



UNIVERSITY OF OTTAWA – FACULTY OF ENGINEERING

ENGINEERING DESIGN

GNG1103

VIRTUAL REALITY MEDICAL EXPERIENCE SIMULATION FOR THE
OTTAWA HOSPITAL

DELIVERABLE L - User Manual

GROUP 15

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Introduction

Our product is set out to create a VR experience for the Ottawa hospital that helps mitigate the patient's stress for their upcoming procedures. We will achieve this by simulating the procedures with stereoscopic video within a HTC VIVE VR system. The level of immersion our product will give will allow the patients to fully experience the treatment while still being in a safe environment. Our goal is to develop an interface that is easy for the staff to upload 180 degree video and a software that is easy for the patients to engage and navigate within.

Need Identification

Our group collected a list of needs statements after interviewing our client Justin Sutherland which helped us generate our problem statement.

Needs of Client:

- The product reduces the anxiety the patients might feel from not understanding the procedure.
- The product is streamlined enough that it is not too difficult for the client to add new video files to it as well as to update videos over time.
- The application is expected to be basic and user friendly (nothing too fancy), enough for the patient be able to navigate through videos and follow instructions. The goal of this is to help navigate the patient through the whole experience of treatment, before actually going through the treatment, so that when they do, what to expect and how to act to hopefully reduce any fear and anxiety related to the treatment itself.
- When the client is viewing the video, prompts appear if they need to lie down/sit up to replicate the procedure and reduce nausea from the VR.
- Experience will last the entire duration of the CT scan and radiation treatment (maximum 30 minutes).
- The application allows other departments in the hospital to make similar applications so once clients provide their video sequence and the application uses these videos to create the content (ex. YouTube provides the platform and people provide the videos).
- Modular design is ideal to be able to select orders of treatments and pre-set it; customize for the patient so they don't waste time seeing things that aren't necessary and also allow them to see more if they are interested in more depth as to how it works.
- The product is just one application which is agnostic to content; can have the videos arrayed on menu and then it just runs it; can focus on specific department but would be good to be able to use multiple.
- An option to select a language, either French or English, would be ideal but not mandatory.
- The whole software will be able to provide clear instructions for the patient to follow (By text, Audio, or both); Ex: lie down to begin video playback.

After recognizing all of the clients needs and ideals, we discussed the relative importance of all the needs and came up with the priority of things that need to be implemented.

First and foremost, the application must successfully display stereoscopic video content simulating the experience of various medical treatments which is provided by the user, in this case the Ottawa Hospital. Once this is accomplished, the main menu should be made modular so that different options can be selected with respect to video playback so that the client is not wasting time viewing content which is not relevant to them. Once this is accomplished the option to select a language preference should be implemented so that the application software is bilingual. This software platform needs to be created in a way that is user-friendly for both the hospital and the client.

Problem Statement

Create a user-friendly interface for a virtual reality program that allows patients of the Ottawa Hospital and their loved ones to simulate medical treatments by watching 180° stereoscopic videos to educate themselves on their upcoming experience and browse through applications all while allowing hospital staff to easily upload videos and update the program as required.

Comprehensive list of design criteria

- Allow hospital to upload various files
 - ◆ (Stereoscopic 3D video files, .WAV files, subtitles, etc)
- Shows patient stereoscopic video
- Lasts entire duration of treatment without problems
- Audio/Text prompts to guide patient
- Interface is easy for patient to navigate
- Experience is comforting for patient
- Experience is educational/informational for patient
- Design should be adaptable for others in the hospital to use
- Modular design
- Makes sure patient is in the right orientation
- Application should be agnostic to content
- Option to switch between languages

How did the Client meeting impact our design criteria

Functional requirements

The Client Meeting allowed us to get a full scope of this project and a greater sense of what direction we must take. Our design criteria before were nebulous and not enough to begin work on our project. Before the meeting it wasn't immediately clear if we were suppose to alter or create the videos ourselves but now we see our project is solely focused on the software and not the actual content. By meeting with the client we now understand that the primary goal of the project is to create a user friendly interface to access the stereoscopic video content for patients to view video content provided by the hospital. Following this meeting, we came up with a variety of functional requirements, non-functional requirements as well as constraints which we will use to determine our feasible design criteria.

Design Criteria for every need

The application should have a design criterion implemented for every need the patient might have. Below are the list of needs, along with the characteristics/requirements of the functions.

- The product/software is simple and basic for the patient to navigate through with ease.
- The application is streamed to both the patient and the hospital staff simultaneously, so that the staff is able to assist the patient should any questions arise.
- The application is user friendly and customizable; that way, the patient/nurse can be able to alter whatever they want in the app. Example: What is shown in the menu/homepage, how they want it to be displayed, etc...
- The application provides different options in regards with how to interact with the patient; adding audio, adding subtitles, both, language choice etc...
- Menu/ homepage should be easily accessible, i.e The patient can just easily click a button to access the menu at anytime while watching the videos.

- An option is also available within the application to call for assistance/staff, that way the patient doesn't have to pause or take off the VR headset to call for help.
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- Show the patients high-quality stereoscopic videos
 - Reliable so that the experience lasts the entire treatment without interruptions
 - The interface has to be simple enough that the patient can navigate through it without difficulty
 - The software must be easy enough that hospital personnel can add videos easily without much training.
 - Software must be compatible with the Oculus Quest
 - Software should be easily used by all-ages (children to adults) and all patient conditions
 - Software could be controlled remotely by personnel
 - The software must make the patient feel entirely immersed in the experience in order to reduce stress
 - The immersive experience should be somewhat connected with the treatment operation, even giving basic instructions to the patient such as lie down, sit up, etc...
 - The software must be useable by all departments in the hospital

Non-Functional Requirements

- The software can include a separate area for kids compared to adults with a more friendly interface
- The software can include a French/English toggle for the user to select their preferred language
- There can be additional scenery within the software to include experiences like sitting in the waiting room

Constraints

Constraints	Relation	Value	Units	Verification Method
Ease of use	=	Yes	N/A	User feedback
Runs on Oculus Quest	=	Yes	N/A	Tests

Customizable	=	Yes	N/A	User feedback
Modular design	=	Yes	N/A	User feedback
Content agnostic	=	Yes	N/A	Tests
Multiple file types	=	Yes	N/A	Tests
Languages	=	Yes	N/A	Test
Controlled remotely	=	Yes	N/A	Test

Metrics

A metric which can be measured at the very end of the project by the client is customer satisfaction. This can be measured on a scale from 1-5 with 1 being unsatisfied and 5 being extremely satisfied.

Throughout the design process itself, we can use several metrics to measure the functionality of the design. One of these metrics is versatility, which can be ranked based on the platforms the software is supported on, such as solely on the VR headset, on a laptop, tablet, or cell phone. We can also measure the performance of the software in its response pace, as well as the quality of the user interface display.

Most Important Design Criteria

The most important part of this project is ensuring a fully functional stereoscopic video display platform which will allow for the Ottawa Hospital to upload content to be viewed by its patients. Although ideally it will be user friendly, modular and easy for the client to modify, our first priority will be ensuring its successful function. Once the basic function is implemented we will work on implementing the other design criteria until we have a fully functioning product.

Problem Statement and Target Metrics

Problem Statement

Create a user-friendly interface for a virtual reality program that allows patients of the Ottawa Hospital and their loved ones to simulate medical treatments by watching 180° stereoscopic videos to educate themselves on their upcoming experience and browse through applications all while allowing hospital staff to easily upload videos and update the program as required.

Design Criteria

From previous deliverables, we have established an assortment of design criteria which would be ideal for our project to have. These design criteria vary from being functional to non-functional requirements. The main requirement is that the hospital needs to be able to upload various stereoscopic 3D video files, .WAV files and subtitles to the software quickly and easily. This uploaded content must be able to be viewed by the hospital patients clearly and effectively. The software should allow the videos to run for the entire duration of the treatment without any problems with audio and text prompts to guide the patient. The interface should be easy for the patient to navigate allowing for a comforting, educational experience for the patient. The design should be adaptable for other departments in the hospital to adapt to with a modular design agnostic to content. Lastly, there should be a bilingual option where the patient can select the french or english language according to their preference.

Benchmarking

A British Columbian Children's Hospital has given VR headsets to children during procedures to distract them and reduce their stress and pain levels. They show the children a Virtual-Reality roller-coaster which allows them to forget about the procedure. Their goals and ours are the same; to make the overall operation less stressful and intimidating to the patient however we differ in execution of that goal. We are focused on educating the patient before the operation while they are distracting the patient during the operation.

BC Children's Hospital Solution	
Ease of use	High
Feasibility	High
Interoperability	Low
Support	Low

Customization	Med
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Subsystem Design Criteria

Our conceptual design has been separated into 6 different subsections. Most of these subsections have their own menus, which we have divided our design criteria for accordingly as shown below:

4.1 Language Selection Menu

- Allow patients to select their preferred language

4.2 Settings

- Allow staff to add/remove video content easily without having to deal with certain code
- Allow staff to access certain important settings such as volume, video quality, etc.
- Does not allow patients to access this section with the help of a secure password.

4.3 Treatment Selection Menu

- Allows patients to access the different videos of the various treatments they can undergo

4.4 Video Playback Selection Menu

- Allows patients or hospital staff to pre-select the video options for automatic play back
- Patients can select a few or all of the videos according to the type of treatment and their interest in getting a preview of it

4.5 In-Video Options

- Give the patient the option to pause, fast forward/reverse in the video during the treatment
- Allows patient to change minor options such as volume

4.6 End of Video Screen

- Screen letting the patient know that the video/treatment is done.
- Has the option of returning to the main menu

Refined Design Criteria

Design is one of the most crucial elements of this project. The premise of the project revolves completely around its design aspects, as they are integrated into every category in our application. From the broad main menu, to the video play settings, our design focus is on simplicity. The design plays a huge role in the interaction between the user and software, so simplicity is key for efficiency. However, our basic design structure does not sacrifice our coverage of all the intricate crucial details that our interface needs. Meaning that all designs serve a purpose in the application, to make the interface as easy as possible for the user to use and to provide all the necessary implementations(buttons/options for the user to click) needed to achieve that. Our final and revised design criteria covers all aspects (big and small) of the interface, and the list goes chronologically as follows:

- In the VR set, a display of two doors first appear, each door corresponding to a language- one in French, one in English. The user's selection of the door will dictate the language of the whole application when he/she starts.
- Once the user chooses his language(door), it will shift the user to a selection screen of kids on adults, and based on the selection, the application will take a different shift of view (for kids display more colors, be more vibrant etc..).
- Now the user is in a hospital waiting room setting, with a "hospital looking like" form in front of them with the list of treatments he/she want to view.
- Once clicked, that particular treatment video will start playing.
- The in-video play options allow playback, pause, volume increase, and exit to main menu.
- Once, the video is over, an option screen will pop up asking the user whether he/she wants to go back to the main menu and select another treatment or end right there

The listed following design elements above show a beginning to end display that the user will encounter while the application is running.

Other design features that are not listed above include:

1. Subtitles during video play of the treatment
2. Allow the same exact interface to be displayed to the nurse, in a way which they can interact with it the same way the patient can
3. Allow a medium for video files (of treatments) to be stored and transferred to the menu of the application, that way the hospital can choose to add/omit treatment videos whenever they choose to.

Solutions Generated from Refined Design Criteria

Solution 1

Use youtube's 'cardboard' solutions in order for patients to watch these videos in the hospital. Hospital staff would upload their videos onto youtube and patients would browse playlist and pick their preferred video.

Solution 2

Design our own basic application that only involves hospital staff uploading and playing videos for patients with no other extra features.

Solution 3

Design our own more complex application that allows hospital staff to upload and play videos, but also features virtual environments like a waiting room or doctor's office. Have options for patients to choose their own path of videos to watch.

Selection Matrix

Solution	Solution 1	Solution 2	Solution 3
Ease of use	High	Med	High
Feasibility	High	Med	Low
Interoperability	Low*	High	High
Support	High**	Low	Low
Customization	Low	Low	High

* Due to the reliance on youtube and not unity there will be lack of support for unity, oculus, and HTC devices.

**Reliance on youtube ensures that device will always be supported as long as the phone is up to date.

Chosen Concept

After analysis using the selection matrix, the option that has the best optimal outcome is the third solution. Although the first and third options have equal amounts of high and low rankings, the third one has less

dependence on the interface and its consequential function. Since the third option does not rely on Youtube, it is one less component we need to concern ourselves with making sure our program is compatible with. This solution is the one which we will use our refined design criteria to base the entirety of our project around.

1. A list of all the tasks which need to be completed, an estimated duration for each task, as well as who is responsible for each task
2. A Gantt diagram (preferably made using MS Project), which includes all significant project milestones and all dependencies.
3. A list of the significant project risks and your associated contingency plans to mitigate the critical risks that are reasonably likely
4. An estimate of the cost for all components and materials which you will need for the different prototyping deliverables described above

Completed Project Plan

Tasks to be Completed

- Video Display
- Menu Options
- Language
- Pause/play
- Presentation
- Deliverables
- Aesthetics
- Client Uploads
- Final Report
- Pre-settings
- Kids mode
- VR Testing
- Make gantt chart
- Combine all components

Tasks to be completed	Duration of Task	Person/People Responsible
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Video Display	1 week	Victor
Menu Options	1 week	Stephanie
Language	Two weeks	Mohamed
Pause/Play	1 week	Victor
Presentation	4 days	Mohamed
Deliverables	N/A	All members
Aesthetics	1 week	Stephanie/all members
Client Uploads	1 week	Faris
Final Report	4 days	Stephanie
Pre-Settings	1 week	Cooper
Kids Mode	1 week	Andrew
VR Testing	1 week/as necessary	All members
Make Gantt Chart	4 days	Faris
Combine all components	1 week	All members

Gantt Diagram



Project Risks and Contingency Plans

To determine the Project risks we conducted a feasibility study by discussing the five TELOS factors

Technological: Our team is very confident that the project idea put forward is possible to create within the confinements we are working in. One problem that may come up is integrating our separate subsystems together. We have given ourselves enough time if we are having trouble creating a cohesive whole to the interface by making sure that the subsystems are finished early.

Economic: We are given \$100 dollars but at this point our team cannot think of any

cost related to this project.

Legal: There is no legal worries involving this project as long as our project design in no way harms the client. There is currently no patents on the design we are making.

Organizational: To succeed in our project our team must become competent in both Unity and Oculus. It is the first time for most of our team dealing with this software so it is very important that we put in time to learn as well as share information among our team. One risk is that some sub systems may be too difficult given our experience with the software but we can overcome this by working together and expanding our knowledge.

Scheduling: The scheduling of the project will be done through a gantt chart that we all put together collectively. In the gantt chart we have divided the tasks equally taking into consideration each team members capabilities and time restrictions. This project must be completed by November 21th. This gives us a flexible and very manageable timeframe to design and build the VR interface. Our team has planned to complete most of the foundational coding such as the video display early.

Estimated Cost of Components

We found a hospital waiting room setting which would be perfect for our display menu. The cost of this scene is \$20. We will look at the possibility of designing our own waiting room scene for the aesthetic, however if we are running out of time and designing it becomes difficult we can purchase this scenery and integrate our menu options into it.

The rest of the material which we need to design our interface is available on the Unity store for free. There should be no other major costs associated with this project.

Future Work

In the future we can expand upon our final design with subsystems that will enhance the quality of the experience. One such change would be to streamline how doctors would upload subtitles to the videos. They would simply write the subtitles into a text file and our code would then display that as a text box within the video. We can also build upon the menu subsystem by fully integrating a french and english option.

CONCLUSION

Our team is very satisfied with the final iteration of our VR project and have accomplished what we set out to do. There are still ways to expand and improve upon our design however our design delivers on showcasing the stereoscopic video while providing the hospital staff an easy way to upload new videos as well as a having a functional and immersive menu system that is easy for patients to navigate.

APPENDIX: Design files

<https://makerepo.com/amill161/virtual-reality-medical-experience-simulation-for-the-ottawa-hospital-b15>

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