Software Requirements Specification (SRS) Document

Revisions

Version	Primary Author(s)	Description of Version	Date Completed
Final Draft	Team-29	All sections being Filled	31/03/23

1. Introduction

1.1 Introduction

The purpose of this document is to define and describe the functional and extra-functional (non-functional) requirements of the **Virtual Reality for Surgery** and to spell out the system's functionality and its constraints. Virtual Reality (VR) has become an increasingly popular technology in the field of surgery. The use of VR technology in surgical training and planning has many potential benefits, including reduced surgical errors, improved surgical outcomes, and increased efficiency.

1.2 Scope of this Document

The document shall highlight the VR Product for Surgery, description, target users, acceptance criteria, any other information that can help developer to build the VR product. The customers and the users of the system are the surgeons and medical students of the Hospitals. Our constraints for this section includes the deadline for the document which is due on 01/04/2023.

1.3 Overview

The Virtual Reality for Surgery is a Surgical simulation system for hands-on training and evaluating surgeons' abilities. For instance, if a trainee needs to remove a tumour, the simulation's script specifies its location, appearance, and how readings from medical devices alter as each stage of the operation protocol is carried out. It is expected that surgeons who successfully finished this VR training would be able to do the actual surgery with little assistance than the surgeons who did not complete the training.

2. General Description

2.1 Product Functions

VR for Surgery solutions help surgeons by generating three-dimensional images of anatomical structures and providing them with tools to simulate a surgery in a safe environment. The 3D surgery simulation recording can be played back to assess a trainee's performance or to show the patients the plan of an impending surgery. The important attributes to be captured in VR for Surgery are:

2.1.1 Capturing the 3D environment properties
2.1.2 Assets or objects of 3D environment
2.1.3 Possible interplay of users and assets, and the potential responses to one another
2.1.4 Authentic acoustics of the 3D environment
2.1.5 Expected journey of a 3D view across a timeline
2.1.6 Asset or Article action flow in a 3D view
2.1.7 Logging of user data to judge the performance of users

2.2 Similar System Information

The system is being developed so that trainers can utilise the telepresence capability to facilitate guided learning, surgeons can debate cases remotely, and medical sales

representatives can instruct surgeons on how to use new medical gadgets in a virtual reality demonstration.

2.3 User Characteristics

The users include the surgeons, residents and med students who undergo periodical and regular trainings in new surgical procedures and demonstrations in class room settings, multi-user, multi-location settings etc., to enhance their skill levels for improved outcomes.

2.4 User Problem Statement

The training of surgeons and med students currently requires lot of resources and time and impracticable to conduct required no of simulations on human cadavers. The real surgery requires lot of guidance, training, preparatory procedures and practice. These issues can be resolved by adopting VR for Surgery to reduce training cycles and costs and improve surgeons' skill levels.

2.5 User Objectives

The user needs 3D models of virtual patients, surgical tools, an operating room layout, etc., each with their own unique patient data and organ response. The user wants a database that will store 3D image data and the data should be available without any lag to simulate real surgical situations for training.

2.6 General Constraints

2.6.1 VR for Surgery simulation should render the interaction of surgical instruments with tissue structures with high precision. A user should receive a real-life response to their manipulations.

2.6.2 Also, to measure trainees' performance is a challenge. The collection of data for performance benchmarks (e.g., a surgical instrument's position, the force applied to an instrument, timeliness, amount of the tissue removed) is a serious challenge.

3. Functional / Extra-Functional Requirements

1. The VR for Surgery software system must support a variety of hardware devices, including VR headsets and controllers.
2. The VR for Surgery software system should enable users to interact with virtual objects and anatomical environments using natural and intuitive hand movements.
3. The VR for Surgery software system should be able to render high-quality graphics of internal organs and audio in real-time to create a realistic and immersive virtual environment.
4. The VR for Surgery system should be able to track and analyze user behavior and interactions within the virtual environment to provide meaningful metrics, insights and feedback.
5. The VR for Surgery software system should provide support for both single-user and multi-user environments to enable collaboration.
6. The VR for Surgery system should include a robust error-handling and debugging system to enable quick resolution of any issues.

7. The VR for Surgery system should provide support for multiple languages and localization to enable global distribution.
8. The VR for Surgery system should provide secure user authentication and access controls to protect user data and privacy.
9. The VR for Surgery system should provide advanced rendering techniques to enhance the visual quality of the virtual environment, such as real-time reflections and shadows.
10. The VR for Surgery system should include support for haptic feedback to enhance the user's sense of immersion and interaction with virtual objects.
11. The VR for Surgery software system should be able to handle large amounts of data without significant lag or performance issues.
12. The VR for Surgery system should provide a flexible and customizable framework for developers to create and integrate their own virtual environments and objects.
13. The VR for Surgery system should provide a mechanism for users in a multi-user Collaboratory environment to customize their virtual avatars and personalize their experience within the virtual environment.
14. The VR for Surgery system should be highly modular and scalable, to enable easy expansion and customization as user needs evolve.

4. Interface Requirements

4.1 User Interfaces

4.1.1 The user's visualizer, a head-mounted display (HMD) or a desktop or a Projector

4.1.2 The HMD/desktop/Projector, receives the data that the client VR application retrieves from the database web server.

4.1.3 Database administration and establishing access are done through the web admin panel.

4.2 Various Technologies

4.2.1 **VR engine:** Unity, Amazon Sumerian

4.2.2 **3D modelling**: MAYA, AUTODESK MAX

4.2.3 **Simulation modelling**: NVIDIA Flex

4.2.4 **HMD**: Oculus, VIVE

5. Performance Requirements

VR for surgery software systems must meet specific performance requirements and normally include a high-performance computer/ server, a VR headset, a tracking system, input devices, and an audio system. These components must be of high quality and compatible with each other to ensure a seamless and realistic VR experience for surgical training and planning.

1. A high-end processor, such as an Intel Core i7 or i9 or AMD Ryzen 7 or 9, and a powerful graphics card, such as an NVIDIA GeForce RTX 2060 or higher, can help ensure a smooth and realistic VR experience.

2. VR for Surgery system may require 32GB or more of RAM, especially for more complex surgical simulations.The headset must have a high-resolution display, low latency, and high refresh rates to ensure a smooth and realistic experience.

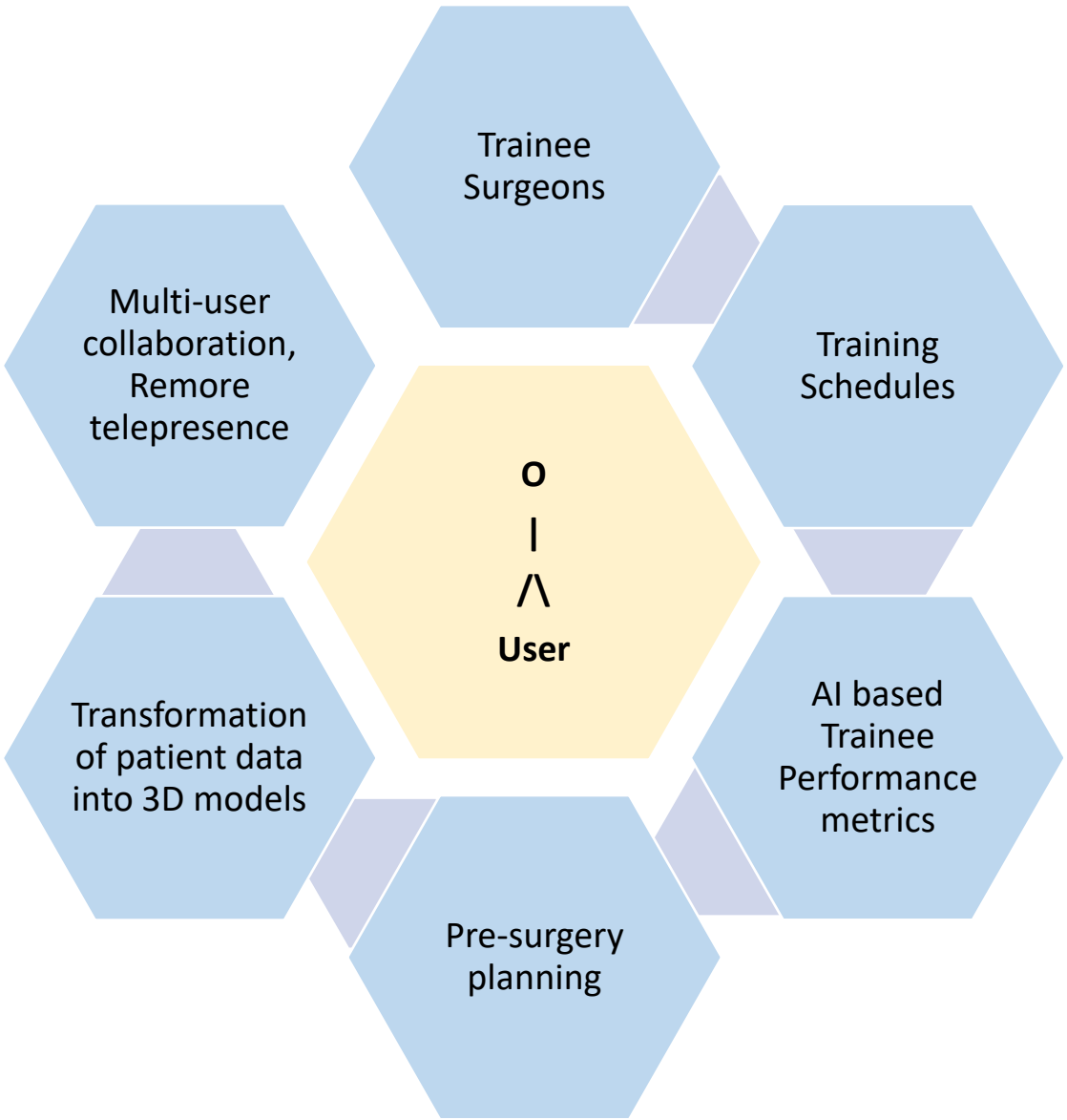
3. VR software can generate large amounts of data, such as high-resolution images and videos, which can quickly fill up the HDD. Therefore, a fast and large capacity SSD (solid-state drive) is recommended for VR for surgery. A minimum of 256GB SSD is recommended, although 512GB or more is preferred.

4. Most VR software is designed to work with the major operating systems such as Windows, Mac, and Linux. The Oculus Rift and Oculus Quest, two popular VR headsets used for medical and surgical training, require a Windows 10 operating system for optimal performance and has the largest library of VR software.

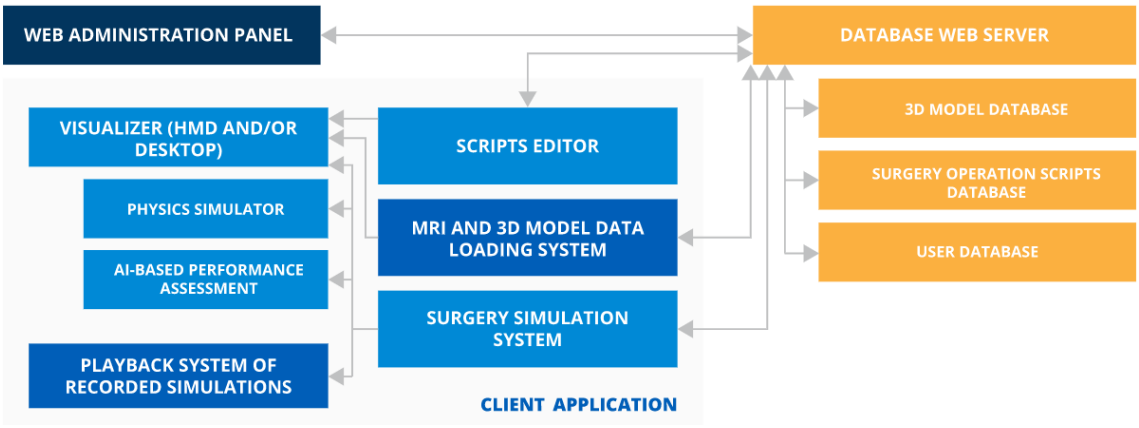
6. Preliminary Use Case Models and Architecture Diagrams

This section presents a list of use cases that satisfy the system's requirements. The purpose is to provide an alternative, "structural" view of the requirements stated above and how they might be satisfied in the system.

6.1 Use Case Model



6.2 Architectural Model



7. Appendices

7.1 Definitions, Acronyms, Abbreviations

VR – Virtual Reality

HMD – Head Mounted Display

Haptic feedback – Use of touch to communicate with the users

HDD – Hard Disk Drive

SSD – Solid State Drive