# DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
# THE UNIVERSITY OF TEXAS AT ARLINGTON

# PROJECT CHARTER
# CSE 4316: SENIOR DESIGN I
# SPRING 2023



# VR NURSING TEAM
# VR PALLIATIVE CARE

CESAR CANTU-PEREZ
BRADDOCK BRESNAHAN
CARLOS CRUZ
NELSON LAM

## REVISION HISTORY

| Revision | Date | Author(s) | Description |
|---|---|---|---|
| 0.1 | 02.16.2023 | CCP | document creation |
| 0.2 | 02.17.2022 | CCP, GH, NL, BB, CC | complete draft |
| 2.0 | 02.17.2022 | CCP | Updated for V2 |

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# 1  PROBLEM STATEMENT

The Nursing program at the University of Texas at Arlington currently does not have a simulation for hospice care available to their students. To ensure that the nursing students have adequate experience with patients on hospice care, the nursing program has decided to commission a virtual reality simulation of hospice care. This simulation has already been developed and worked on by various computer science teams made of up computer science students. Fine tuning the product of these various teams and allowing the nursing students to receive experience that can easily translate to the real world is our goal.

# 2  METHODOLOGY

Our methodology will consist of reviewing and analyzing the work that the other teams have put into the virtual reality simulation so we can add planned features that are still missing or not working. We will fix any bugs left over from the previous development. Making sure all scenarios are brought together in a cohesive package while maintaining a stable frame rate will also be necessary. We are also going to optimize the simulation for wireless headsets.

# 3  VALUE PROPOSITION

The nursing program will benefit from the virtual reality simulation by being able to use the simulation to give the nursing students the opportunity to explore the fundamentals of hospice care in order to prepare them for real world application. Having members of the nursing program test the simulation will help us create a more realistic feel for nursing students.

# 4  DEVELOPMENT MILESTONES

This list of core project milestones should include all major documents, demonstration of major project features, and associated deadlines. Any date that has not yet been officially scheduled at the time of preparing this document may be listed by month.

Provide a list of milestones and completion dates in the following format:

- Project Charter first draft - February 17, 2023

- System Requirements Specification - March 20, 2023

- Architectural Design Specification - April 2023

- Demonstration of Movement - June 2023

- Detailed Design Specification - June 2023

- Demonstration of Optimization - July 2023

- Demonstration of Bug fixes - July 2023

- Final Project Demonstration - July 2023

# 5    BACKGROUND

The University of Texas at Arlington's Department of Nursing wants a simulation in virtual reality that allows its user to take care of a patient on hospice care. The representatives of the Department of Nursing are Jennifer Roye and Shawn Gieser. Shawn Gieser is our main point of contact for any technical questions or issues we may experience effectively serving as our manager.

The reason the Department of Nursing has commission this virtual reality simulation is that the Department of Nursing has no effective way to prepare their students for end of life (hospice) care. Hospice care is needed when there is nothing that can be done to save the patient's life. It is much different than other forms of healthcare as nurses no longer need to think about how to prolong someone's life. Instead, nurses think about how their patient can live their final days comfortably and without pain. Due to the nature of hospice care, the nurses must also be able to deal with the patient's families and help them through this difficult time. Hospice care is emotionally difficult for the patient, their family, and for the nurse as well. Watching the patient live out their final moments is exceptionally difficult and nurses need to be trained to be able to handle that sort of situation. Due to this difficulty, it is imperative that nurses be exposed to that type of environment before heading into the real life workforce.

The pallative care simulation will give nurses the training they need to be able to excel in a hospice care situation. The nurses will gain experience in taking care of an elderly individual with a terminal disease. The nursing students will also be dealing with the patients family so they can have an understanding of how they should act towards the family. The pallative care simulation will be developed with the nursing students experience in mind so as to be able to recreate the feeling of being in a hospice care scenario and because this will be a virtual reality experience, the nursing students should find that it will be much easier to immerse themselves in the hospice care scenario.

# 6    RELATED WORK

Some current solutions for optimizing the performance of the project with be optimizing the graphics. With the Unity Game one can set up a multitude of different features to speed up the processing of graphics. For instance, light baking allows the engine to pre-render the lighting for a static map. [3] Occlusion culling cuts down on the workload of the GPU by not rendering objects that are off screen. Another technology that unity offers is dynamic resolution. [1]

A related work that will be similar to the finished product is known as Ubisim. Ubisim is a virtual reality simulation made to train nurses for a variety of scenarios. Ubisim has their own headset and controllers owned by the Ubisim Company. Users have the ability to modify scenarios and choose different medical equipment to use. This is helpful if a nurse requires experience in a specific machine. It runs on wireless VR headsets and uses hand gestures to interact rather than the traditional point-and-click menu. Ubisim's price is flexible based on the size and scope of the Department requesting it. [4]

Another related work is called SimX. SimX is a cross platform VR simulation for nursing practice. It has a highly customizable environment with over 300 tools and procedures. It also includes over 30 different environments and over 150 different patient models. This VR simulation also is cross platform meaning it can run on different headsets such as the Meta Quest 2 and the HTC Vive headsets. SimX also allows for multiplayer gameplay so nurses can practice working together as well. One of SimX's selling points is their extensive post simulation reports designed to give the nurses in-depth information on their performance. [2]

# 7    SYSTEM OVERVIEW

To implement our solution each sprint we will research different areas of interest where the possibility of optimization exists. The most important aspect of implementation will be to ensure the stability of different solutions added to the project, as well as making necessary changes where needed. The areas of

possible optimization that we will be looking at include graphics, scripts, and object loading/offloading. Throughout the project we will be recording and comparing the performance of game builds as we progress. Each sprint will be variable in the performance increase but the project will be a success if it runs stable around 60 fps untethered.

## 8   ROLES & RESPONSIBILITIES

The following table displays the division of roles for this project. For the most part, the role of scrum master will be flexible to change as needed. Our point of contact will be responsible for scheduling meetings and communicating with our product owner, however all developer team members will be responsible for attending scheduled meetings with said product owner.

| Role | Name(s) | Responsibilities |
|---|---|---|
| Product Owner | Jennifer Roye, Shawn Gieser, Nursing Department | • Communicate the vision of the product to the team's point of contact. |
| Point of Contact | Cesar Cantu-Perez | • Maintaining communications with product owner and stakeholders. <br> • Communicate the product owner's vision to the rest of the team. |
| Scrum Master | Role will change from sprint to sprint | • Organize meeting times. <br> • Make and present sprint power points. |
| Developers | Carlos Cruz, Cesar Cantu-Perez, Braddock Bresnahan, Nelson Lam | • Research different means of optimization in Unity. <br> • Coordinate with other teammates on tasks. <br> • Test code changes and implementations for bugs/errors. |
| Stakeholders | Shawn Gieser, Jennifer Roye | • Help in providing direction to the team. <br> • Provide the team with resources needed to work. <br> • Provide funding for needed resources. |

## 9   COST PROPOSAL

Most of the funding received by the Computer Science and Engineering Department is going to be used for this product. Between getting another VR headset for the group and the cost of Plastic, a version control software, our budget will be very tight. We may need to get a few assets if necessary as well.

## 9.1 PRELIMINARY BUDGET

| Item | Quantity | Approximate amount |
|---|---|---|
| Meta Quest 2 headset | 1 | $400.00 |
| Plastic | 1 | $300.00 |

Table 1: Approximate costs for the VR simulation

## 9.2 CURRENT & PENDING SUPPORT

All of the funding will be provided by the Computer Science and Engineering Department at the University of Texas at Arlington. They amount the CSE department is able to provide is $800.00 and that will be all that the team will be able to work with unless the team submits a request for more resources.

## 10 FACILITIES & EQUIPMENT

The lab space has been provided by the Computer Science and Engineering Department of the University of Texas at Arlington. The room that currently contains the virtual reality simulation along with the headsets is in the Engineering Research Building(ERB) in room 202. Room 202 is designated as a senior design lab meant for teams to work on their projects. This means that other teams will also be sharing the same room and may be present while the VR team is working. For the VR simulation this may pose a problem as adequate space is needed to interact with the virtual environment. When the room is empty other than the team however, there is ample space for a user to test the vr simulation wearing the Quest 2 headset. For the Palliative Care Simulation there are currently 3 Meta Quest 2s (and another headset being purchased to make 4 headsets) and the PC that is holding the previous team's code for the simulation. For user testing, the VR team will invite other nursing students to the lab to test the simulation and receive their feedback. There should not be a need for a different room or location on the UTA campus to work on the VR simulation unless the Nursing Department has a specific request for a room in a different location. Team meeting will either be remote on Microsoft Teams or Discord, or be in person in room 202 of the ERB.

Off campus the team will be able to work on the simulation remotely in their own homes. To do this, each team member must already possess computer that is powerful enough to run Unity Pro Student. The team will be able to work remotely with the help of Plastic which some of the budget has already been allocated towards. The team may also require the use of the Unity asset store to aid in polishing and adding any new features. It may not be possible to use the headsets outside of the senior design lab (ERB 202) but it is still possible to write and edit scripts needed for the simulation to run. This means that the task of optimizing the simulation can also be achieved at each team members' home.

## 11 ASSUMPTIONS

The following list contains critical assumptions related to the implementation and testing of the project.

- A lab space and computer will be provided by CSE department.

- The team members will be able to use Meta Quest 2 headsets.

- A member of the Department of Nursing will be available to test the simulation.

- There is still many bugs and features missing from the simulation.

- The VR headsets will not be tethered to the computer making the simulation rely on only the GPU on the headset.

## 12  CONSTRAINTS

The following list contains key constraints related to the implementation and testing of the project.

- Final prototype demonstration must be completed by August, 2023.

- The simulation must not take longer than 30 minutes to complete.

- Testing and simulation will be restricted to the senior design laboratory.

- Senior design laboratory will only be accessible by the development team during normal business hours

- Total development costs must not exceed eight-hundred dollars, unless the grant is given to the project of which the budget, or the cost limit, will be determined with the sponsor.

## 13  RISKS

The following high-level risk census contains identified project risks with the highest exposure. Mitigation strategies will be discussed in future planning sessions.

| Risk description | Probability | Loss (days) | Exposure (days) |
|---|---|---|---|
| Scheduling conflicts between team members | 1 | 1 | 1.0 |
| Inclement Weather | 0.01 | 5 | 5.0 |
| Team members are inexperienced in Unity | 0.50 | 7 | 5.0 |
| VR not working | 0.05 | 1 | 1.0 |
| Understanding previous team's code and design structure | 1 | 7 | 7.0 |

Table 2: Overview of highest exposure project risks

## 14  DOCUMENTATION & REPORTING

### 14.1  MAJOR DOCUMENTATION DELIVERABLES

#### 14.1.1  PROJECT CHARTER

The Project Charter will be updated when a change has been made to the above sections. For example, if we need to update a development milestone, or if we discover a new risk. The first version will be delivered on February 20th, 2023 and the final version will be delivered May 15, 2023.

#### 14.1.2  SYSTEM REQUIREMENTS SPECIFICATION

The System Requirements Specification will be updated after each meeting with the sponsor. This will ensure that the sponsor knows the changes we will be making to the document. The first version will be delivered on March 20th, 2023 and the final version will be delivered May 15, 2023.

#### 14.1.3  ARCHITECTURAL DESIGN SPECIFICATION

Due to this group's purpose for this project, bug-fixing and polish, we may not need to update this document. However, if we do need to make changes, the ADS will be changed with group consensus. The first version will be delivered on July 1, 2023 and the final version will be delivered August 7th, 2023.

### 14.1.4  DETAILED DESIGN SPECIFICATION

The Detailed Design Specification document will be maintained in the same way as the Architectural Design Specification document (see above). The first version will be delivered on July 1, 2023 and the final version will be delivered August 7th, 2023.

## 14.2  RECURRING SPRINT ITEMS

### 14.2.1  PRODUCT BACKLOG

Items from the SRS will be added to the product backlog. These items will be prioritized by the method stated in the SRS. Beyond that, items can be added to the product backlog with group consensus.

### 14.2.2  SPRINT PLANNING

Each sprint plan will require a meeting of all group members. Currently, team meetings are held weekly so if it is the beginning of a sprint, the meeting will be primarily dedicated to spring planning.

### 14.2.3  SPRINT GOAL

The sprint goals will be decided by the group. There will be occasional meetings with the sponsor to discuss what is being, and what should be, worked on.

### 14.2.4  SPRINT BACKLOG

The team and the sponsors will be responsible for managing the sprint backlog. A project management software such as Trello may be used for maintaining a backlog and is up to the product owner for that sprint.

### 14.2.5  TASK BREAKDOWN

The scrum master will propose a division of tasks based on the sprint backlog to each individual member. If an individual has other commitments and cannot take on that many tasks, another member can take the task or the number of tasks can be reduced by pushing low priority tasks to the next sprint.

### 14.2.6  SPRINT BURN DOWN CHARTS

The scrum master is responsible for generating the burn down charts for each sprint. The team will have a shared excel spreadsheet to keep track of each individual team member.
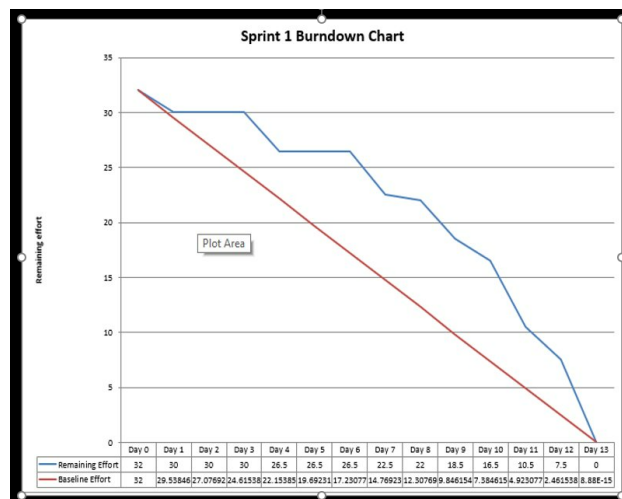


Figure 1: Example sprint burn down chart

### 14.2.7 SPRINT RETROSPECTIVE

The Sprint Retrospective will be held during the team meeting after the Sprint Review presentation. We will document the changes we make as a group and what each person's responsibilities for the next sprint are.

### 14.2.8 INDIVIDUAL STATUS REPORTS

Status reports will be verbally conducted during each team meeting. It can also be conducted through team chats online.

### 14.2.9 ENGINEERING NOTEBOOKS

Each team member is responsible for their own notebook. There is no minimum requirement for update intervals; however, it should be updated to record progress, ideas, meetings, and major changes to the project, along with any other information. Team members are held accountable through ENB assignments, where scanned pages are submitted for review.

## 14.3 CLOSEOUT MATERIALS

### 14.3.1 SYSTEM PROTOTYPE

Our final system prototype will include a packaged Unity project. The project will be demonstrated in a video submitted early August and will be published on the group's page of the UTA CSE Senior Design blog. Field acceptance testing will be conducted with the Nursing school.

### 14.3.2 PROJECT POSTER

The poster will have dimensions of 3x4 feet (36"x48") and will include the project vision, mission, architectural design diagram, key requirements, and future work, along with in-game screenshots of the simulation. The poster will be delivered in early August.

### 14.3.3 WEB PAGE

The web page will include the name of our team and all members, our active time as a team, and our sponsors. It will have sections for an abstract, background information, project requirements, system overview, results, and future work, along with links to our project files, a demo video, and any additional references. It will be finalized early August.

### 14.3.4 DEMO VIDEO

In our video we will be be presenting the major changes we made to the project and demonstrate that it runs as smooth as butter.

### 14.3.5 SOURCE CODE

The source code will be contained on Plastic. The previous team currently has the source code on the PC in the lab in ERB 202. It is currently unknown if the sponsor has access to the source code or if the sponsor plans to keep this as an open source project.

### 14.3.6 SOURCE CODE DOCUMENTATION

Although no code has been written thus far, the team plans on using a tool to organize the code such as doxygen to generate the documentation and a browsable HTML for the final documentation. The reason for this is to provide an organized and easy-to-access documentation for future teams and/or as this project is adopted by others.

### 14.3.7  HARDWARE SCHEMATICS

There are no hardware components that the team will be developing themselves. There will only be pre-made hardware that must be used such as a Quest 2 VR headset and controllers that the customer is assumed to be equipped with.

### 14.3.8  CAD FILES

There is no aspect of the project that involves mechanical design.

### 14.3.9  INSTALLATION SCRIPTS

This program runs on Unity which has the means for building the code base for different platforms on its own. The sponsor may use Unity's own building tools to port the project over to other platforms.

### 14.3.10  USER MANUAL

The sponsor will be provided a tutorial for users to learn how to interact with the game world.

## REFERENCES

[1] Unity Documentation. Graphics Performance Fundamentals, 2021.

[2] SimX. Virtual Reality Medical Simulation, 2023.

[3] Unity Technologies. Optimizing your VR/AR Experiences, 2020.

[4] Ubisim. A Complete Immersive Virtual Reality Lab, 2023.