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# **Software Requirements Specification**

**for**

## **Measuring EEG during a Virtual Reality Fear of Heights Paradigm**

**Version 1.1 approved**

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## Revision History

Name	Date	Reason For Changes	Version

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# **1. Introduction**

## **1.1 Purpose**

The purpose of the Software Requirements Specifications(SRS) document is to provide a clear, documented model of requirements for measuring EEG (Electroencephalogram) during a virtual reality paradigm based on the fear of heights. The SRS document will define all software features, functional, and nonfunctional requirements related to software required to measure the EEG during a virtual reality fear of heights paradigm, based on the stakeholder's requirements. The document only refers to systems of version 1.1, updates to the document will be explored if the system changes.

## **1.2 Document Conventions**

The SRS document is composed in different sections ranging 1-5. Each section heading is bolded in Times font size 14 with numerical format that follows the format **Y. Title** where the Y represents the section number and Title represents the section title. Subsection headings are bold in Times font size fourteen with numerical format that follows the format **Y.Z Title** where Y is the section number and Z is the index of the subsection, and Title is the title of the subsection

## **1.3 Intended Audience and Reading Suggestions**

The SRS design document is designed for developers, team leaders, project managers, or any other stakeholder who is interested in learning about measuring EEG during a virtual reality(VR) simulation. The Document follows a relatively simple pattern. Section 1 of the SRS document begins with an introduction-outlines the purpose, intended audience, and product scope. Section 2 offers a glimpse of overall description, outlining functional requirements, software development diagrams(class diagrams, sequence diagrams, etc), the environment the technology will be deployed in, constraints, and documentation used in the project. Section 3 focuses on the hardware, software, and communication interface requirements. Section 4 highlights the system features (a more detailed account on the software functional requirements). The last section, section 5, emphasizes the nonfunctional requirements such as performance, security, and data protection.

## **1.4 Product Scope**

The product scope will focus on measuring EEG on a small sample of participants wearing a VR headset as well as sensors to provide sensory feedback. The benefits of the technology is to provide exposure therapy to a particular threatening stimulus such as a fear of heights in a simulation and not in real life, mitigating any risks or dangers to participants.

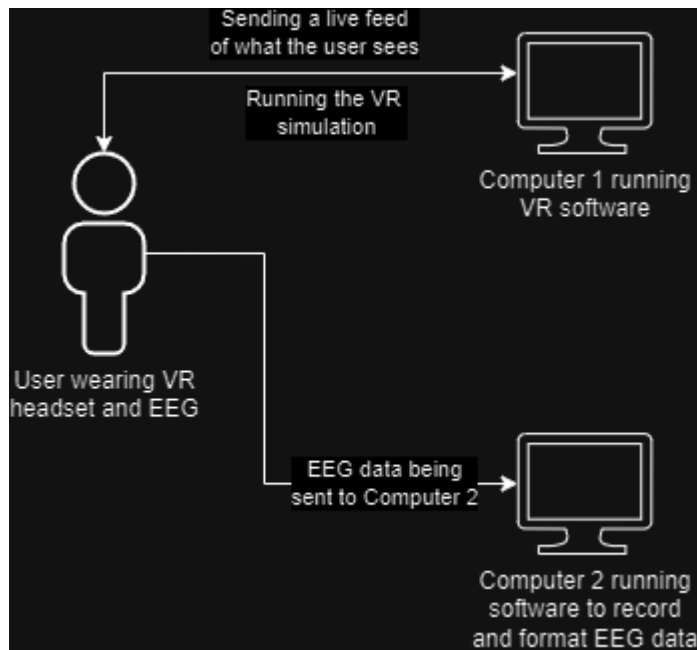
## **1.5 References**

TBA

## 2. Overall Description

### 2.1 Product Perspective

The product that is being developed is custom software that will be used for a virtual reality system. This virtual reality system will consist of a headset, two controllers for each of the user's hands, and two computers. These controllers will be used to allow the user to manipulate the software. An EEG or electroencephalogram will be used to track the electrical activity in the user's brain. Two computers will be used for this product. One computer is required to run the virtual reality software, and the other computer is used to record the data that is given from the EEG.



### 2.2 Product Functions

The product that is being provided must be able to perform the following functions:

- Record data from an EEG
- Display data from the EEG as a graph
- Segment data from the EEG based on events that happen in the virtual environment

### 2.3 User Classes and Characteristics

User classes will be defined as the following:

- Instructor - The one who is observing the information that is collected by the EEG.
- Patient - This user will be the one who will be equipped with the VR headset and controllers, and he or she will also be connected to an EEG system for monitoring.

## **2.4 Operating Environment**

The software that is to be developed will operate using a Meta Quest 3S; moreover, the two computers that will also be used will be operating with Windows 11, so the software must work on that operating system. A BioSemi Trigger Interface will be used to receive signals from the virtual environment, and timestamp the EEG data.

## **2.5 Design and Implementation Constraints**

There will be a challenge in placing both the VR headset and the EEG cap on the user's head.

## **2.6 User Documentation**

Currently, there are no plans to create documentation for this piece of software, however we plan to make our product as intuitive to use as possible, so that there will not be a need for a tutorial or any documentation.

## **2.7 Assumptions and Dependencies**

According to Dr. David, his colleague has already written a piece of software that can be used to record data from an EEG. If this is not the case, or we are not able to acquire this software, we will have to create it ourselves.

# **3. External Interface Requirements**

## **3.1 User Interfaces**

There will be very limited interfaces between the users and the software. Once started, the software will display the EEG data of the user in the virtual environment of the headset, but the user will have no need or way to interface with the software. If any errors occur within the software, an error message will be displayed in the VR headset.

## **3.2 Hardware Interfaces**

The software will have to interface with both computers being used, the one running the VR simulation and the one recording the EEG data. We will accomplish this by using a BioSemi Trigger Interface to transfer signals from the VR simulation to the EEG computer.

## **3.3 Software Interfaces**

Our software will interface with the EEG recording software and the virtual environment. At points throughout the VR simulation, the virtual environment will send out signals that will have to be

conducted to the EEG recording software, and will segment the EEG data. The software will have to run on Windows 11 and be compatible with the Unreal Engine virtual environment software.

### 3.4 Communications Interfaces

The software will have to facilitate communications between two computers. The data flow will be in the form of Python signals.

## 4. System Features

### 4.1 Virtual Reality Experience

#### 4.1.1 Description and Priority

The virtual Reality experience allows participants to fully immerse themselves into a VR environment that simulates heights to cause emotional and physiological responses. The feature is High priority as it is the core of the study.

#### 4.1.2 Stimulus/Response Sequences

1. **User Action:** Participant uses the VR headset
  - **System Response:** the VR environment displays the main menu.
2. **User Action:** Participants selects "Start"
  - **System Response:** The system loads the height simulation scene.
3. **User Action:** Participants interacts with the VR environment
  - **System Response:** The system updates the visual display based on movement and triggers effects.
4. **User Action:** Participant exhibits signs of fear (e.g., hesitation, gasping).
  - **System Response:** The system captures the EEG data to monitor emotional responses and may provide gentle prompts to encourage engagement.

#### 4.1.3 Functional Requirements

**REQ-1:** The system initializes and loads the VR environment within 5 seconds of the participant selecting "Start Experience."

**REQ-2:** The system supports head and hand tracking with a precision of 1 cm to enhance immersion in the VR experience.

**REQ-3:** The system captures and stores EEG data in real-time during the VR experience, ensuring synchronization with participant actions.

**REQ-4:** The system provides a menu option for participants to exit the VR experience at any time, returning them to the main menu without data loss.

**REQ-5:** The system logs any errors or interruptions during the VR experience and displays an error message to the participant, with options to restart or exit.

## **5. Other Nonfunctional Requirements**

### **5.1 Performance Requirements**

- High sampling Rate
- Low Latency
- Portability
- High Spatial Resolution
- Real-Time Signal Processing

### **5.2 Safety Requirements**

- Safe Movement in Virtual Reality
- Secure EEG Equipment
- Support mechanism
- Monitoring for Signs of Distress
- Gradual exposure
- Exit Mechanism

### **5.3 Security Requirements**

- Encryption of EEG Data
- Secure Storage
- Session Timeouts

### **5.4 Software Quality Attributes**

- Performance
- Usability
- Reliability
- Maintainability
- Security

### **5.5 Business Rules**

- Data ownership- Dr. David and our group own all data that is obtained during the study, including EEG measurements and participant interactions within the VR environment.
- Participant Management Rules: define a eligibility criteria for participants



## **6. Other Requirements**

TBA

## **Appendix A: Glossary**

EEG - Electroencephalogram

SRS - Software Requirements Specifications

VR - Virtual Reality

## **Appendix B: Analysis Models**

N/A

## **Appendix C: To Be Determined List**

1.5 - References

6 - Other Requirements