

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING  
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**SYSTEM REQUIREMENTS SPECIFICATION  
CSE 4316: SENIOR DESIGN I  
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**TEAM R.O.B  
CAMERA GIMBAL**

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# CONTENTS

<b>1</b>	<b>Product Concept</b>	<b>6</b>
1.1	Purpose and Use . . . . .	6
1.2	Intended Audience . . . . .	6
<b>2</b>	<b>Product Description</b>	<b>7</b>
2.1	Features & Functions . . . . .	7
2.2	External Inputs & Outputs . . . . .	7
2.3	Product Interfaces . . . . .	7
<b>3</b>	<b>Customer Requirements</b>	<b>8</b>
3.1	Camera Rotation . . . . .	8
3.1.1	Description . . . . .	8
3.1.2	Source . . . . .	8
3.1.3	Constraints . . . . .	8
3.1.4	Standards . . . . .	8
3.1.5	Priority . . . . .	8
3.2	Camera-to-VR Resolution and Responsiveness . . . . .	8
3.2.1	Description . . . . .	8
3.2.2	Source . . . . .	8
3.2.3	Constraints . . . . .	8
3.2.4	Standards . . . . .	8
3.2.5	Priority . . . . .	8
<b>4</b>	<b>Packaging Requirements</b>	<b>9</b>
4.1	Software Packaging . . . . .	9
4.1.1	Description . . . . .	9
4.1.2	Source . . . . .	9
4.1.3	Constraints . . . . .	9
4.1.4	Standards . . . . .	9
4.1.5	Priority . . . . .	9
4.2	Hardware Packaging . . . . .	9
4.2.1	Description . . . . .	9
4.2.2	Source . . . . .	9
4.2.3	Constraints . . . . .	9
4.2.4	Standards . . . . .	9
4.2.5	Priority . . . . .	9
<b>5</b>	<b>Performance Requirements</b>	<b>10</b>
5.1	Fast Image Processing . . . . .	10
5.1.1	Description . . . . .	10
5.1.2	Source . . . . .	10
5.1.3	Constraints . . . . .	10
5.1.4	Standards . . . . .	10
5.1.5	Priority . . . . .	10
5.2	Fast Movement Detection . . . . .	10
5.2.1	Description . . . . .	10

5.2.2	Source	10
5.2.3	Constraints	10
5.2.4	Standards	10
5.2.5	Priority	10
<b>6</b>	<b>Safety Requirements</b>	<b>11</b>
6.1	Photosensitive Users	11
6.1.1	Description	11
6.1.2	Source	11
6.1.3	Constraints	11
6.1.4	Standards	11
6.1.5	Priority	11
6.2	Environmental Safety	11
6.2.1	Description	11
6.2.2	Source	11
6.2.3	Constraints	11
6.2.4	Standards	11
6.2.5	Priority	11
6.3	Blackbox Hardware	11
6.3.1	Description	11
6.3.2	Source	11
6.3.3	Constraints	12
6.3.4	Standards	12
6.3.5	Priority	12
<b>7</b>	<b>Maintenance &amp; Support Requirements</b>	<b>13</b>
7.1	Mechanical Maintenance	13
7.1.1	Description	13
7.1.2	Source	13
7.1.3	Constraints	13
7.1.4	Standards	13
7.1.5	Priority	13

## LIST OF FIGURES

1	X conceptual drawing . . . . .	6
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# 1 PRODUCT CONCEPT

This section describes the purpose, use and intended user audience for the Camera Gimbal prototype. The Camera Gimbal is system that let users view live video feeds from a possible 360 degree external camera through a Virtual Reality (VR) headset. Currently the intended user is military personnel or border patrol agents. With this product, border patrol agents can mount the system onto a small mobile unit to check for possible weapons or unwanted objects underneath vehicles.

## 1.1 PURPOSE AND USE

The product should be able to provide live video feed from the rotating camera to the VR headset. The movement of the VR headset will also dictate how the camera is going to be rotated. As the user perform directional movement while equipped with the VR headset, the camera should also rotate to the corresponding movement.

## 1.2 INTENDED AUDIENCE

There are a wide range of audience for this product. Border patrol agents can use the product to check for unwanted objects underneath vehicles. Cave diver can mount the product into a small mobile unit to be able to view live video feeds from areas that are not possible to reach physically. In general, this product can be use for any situation that requires live images or videos in areas that can be hard to reach physically.

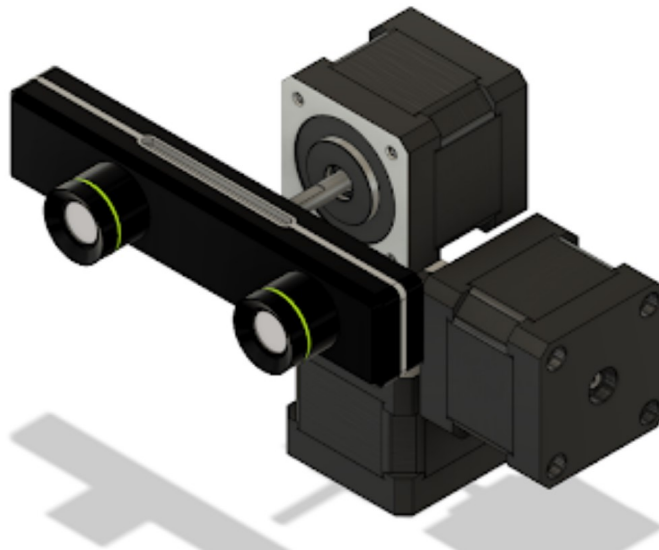


Figure 1: X conceptual drawing

## **2 PRODUCT DESCRIPTION**

This section provides the reader with an overview of R.O.B. The primary operational aspect of the product, from the perspective of end users, maintainers and administrators, are defined here. The key features and functions found in the product, as well as critical user interactions and user interfaces are described in detail.

### **2.1 FEATURES & FUNCTIONS**

The R.O.B camera gimbal is a multi-directional 360 degree camera that sends a feed to a Virtual Reality headset while the Virtual reality headset controls the camera gimbal. The product will not manipulate the physical world. The product has limitation since it is mounted. The product will look like a Nintendo character's head named R.O.B mounted on motors which will be connected to a PCB and that will be connected to a computer then to a virtual reality headset.

### **2.2 EXTERNAL INPUTS & OUTPUTS**

The only input is user head orientation, provided by the user via the VR Headset, which will directly controls the camera orientation. These orientation data is processed internally and will update the only output which is the camera-to-VR video feed.

### **2.3 PRODUCT INTERFACES**

User will only use the headset to communicate with the camera. So the interface will be within the VR headset which will feature a menu.

### **3 CUSTOMER REQUIREMENTS**

The Camera Gimbal system should be able to provide live stereo video feeds from the camera to a VR headset. Ideally, the user should be able to see stereo video from the camera in a fixed aspect ratio. In addition, the camera should be able to rotate corresponding to the users head movements. The image and video processing unit should also be able to process the video feeds such that the user does not experience motion sickness as they move.

#### **3.1 CAMERA ROTATION**

##### **3.1.1 DESCRIPTION**

Camera should be able to synchronize with the user's head movement using the VR Headset as reference.

##### **3.1.2 SOURCE**

Customer

##### **3.1.3 CONSTRAINTS**

The camera, at this time, will only simulate stationary body head rotation. That is movement of the head without the rotation of the body.

##### **3.1.4 STANDARDS**

There are no specific standard requirements.

##### **3.1.5 PRIORITY**

Critical (must have or product is a failure)

#### **3.2 CAMERA-TO-VR RESOLUTION AND RESPONSIVENESS**

Video feed has to be in color and adequate resolution with minimal input delay.

##### **3.2.1 DESCRIPTION**

The User should be able to identify objects and their respective color through the VR headset. This should be performed smoothly and the user should not be able to notice the delay between the head movement and the camera rotation.

##### **3.2.2 SOURCE**

Customer

##### **3.2.3 CONSTRAINTS**

A resolution of at least 640 by 480 depth and RGB is required. Input delay should be at or below human visual perception threshold.

##### **3.2.4 STANDARDS**

the ATSC digital television standards define 480p with 640x480p (4:3) pixel resolutions, at p24, p30, or p60 frames per second.

##### **3.2.5 PRIORITY**

Critical (must have or product is a failure)



## **4 PACKAGING REQUIREMENTS**

The product shall be packaged with all the required hardware and a storage unit that contain the executable files and the main executable that will run the program that let the screen viewer see what the user with the VR headset sees. All the requires software packages, and all the codes will be included in a small USB flash storage unit

### **4.1 SOFTWARE PACKAGING**

#### **4.1.1 DESCRIPTION**

The developed source codes along with executable files, scripts, and prerequisites packages will be included in a USB storage unit that is included with the physical packaging of the product

#### **4.1.2 SOURCE**

Customer

#### **4.1.3 CONSTRAINTS**

Only operating system that can read FAT32

#### **4.1.4 STANDARDS**

The application will be packaged in the Standard Windows executable (.exe) format.

#### **4.1.5 PRIORITY**

Low

### **4.2 HARDWARE PACKAGING**

#### **4.2.1 DESCRIPTION**

The hardware packaging shall include the Oculus Rift VR headset, camera, physical camera rotation system, circuit board, and the USB flash drive that contain all the required packages and source codes.

#### **4.2.2 SOURCE**

Customer

#### **4.2.3 CONSTRAINTS**

None

#### **4.2.4 STANDARDS**

Packaging standard for fragile product

#### **4.2.5 PRIORITY**

Low

## **5 PERFORMANCE REQUIREMENTS**

The Camera Gimbal system shall provide minimal delay both physically and image processing. This means the image processing from the image and video processing computer will need to be efficient enough. The camera itself must also rotate and able to detect movement without any shaking movements and delay

### **5.1 FAST IMAGE PROCESSING**

#### **5.1.1 DESCRIPTION**

When the video and image processing unit receive video feeds from the camera, it must do all the processing and passed the processed images to the VR headset with a rate of sixty frames per second.

#### **5.1.2 SOURCE**

Customer

#### **5.1.3 CONSTRAINTS**

Communication must utilizes USB 3.0 standard transfer speed.

#### **5.1.4 STANDARDS**

None

#### **5.1.5 PRIORITY**

High

### **5.2 FAST MOVEMENT DETECTION**

#### **5.2.1 DESCRIPTION**

The time delay between the user movement and when the camera moves should be less than 50 milliseconds.

#### **5.2.2 SOURCE**

Customer

#### **5.2.3 CONSTRAINTS**

None

#### **5.2.4 STANDARDS**

None

#### **5.2.5 PRIORITY**

Medium

## **6 SAFETY REQUIREMENTS**

This section will provide the safety requirements that the camera gimbal system will strictly follow.

### **6.1 PHOTSENSITIVE USERS**

#### **6.1.1 DESCRIPTION**

A small number of the population experience ocular induced seizures, our product is not recommend for use with these users.

#### **6.1.2 SOURCE**

CSE Senior Design laboratory policy

#### **6.1.3 CONSTRAINTS**

Equipment usage, due to lock removal policies, will be limited to availability of the course instructor and designed teaching assistants.

#### **6.1.4 STANDARDS**

Occupational Safety and Health Standards 1910.147 - The control of hazardous energy (lockout/tagout).

#### **6.1.5 PRIORITY**

Critical

### **6.2 ENVIRONMENTAL SAFETY**

#### **6.2.1 DESCRIPTION**

Users should be mindful to their respective surroundings while utilizing VR hardware.

#### **6.2.2 SOURCE**

CSE Senior Design laboratory policy

#### **6.2.3 CONSTRAINTS**

Unexpected objects, people, flooring may cause users to injure themselves and or fall.

#### **6.2.4 STANDARDS**

NFPA 70

#### **6.2.5 PRIORITY**

Critical

### **6.3 BLACKBOX HARDWARE**

#### **6.3.1 DESCRIPTION**

The users should not be able to access the internal mechanisms of the product, mechanically and electronically. Failure to do so can jeopardize the user's safety. This can expose the user to pinch-points, and possible high voltage.

#### **6.3.2 SOURCE**

CSE Senior Design laboratory policy

### **6.3.3 CONSTRAINTS**

Collaborative robotic manipulators will be preferred over non-collaborative units in order to minimize potential hazards. Sourcing and use of any required safety interlock mechanisms will be the responsibility of the engineering team.

### **6.3.4 STANDARDS**

ANSI/RIA R15.06-2012 American National Standard for Industrial Robots and Robot Systems, RIA TR15.606-2016 Collaborative Robots

### **6.3.5 PRIORITY**

Critical

## **7 MAINTENANCE & SUPPORT REQUIREMENTS**

Although the system is designed to be practically maintenance-free, there are certain adjustments to the system that can be done manually by the user to ensure quality of performance and extend product life.

### **7.1 MECHANICAL MAINTENANCE**

#### **7.1.1 DESCRIPTION**

The rotational axis might be worn out or went out of sync if abused or misused, therefore, there are mechanical adjustments to help recenter and re-synchronize the camera to its original home and 3D models provided for 3D printing replacement parts/mechanism.

#### **7.1.2 SOURCE**

System engineers

#### **7.1.3 CONSTRAINTS**

None

#### **7.1.4 STANDARDS**

None

#### **7.1.5 PRIORITY**

Low

## REFERENCES