . . . . .	5
4.2.1.3 Associated functional requirements . . . . .	5
4.2.1.4 Functional requirements 1 . . . . .	5
4.2.2 System Feature 2: Shadows . . . . .	5
4.2.2.1 Introduction/Purpose of feature . . . . .	5
4.2.2.2 Stimulus/Response sequence . . . . .	6
4.2.2.3 Associated functional requirements . . . . .	6
4.2.2.4 Functional requirements 1 . . . . .	6
4.2.3 System Feature 3: Silhouettes . . . . .	6
4.2.3.1 Introduction/Purpose of feature . . . . .	6
4.2.3.2 Stimulus/Response sequence . . . . .	6
4.2.3.3 Associated functional requirements . . . . .	6
4.2.3.4 Functional requirements 1 . . . . .	6
4.3 Performance requirements . . . . .	6
4.4 Design constraints . . . . .	6
4.5 Software system attributes . . . . .	7
4.5.1 Reliability . . . . .	7
4.5.2 Maintainability . . . . .	7
4.5.3 Portability . . . . .	7
4.6 Other requirements . . . . .	7
<b>5 Gantt Chart</b>	<b>8</b>

## 1 OVERVIEW

This document describes requirements needed to enhance the current OpenRave simulation. Clause 2 lists the references made to other documents. Clause 3 provides definitions of specific terms used. Clause 4 lists the specific requirements that will be met. This includes the external interface requirements, functional requirements, performance requirements, design constraints, software system attributes, and other requirements.

## 2 REFERENCES

Gooch Shading<sup>1</sup>

IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications<sup>2</sup>

Shadow Mapping<sup>3</sup>

Silhouette Extraction<sup>4</sup>

## 3 DEFINITIONS

**Contract:** A legally binding document agreed upon by the customer and supplier. This includes the technical and organizational requirements, cost, and schedule for a product. A contract may also contain informal but useful information such as the commitments or expectations of the parties involved.

**Customer:** The person, or persons, who pay for the product and usually (but not necessarily) decide the requirements. In the context of this recommended practice the customer and the supplier may be members of the same organization.

**Supplier:** The person, or persons, who produce a product for a customer.

**User:** The person, or persons, who operate or interact directly with the product. The user(s) and the customer(s) are often not the same person(s).

**Modern Computer:** Modern computer defined by the Oregon State University (OSU) EECS minimum laptop requirements: Intel Core i5 or i7, or AMD A8 and AMD A10 APU 8GB RAM

1. ECG Wiki. *Gooch Shading*. URL: <https://lva.cg.tuwien.ac.at/ecg/wiki/doku.php?id=students:gooch>.

2. IEEE Computer Society. "IEEE Recommended Practice for Software Requirements Specifications". In: (Oct. 1998).

3. LearnOpenGL. *Shadow Mapping*. URL: <http://learnopengl.com/%5C#!Advanced-Lighting/Shadows/Shadow-Mapping>.

4. Bruce Gooch. *Silhouette Extraction*. URL: <http://www.cs.rutgers.edu/~decarlo/readings/gooch-sg03c.pdf>.

## 4 SPECIFIC REQUIREMENTS

### 4.1 External interface requirements

The purpose of the software's output is to give a visual understanding of the robot's grasping capabilities. The software will accept an input simulation file (.py file) through the console. The software will then output a simulation onto a new window.

#### 4.1.1 User interfaces

user interface here

#### 4.1.2 Hardware interfaces

hardware interface

#### 4.1.3 Software interfaces

software interface here

#### 4.1.4 Communication interfaces

communication interface

### 4.2 System features

#### 4.2.1 System Feature 1: Warm cool shading

4.2.1.1 Introduction/Purpose of feature: The purpose of warm cool shading is to improve visibility of the object on screen. Warm cool shading shades an object so that no part of an objects' visibility is hidden from view, due to this the objects' geometry is highlighted.

The method that will be used to implement this feature will be Gooch Shading. Gooch shading was developed by Bruce and Amy Gooch, Peter Shirley, and Elaine Cohen in 1998. The characteristics of Gooch Shading are as follows:

4.2.1.2 Stimulus/Response sequence:

4.2.1.3 Associated functional requirements:

4.2.1.4 Functional requirements 1: The system shall render the scene and output to a new window. The rendered scene shall include all 3D objects to be displayed in the scene with correct geometry. No objects should have clashing vertex lines, and all shapes should be drawn as intended by the user. Refer to Fig. 1 below.

Refer to "Description" section of Gooch Shading listed in this document's references section.

The system shall continuously re-render the scene until completion of the simulation or software termination.

#### 4.2.2 System Feature 2: Shadows

4.2.2.1 Introduction/Purpose of feature:

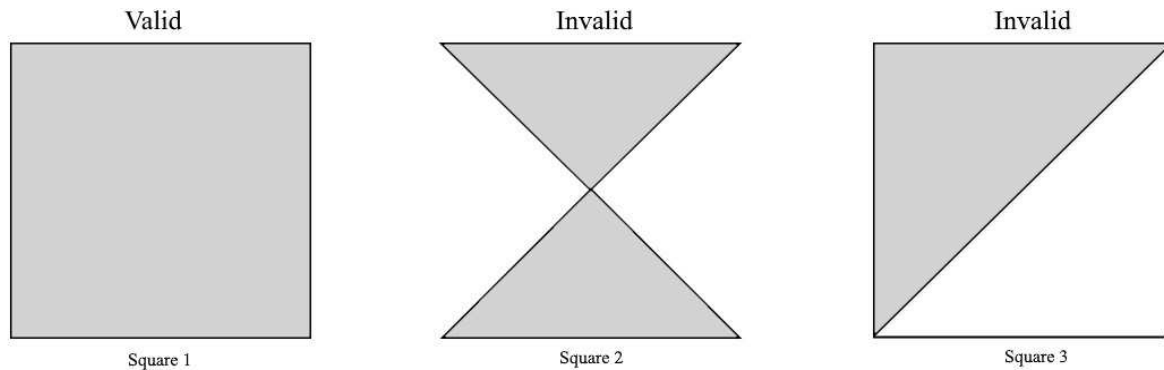


Fig. 1.

Square 1: Vertex lines drawn correctly resulting in desired geometry.

Square 2: Vertex lines cross resulting in undesired geometry.

Square 3: Incorrect vertex line drawing resulting in undesired geometry.

4.2.2.2 Stimulus/Response sequence:

4.2.2.3 Associated functional requirements:

4.2.2.4 Functional requirements 1: A dark area or shape produced by a body coming between rays of light and a surface.

#### 4.2.3 System Feature 3: Silhouettes

4.2.3.1 Introduction/Purpose of feature:

4.2.3.2 Stimulus/Response sequence:

4.2.3.3 Associated functional requirements:

4.2.3.4 Functional requirements 1: Refer to "Definition of a Silhouette" section of Silhouette Extraction listed in this document's references section.

### 4.3 Performance requirements

- The system output should maintain a minimum stable 30FPS on an average modern computer.
  - Modern computer defined by the Oregon State University (OSU) EECS minimum laptop requirements:  
Intel Core i5 or i7, or AMD A8 and AMD A10 APU 8GB RAM
- The system will only run one simulation per window.
- The initial scene will be rendered within the first 30 seconds after accepting an input file.

### 4.4 Design constraints

- The system currently utilizes outdated OpenGL libraries.
- The location of the main render loop is not known to the customer.
- OpenRave is not open sourced.

## **4.5 Software system attributes**

### *4.5.1 Reliability*

The system shall always run properly created simulations.

### *4.5.2 Maintainability*

The system shall:

- Be easily maintained and upgraded.
- Have well documented and easily testable functions.
- Have functions with single, clear purposes; they should not overlap in what they do.

### *4.5.3 Portability*

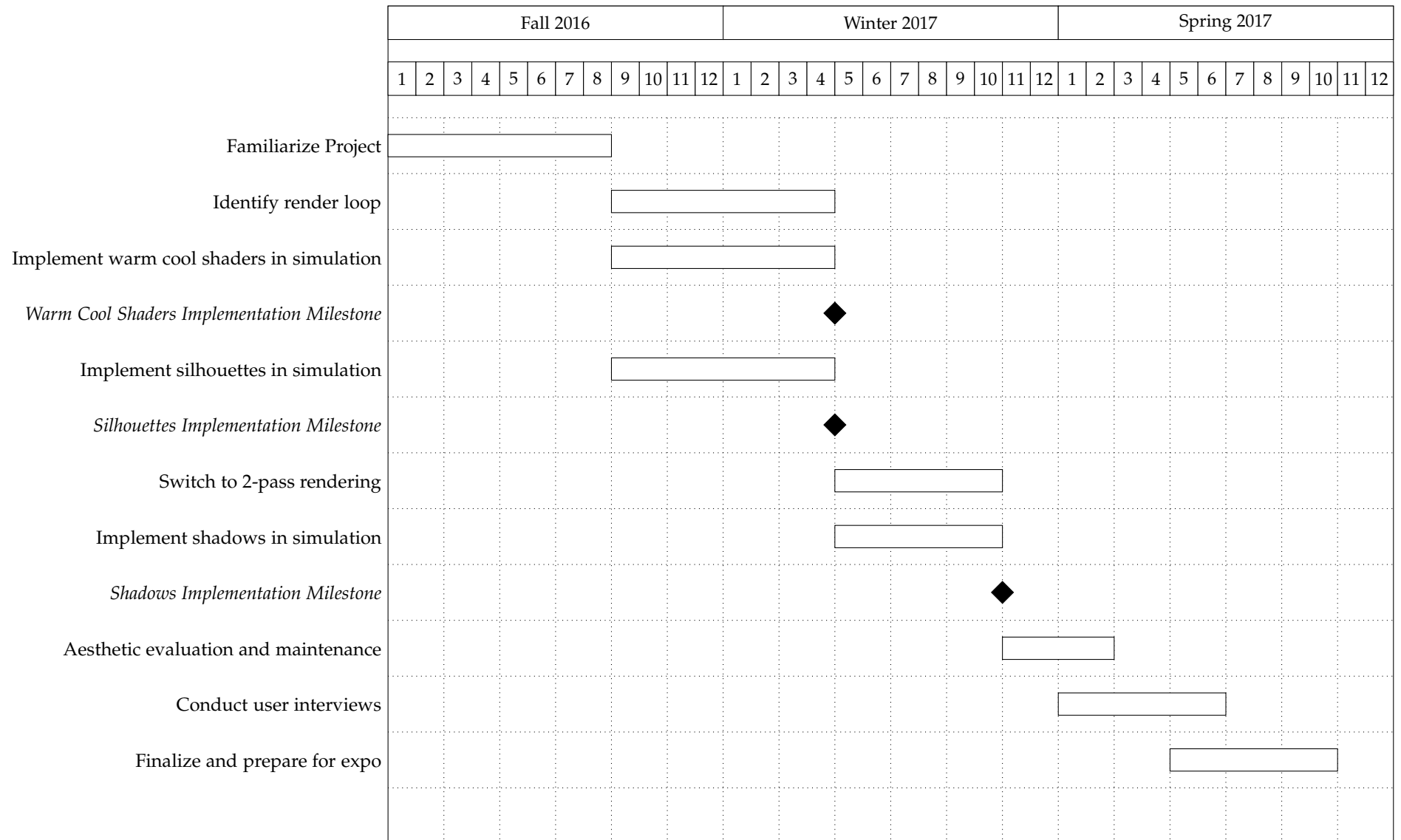
The system shall work on Linux operating systems.

## **4.6 Other requirements**

The outdated OpenGL libraries will be updated to utilize OpenGL 3.0 libraries.



## 5 GANTT CHART



Gantt Chart for Shady Robots' Senior Design Project

Cindy Grimm	Date
Justin Bibler	Date
Matthew Huang	Date
Daniel Goh	Date