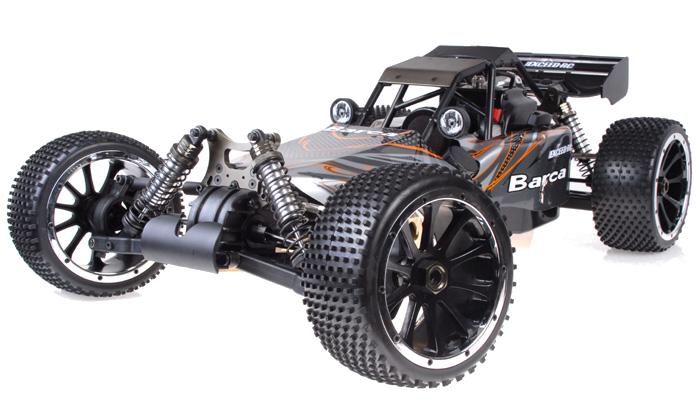
|  |
| --- |
| Oculus RC Buggy |
| Submitted By: Jack Sanchez |
| Submitted To: Calvin Caldwell |
| E-mail: jack.sanchez@oit.edu |
| Date: Monday, May 19th 2014 |
| Version: 1.0 |
| A remote controlled all-terrain vehicle will be controlled by an Oculus Rift enabled user combined with a full steering wheel with accelerator and break pedals to allow for complete control of a miniaturized off-road sports buggy. |
|  |





# 1.0 Legal Notice\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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# 3.0 Revision History\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author** | **Company** | **Version** | **Date** | **File Name** | **Comments** |
| J. Sanchez | OculusRC | <0.1> | May 19, 2014 | OculusRcProposal.docx | Rough Draft |
| J. Sanchez | OculusRC | <1.0> | June 6, 2014 | OculusRcProposal.docx | Final Draft |
| J. Sanchez | OculusRC | <1.1> | Sept. 30, 2014 | OculusRcProposal.docx | See Appendix C |

# 4.0 Signature Page\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Submitted By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Company: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Job Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Approved By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Company: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Job Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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## 6.1 Purpose\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The purpose of this document is to describe, in detail, the functionality, requirements, and specifications of the Oculus RC Buggy project. This document will describe the functional and non-functional requirements of the system and give brief descriptions of each requirement grouping. The specifications of the project will also be described at length throughout the document. Both requirements and specifications will be explained categorically on a case-by-case basis throughout the following document.

## 6.2 Scope\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This document discusses a general introduction to the Oculus RC Buggy project, its intended functionality, both functional and non-functional, as well as the specifications from the Senior Project Advisor and the Project Manager. This document will further develop the intended project management structure and the expected project development lifecycle.

## 6.3 Intended Audience\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The intended audience for the project is the Senior Project Advisor for his required project approval. Jack Sanchez, due to his invested role in development and anyone who is interested in the project for personal or business reasons.

# 7.0 Project Management\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## 7.1 Change Management Procedure\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**7.1.1 Change Administration Team**

The change administration team (CAT) includes the Senior Project instructor, Calvin Caldwell, and Jack Sanchez, the lead developer and project manager. Any changes to the project will need to be approved by each member of the CAT team. Changes to the project can be submitted by either member of the CAT team and will be required for any scale of project design change.

**7.1.2 Medium**

Any and all changes to the project will require that a Design Service Enhancement/Alteration Request Form be filled out (Appendix A) and signed by Jack Sanchez, the project manager and Calvin Caldwell, the Senior Project Advisor.

**7.1.3 Protocol**

If a change is required, the individual requesting the change should first contemplate if the change is really necessary for the success of this project. If the change is really required, the requesting individual will then request a Design Service Enhancement/Alteration Request Form from Jack Sanchez and upon filling out the form, the individual should submit the form to the opposing individual. The opposing individual, upon receiving the Design Service Enhancement/Alteration Request Form will have a set period of time to respond to the request as outlined in the Time Lines section with either an approval or a denial.

**7.1.4 Time Lines**

The opposing individual must complete all Design Service Enhancement/Alteration Request Forms within 3 business days, except in the following conditions: the opposing individual is out of the office, deathly ill, a victim of crime, or a natural disaster.

**7.1.5 Impact Analysis**

A project impact analysis will be included with all Design Service Enhancement/Alteration Request Form as a section. Changes to the product timetable as well as the impact on other systems of the project and end functionality will be recorded in the Impact analysis section.

**7.1.6 Archive**

All Design Service Enhancement/Alteration Request Forms are to be kept as a paper copy by Jack Sanchez and are to be submitted with the final project packet at the end of the project lifecycle.

## 7.2 Software Delivery, Installation and Acceptance criteria\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The software for the OculusRC system is to be submitted through either a USB drive, or on a CD-ROM. The software can then be installed on any number of computers without the requirement of any licensing codes. All documentation pertaining to the project, including this document will also be present with the installation binaries for future reference. Installation of the software is to be performed by the customer and is not the responsibility of OculusRC.

The hardware for OculusRC includes a Microsoft Xbox 360 Steering Wheel controller, which includes an accelerator and brake pedal assembly, an embedded system which is meant to be attached to a customer provided remote controlled vehicle, and the Oculus Rift virtual reality device. The software installation material will include documentation on the setup and general use of the hardware related components.

## 7.3 Documentation and Online-help\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Documentation pertaining to the OculusRC systems will be recorded, formatted, and displayed through the Windows Help utility system. This will be a formatted document allowing quick traversal of all help subsections.

## 7.4 Project Risks\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The project risks involved in the Oculus RC Buggy are mostly related to the virtual reality aspect. Any customers with sensitivity to motion sickness will likely experience either simulator sickness during Oculus Rift use, or will experience after-effects associated with the brain readapting to the real environment around them. There is also a chance the user will not experience any negative side effects or after effects related to the Oculus Rift at all. The other major snag that could occur in this project is the wireless transmission of OculusRC telemetry including vehicle control systems and possible extreme video latency and frame drop over the wireless peer-to-peer connection between the RC Buggy and the client machine.

## 7.5 Customer Responsibility\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The customer is responsible for knowing the “basics” of operating and maintaining a remote control electric vehicle that is 1/10th of the scale of a standard automobile. The customer must also be aware of the possible effects of immersion in a virtual reality environment which is enabled through the Oculus Rift. The customer, for the end system delivery, will also need to supply the client machine which supports multiple USB ports, HDMI output as well as having OpenGL support.

## 7.6 Status Reporting\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Status reports will be submitted each week on Friday by 5:00pm. These reports will be completed on the Weekly Status Report Form (Appendix B). The reports will be completed by Jack Sanchez and submitted to the Senior Project Advisor.

# 8.0 System General Description\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## 8.1 Problem Statement\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The problem presented was to create, propose, design, develop, implement, and release an enterprise-like system with all the appropriate documentation. This system will utilize hardware, software, and embedded components to deliver the fully functional deliverable. This will include camera hardware, which will be mounted on the vehicle, which feeds two video signals into an NVIDIA device which will utilize the Kepler architecture to quickly and seamlessly create and transform a high definition virtual environment ready to be sent to the Oculus Rift device. The system shall also have a proximity sensor to track the vehicle’s distance from a wall, to alert the user they must turn. This sensor will be monitored by the mainboard which will process the readings into an acceptable format for the client machine to display over the Oculus Rift feed. After every onboard component has been processed by the master embedded platform, it will be transmitted to a client machine using a peer-to-peer wireless network in order to facilitate the huge data bandwidth required for optimal data transmission. The client machine will receive all data and transmit it over HDMI to the Oculus Rift device. It will also pair the vehicle control system to a steering wheel with accelerator and brake pedals for accurate control of the vehicle.

## 8.1.1 Software Components\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The software components for this project will include video and image processing on the remote control system and a video stream on the client application system. This will be done using a combination of OpenGL, with the OculusSDK, and the purpose-built, NVIDIA overhauled OpenCV library to process the two camera signals into the Oculus barrel distortion images and overlay the heads-up display onto each frame of the Oculus video feed. The remote system will also feature a proximity sensor to aid the user in not getting the RC caught on a wall. The remote system will also contain a module which translates the new control system’s signals to appropriate values for the original control system. These new control signals will come from the client application system from a steering wheel controller interface. The client system will, on top of managing the control system, receive the video data to feed into the Oculus Rift. This client application system will have a menu system and allow configuration of both the remote and client systems outside of the virtual environment.

## 8.1.2 Hardware Components\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The hardware will consist of a barebones remote control off-road vehicle that will securely contain a camera apparatus within the cockpit of the vehicle. The main embedded processing component will be an NVIDIA Jetson TK1, powered mobile Linux board which will communicate with a control system module, a sensor manager module, and a Wi-Fi communication platform. The client system will consist of an OpenGL capable computer which will send video data to the Oculus Rift device and will manage controller data from a steering wheel control unit with accelerator and brake pedals.

## 8.2 Perspective\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*History*

The field of small scale remote control vehicles has been thriving among hobbyists for many years, and there is already a huge market place for any RC related needs. The field of virtual reality, however, is making a comeback – reborn as Oculus Rift. Back in the 1990’s, many technology companies were attempting to bring virtual reality to life, a couple example companies are SEGA and Nintendo. Due to technology constraints and a general lack of knowledge and experience in the video game and electronic entertainment industry, virtual reality quickly fell off the map, due mostly to the massive sicknesses induced by the high-latency, low-resolution, and high-persistence of the existing technology of the time. Since then, the military and other organizations, such as NASA and Formula One, have continued their implementations of virtual reality in the form of flight simulators and driving simulators. Thus, the medical community has had a brief window of time to perform virtual reality studies. Now, roughly 20 years later, we have the technology to make consumer grade and consumer cost virtual reality devices. This forward development has allowed the partnering of such a novel concept with a high-powered off-road Nitro RC Buggy.

*Similar Systems on the Market*

As of right now, just about everything to do with the Oculus Rift is experimental or prototyped in nature. However, there is a vast array of remote controlled virtual reality implementations that are being tested. One such project that immediately comes to mind is a recent development by a company called Parrot. They have begun building Oculus Rift enabled quad-copter drones, which are controlled wirelessly through an app with an attachable control system.

## 8.3 Major Subsystems\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The major subsystems involved in this system include the Oculus Rift, RC buggy, client application, server application, and the camera controller.

*Oculus Rift:*

The Oculus Rift involves the 2nd generation development kit in the works from the company OculusVR which can be interfaced easily with their SDK. The user will experience the perspective of a driver of the RC vehicle that the system is installed.

*RC Buggy:*

The RC Buggy consists of a barebones kit which includes the frame, suspension, a brushed DC motor and a basic servo. This will carry the camera system, and the embedded video/image processing system and be controlled wirelessly by a remote client station.

# 8.4 Relation of System to existing Systems\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This section is intentionally left blank.

# 8.5 Hardware Platform Description\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The hardware involved in this project will consist of an embedded system designed to record, transform, encode, and transmit video data to a client machine. It is also intended to control the motor and servo. The main board for the RC system will be the NVIDIA Jetson TK1 Development board. This will process video data which is received via two Logitech C920 Webcams which will record and encode the video data in H264 compression and are attached to the board through a powered Belkin USB 3.0 Hub in order to eliminate any extra draw from the board through the USB port. The system will communicate with a client application via Wi-Fi networks.

# 8.6 Software Platform Description\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The software in this system will be present on both the server and the client in the form of a daemon running on the embedded server system to collect, and transform the video for the Rift, the daemon will then use that feed and transmit to the client machine which will be running an application to collect and send the Rift images to the Rift, and transmit the steering controls from the client to the server system.

# 9.0 Product Requirements\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## 9.1 Functional Requirements\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Network Communications:**

The network communications component is related to all systems which transmit or receive video signals, sensor data, and controller systems. The video and sensor data will be communicating over a Wi-Fi network and the controller system will communicate to the existing control system onboard the RC Buggy.

1. **Network Communications**

1.1 The system shall wirelessly send video data to the client

1.2 The system shall wirelessly initialize video systems

1.3 The system shall wirelessly send sensor data to the client

1.4 The system shall wirelessly initialize sensor systems

1.5 The system shall wirelessly send controller data to the server

1.6 The system shall wirelessly initialize controller systems

1.7 The system shall wirelessly connect the client to the server

1.8 The system shall maintain the wireless connection until user termination

1.9 The system shall allow the user to terminate the wireless connection

**Controller Systems:**

The controller systems, utilizing the existing communication system, will be handled by the client machine which will connect to the proper channel and frequency in order to transmit converted readings from the Xbox 360 Wireless Steering Wheel controller.

1. **Controller Systems**

2.1 The system shall control vehicle steering

2.2 The system shall control vehicle acceleration

2.3 The system shall control vehicle deceleration

2.4 The system shall convert controller data into PWM signals to control the vehicle

2.5 The system shall interface to the controller through the Microsoft SDK

**Video Systems:**

The video systems encompass all functionality related to the Oculus Rift and the two cameras which will feed live data to an embedded system and following into the client machine to the Oculus. The embedded system will perform all video processing using OpenGL, OpenCV, and the Oculus Rift SDK libraries to accomplish all required video transformations; this will produce a single video feed to wirelessly transmit over Wi-Fi through the Network Communications modules.

1. **Video Systems**

3.1 The system shall record live video

3.2 The system shall have two cameras

3.3 The system shall stream video from both cameras simultaneously

3.4 The system shall create a heads up display which is overlaid onto the video feed

3.5 The system shall display an inertial graph

3.6 The system shall update the inertia graph based on accelerometer readings

3.7 The system shall display the video data to the Oculus Rift

3.8 The system shall process the video data for the Oculus Rift

**Sensor Systems:**

The sensor systems consist of any vehicle tracking hardware which will be processed to pick out relevant values to overlay as a heads-up display on top of the Oculus video feed.

1. **Sensor Systems**

4.1 The system shall process sensor readings from an accelerometer

4.2 The system shall send g-force data about the vehicle’s acceleration

4.3 The system shall track the vehicle’s distance from rest

4.4 The system shall reset the accelerometer zero position

## 9.2 Performance\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* The system will need to transmit video at least at 30 frames per second.
* The client machine will need to support two USB ports and an HDMI port at minimum.
* The client machine will need to support OpenGL.

## 9.3 Reliability\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The device should work seamlessly except in circumstances where the surrounding areas provide a high level of wireless interference which could cause an unknown amount of packet loss as well as control communication issues.

## 9.4 Interfaces\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This system will be very tightly coupled to itself; the only interface that could exist would be the server-side embedded system. Ideally, the user could take the embedded system and cameras and attach it to any other remote control device, assuming an existing controller system works with this new system.

## 9.5 Data Description\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The data that this system will deal with will include controller interaction and video stream data which will be distorted and combined to be easily fed to the Oculus Rift device.

## 9.6 Security and Safety\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This system has no security concerns involved in the operation, however, there is definitely a safety concern related both to the Oculus Rift and to the operation of a high-speed, high-power remote control buggy device. The user will be recommended to be at least age 13 to operate this system, and will need to operate only in a wide, open environment with minimal wireless interference for optimal usability.

## 9.7 Constraints\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The client machine must be running a current generation operating system with at least 4GB of RAM, a dedicated graphics processing device with a usable HDMI port, as well as current generation processing power. The server system will be running an embedded Linux operating system that will prepare all system data for transmission to the client system in order to reduce as much processing as possible on the client system. The system will also require some sort of wireless peer-to-peer network available for the server and client system to communicate.

# 10.0 User Profiles\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The OculusRC system will be intended for use as an entertainment platform for hobbyists and basic users alike. The system requires very minimal knowledge on using a remote control vehicle, only requiring the knowledge to operate the vehicle steering, acceleration, and deceleration. Therefore, a general user could buy the system ready-to-run or a hobbyist could buy the embedded system and custom fit it to a custom built remote control vehicle. This would not be limited to a four wheeled vehicle. The configuration of the vehicle is completely decoupled from the virtual reality generation system.

# 11.0 Glossary\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Oculus Rift – a virtual reality, head-mounted display designed to be worn by a user
* OculusRC – the name of the proposed system
* RC – remote control, generally referring to a remote control vehicle
* TCP/IP – a specific network communication protocol which dictates zero packet loss
* UDP – a specific network communication protocol which does not care about packet loss
* OpenGL – a specific video processing language which is hardware accelerated on a GPU
* GPU – graphics processing unit, required for smooth video processing
* OpenCV – a “computer vision” library which aids in image/video process and camera streaming
* NVIDIA Jetson TK1 – a developer board custom built from the ground up by NVIDIA

Appendix A:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# OculusRC

# Weekly Progress Report

Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Submitted By:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Accomplishments for week of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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Planned Accomplishments for the week of\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Issues Encountered:

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Appendix B:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# OculusRC

# Design Service Enhancement/Alteration Request Form

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Submitted By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Change Requested (give brief description):

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Reason for Change (give brief description):

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Impact Analysis (give brief description):

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Approval Signatures:

Project Lead: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Senior Project Advisor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Appendix C:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# OculusRC

# Design Service Enhancement/Alteration Request Form

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Submitted By: \_\_\_\_Jack Sanchez\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Change Requested (give brief description):

\_\_\_\_\_This change is a general overhaul based on information gathered throughout the summer. See Appendix D for details.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Reason for Change (give brief description):

\_\_\_\_\_Refined specifications and requirements and better understanding of the problem at hand.\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Impact Analysis (give brief description):

\_\_\_\_\_There will be no noticeable impact of the changes at this point as they only help to better define the scope of the project.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Approval Signatures:

Project Lead: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Senior Project Advisor: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Appendix D:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Sections Changed:*

Section 7.2

Clarified and edited text

Section 7.4

Clarified and edited text

Section 7.5

Clarified and edited text

Section 8

Clarified Problem Statement

Clarified Software Components

Clarified Hardware Components

Clarified Hardware Platform Description

Clarified Software Platform Description

Section 9

Specified Sensor Systems

Clarified Heads up display system

Expanded on controller system

Added requirements numbering scheme

Trimmed Functional Requirements

Updated Performance Requirements

Updated Reliability

Removed extraneous Title text