SIT383 – Design Document

Team Cardiac Arrest

Members

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Project Goal

The project's goal is to create an interactive educational VR/AR application that will assist doctors and nurses learn how to use a pacemaker. In the current state of the world, face to face classes are much harder to make happen, so most people prefer to learn online. The problem presented to us by our industry contact is nurses are well trained in pacing using emergency pacemakers but lack the confidence to use these devices in these situations and this anxiety can lead to pauses, mistakes and sometimes loss of life. Our app aims to provide these nurses with exposure to these situations so they can practice in a safe environment and receive feedback. By the time they finish self-training and are involved in these situations with some level of risk, they can feel ready to take on the task.

Initial Opportunities

Below are the contributions to the creation of the concept of our design.

Aya

Score system with how well nurse did keeping the blood pressure out of amber.

Sounds for turning clicks (phone vibrations), lights flashing, connect cords at start.

Emotional support for nurses who failed.

Simple as layout for clarity. I'm pretty sure we will get a list of the necessarily elements.

Hold and swipe option in a clockwise/anticlockwise motion for twisty bits.

ECG display

Blood pressure gauge

Chris

Having the app log the users' attempts so they can review their actions to see what they have done right and wrong.

Ratings to show the user where they can improve.

Teacher interacts with the patient heart through hand gestures, setting the heart rate or pressure with a scale

Have the user look around in the AR space by moving their phone around, rather than having everything on screen at once? (I assume that the nurses can't see the patient, monitor and device at once)

Phil

AR Pacemaker appearing on the table (For size comparison)

Can otherwise have a heart to represent what the doctor/ nurse can't usually see.

Have the app trace a table to make it look like a pacemaker with the knobs being interactable.
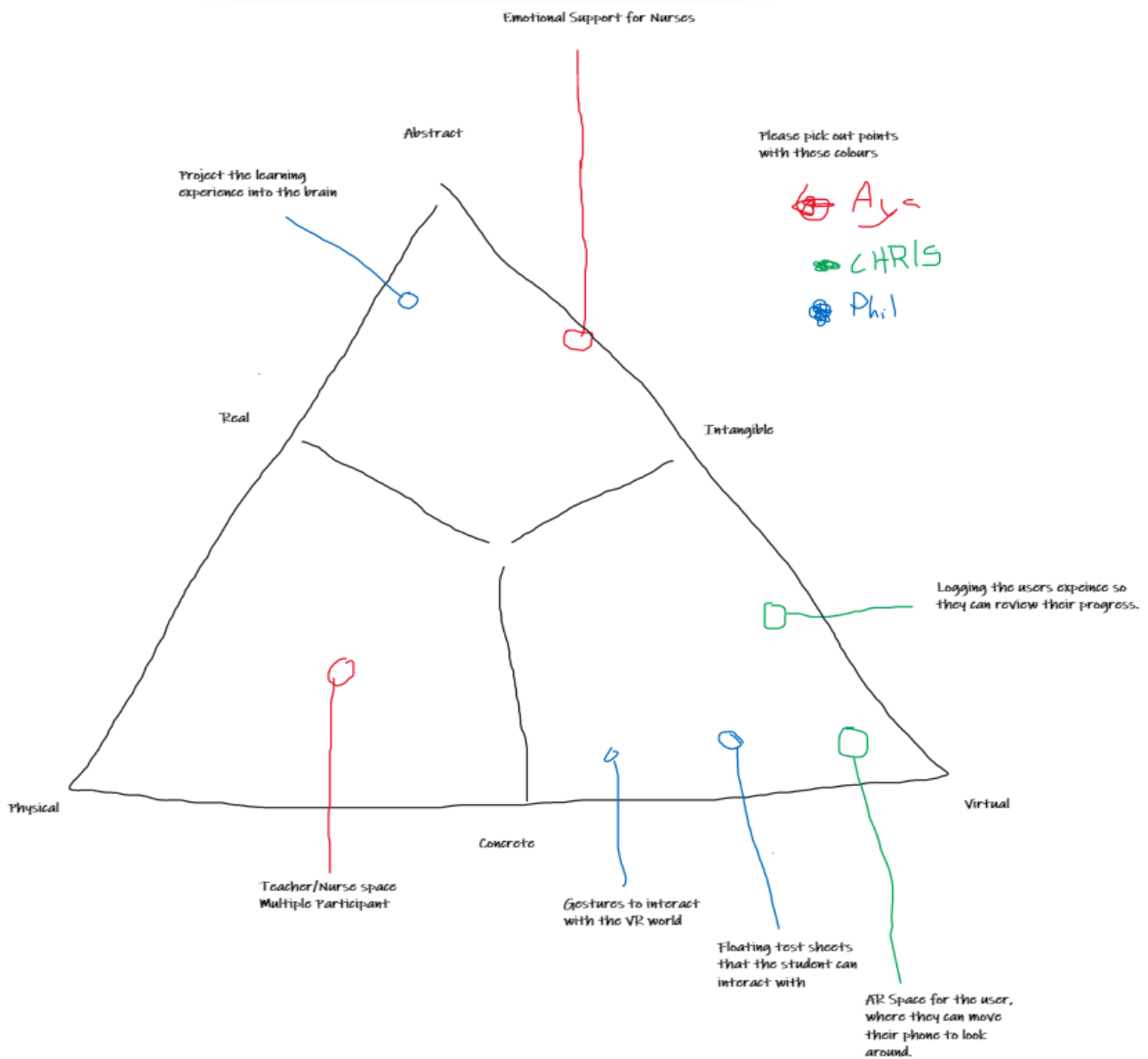
Pick the order type events for connecting the pacemaker with the heart.

(Abstract) Project to the brain with the application instead of keeping it on mobile.

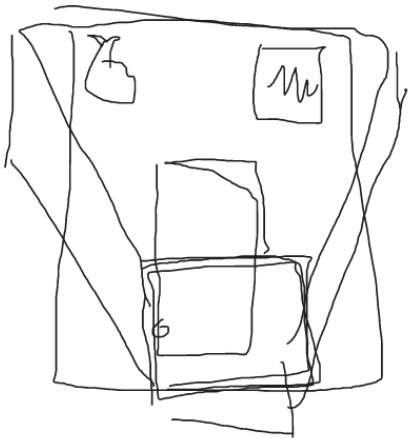(Abstract) Making doctors feel bad for failing.

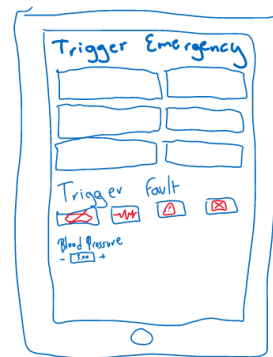Hand gesture detection to turn knobs of the pacemaker.

Classification

Emotional Support for Nurses

Abstract

Please pick out points with those colours

Aya

CHRIS

Phil

Project the learning experience into the brain

Real

Intangible

Logging the users expeince so they can review their progress.

Physical

Virtual

Concrete

Teacher/Nurse space
Multiple Participant

Gestures to interact with the VR world

Floating test sheets that the student can interact with

AR Space for the user, where they can move their phone to look around.

Individual ideas

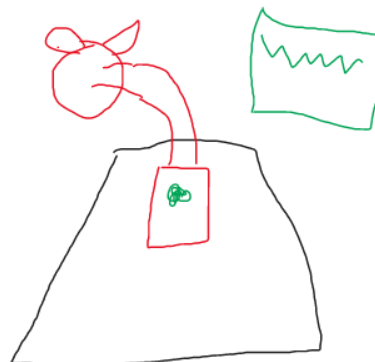| Aya	
The 3d space available to the player as seen through and iPad with the pacing device, ECG monitor, and a visualisation of a heart for the user to orient the device toward.	The flat/phone screen version of the teacher/mentor to test the nurse's capacity with a variety of modification to the heart including specific heart events that may occur in real life situation (provided by contact)
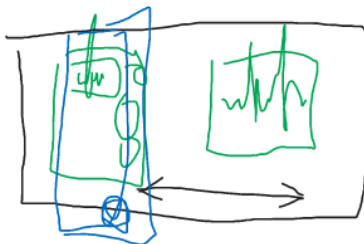
Chris	
Sketch to convey moving the phone to see more, here they can only see the pacemaker or monitor individually and must move the phone to change.	Potential layout for the key aspects of the virtual environment. Shows the pacemaker connected to the heart and the monitor to the right.

Interactive test sheet for attaching wires to the heart

2	4	2	3	5	6

Phil

teacher's Phone

Trigger Emergency

Trigger Fault

Blood Pressure
− 500 +
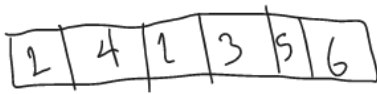
Interactive test sheet for attacking pacemaker to heart (Represented in AR space)
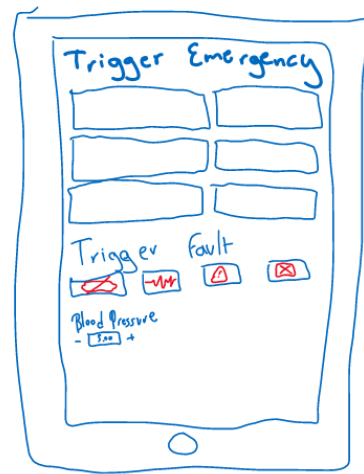
Display on teacher's perspective that manipulates state of patient, with camera button for monitoring.

Nature of the prototype

This app's goal is to prepare nurses in a real-time virtual environment through cellular devices and other optional tools using visual tracking for heart pacing. This app provides a variety of tools such as an initialisation test, the pacing process, and an optional teaching tool with heart control and camera view options so that a mentor can monitor or mentor the nurse in training. This will prepare the nurses for the real-life situation and reduce the nerves and failure that comes with lack of confidence with the procedure.

The initialisation test goes through the card typically given to nurses and doctors regarding what order to add the device to the heart and turn it on safely. It can be done as a VR experience through the phone or a swipe test of randomly order steps. Swiping left and right between the steps and swiping up to select/remove the option from the set. (Given the opportunity this could extend to procedures outside of pacing). Optionally, the

The pacing will involve the nurse having a view of the heart monitor and the pacemaker and use a combination of visual/audio/haptic feedback to modify the representation of the device and reorient the phone to see the heart monitor for results of their changes before swinging the phone back to the virtually placed pacemaker. There will be a variety of additional information such as a blood pressure gauge and encouragement or tips for nurses as they go on which can be switch off in the settings. At the end of the pacing session, a nurse will receive a review of their performance.

Lastly, we can add the element of a teacher or mentor altering the student's experience through a different part of the app. This addition provides the mentor with the ability to trigger an emergency instead of being randomly generated by the program. They can also adjust blood pressure and other medical issues that may occur during the pacing session through either the phone screen or a virtual display they can be panned over with the phone in 3D space and respond to gestures.

Task board

Task	Output	Validation	Who	Pre-reqs	Required for	Start-End	
3D Imagery (Initialisation test)	Floating heart and pacemaker with wires	Both Teacher and participant can view the operating surface and the 3D model of the heart.	Aya		Creating a visual understanding between the order of the steps and the feedback	Wk 4	Wk 6
Answer selection (Initialisation test)	Rectangles with numbers, with a selector that can move on top, depending on the input of the participant.	Participant can see and manipulate the selection rectangle to select an answer.	Phil			Wk 4	Wk 6
Feedback (Initialisation test)	Response after an answer was selected.	Participant can see if their answer is correct or not, by looking at the animation of the 3D imagery.	Chris	Answer Selection (Initialisation test)		Wk 4	Wk 6
Pacing simulation space (Pacing simulation)	3D space	Camera placed in 3D environment for user to be able to 'look around' in using the phone gyroscope/orientation.	Phil		The virtual space is a prerequisite for Device position tracking. We need to be able to adjust the tracking based on the virtual space.	Wk 7	Wk 9
3D Imagery (Pacing simulation)	3D models for the Pacing device, the monitor, patient & their heart.	We have 3D models for all the components requires that clearly represent what they are.	Aya	3D Imagery (Initialisation test) (the assets should be able to be re-used here)	The 3D models are vital to the project as most of the user's interaction is based on the models. Most tasks need to be "linked up" with these models for the final product.	Wk 6	Wk 7
Interaction with virtual devices (Pacing simulation)	Make a UI for the relevant devices so that user can interact with them.	We will have a system that allows a user to control the virtual pacemaker device.	Chris	3D imagery (pacing simulation)		Wk 7	Wk 9

3D Position tracking (Pacing simulation)	Implement method to track where the user is 3D space in the app	We will be able to track the virtual rotation and location of user.	Chris	Virtual Space		Wk 6	Wk 8
Gestures (Pacing simulation)	Gesture implementation for interaction with the pacemaker	Participants will be able to interact and manipulate the 3D model of the pacemaker via screen swipes, tap and drags, pinch and spread.	Chris			Wk 8	Wk 10
Online Connectivity (Teacher features)	Create a network structure to allow teachers to join students to enhance the learning experience.	We have a network infrastructure that allows multiple users into one session, it can distinguish between students and teachers.	Aya			Wk 8	Wk 10
Camera view (Teacher features)	Create the camera view for the teacher so they can observe the student.	The teacher user has a separate view from the student type users.	Chris	3D imagery (pacing simulation) & Virtual Space (pacing simulation)		Wk 7	Wk9
Visual Tracking (Teacher features)	Implement feature that allows teacher to use a 3D board with ways to modify the heart, optional tool usage	Teacher will be able to view the patient's state along with what alterations the participant has made.	Phil			Wk 8	Wk 10
Gestures (Teacher features)	Gesture support in teacher's view for fast changes of patient state	Teacher can change the state of the patient for the participant.	Chris	Interaction with virtual devices (Pacing simulation)	Visual Tracking Board for interaction	Wk 8	Wk 10

Update

User Stories:

Trainee

Part 1: Person downloads the app, if they are a trainer or trainee, if they are a trainee, Dr. Cardi A. C. will ask if trainee is familiar with pacing or not and if not, introduce the process of pacing to the trainee. If so, they are taken to the main menu as described in part 3.

Part 2: Then Dr. Cardi will go through the different parts of the layout for pacing, machines will be explained so they can associate the devices with their 4D counterparts, explaining what each of the lines on the ECG mean, the switches and dials on the simulated pacemaker that the nurse can interact with and receive feedback from in terms of haptic buzzing when turning the dial, and things to look out for like blood pressure which will be presented as a gauge. There will also be an avatar of a person/patient presented to the nurse with a heart (cartoon or anatomically correct model) for scene establishment per trainee.

The doctor will encourage the nurse to apply the pads in the AP position using Cloud Anchors on the avatar, connecting the 3D ECG leads to patient as well, and using the buttons and dials to start of the pacing process on the virtual device (pacing rate >30bpm above patient's intrinsic rhythm, setting the mA to 70). The nurse can then start pacing and increasing the mA (power) until the rate is capture on the monitor in 3D space. There is a chance that pacing rate is not captured even if the pacing device is outputting 120 mA, at which point the nurse must resite the electrodes and repeat the attachment process and then keep the mA 5-10 units above the threshold.

 Dr. Cardi will get a free session where the patient cannot die. Then the doctor will explain how the score system works and ask the nurse if they want another free go or to try with the possible death of the patient. Every pacing session will come with feedback on performance. From there, the nurse will be notified that they can redo the tutorial if they feel they need for more practice.

Part 3: The user will be taken to a screen with a menu of session reviews which can be used for feedback, sessions of increasing difficulty (starting from no death to highly "active" area with many distractions using spatial sound such as patients screaming in pain and doctors giving orders and many heart events), a scoreboard, and a code input area from the trainer to enter a shared space for mentoring.

Add a name to the patient

Trainer

If the person who downloaded the app is a trainer, their tutorial walks them through their capabilities as a trainer. This means there will be multiple cameras the trainer can cycle through (one per trainee and the heart "settings"). The heart settings allow the trainer to make changes to the current state of the heart (regarding the rate, pressure, rhythm, etc) to test and mentor the nurses in real time with the option to pause the simulation.

Once they have confirmed understanding, they are taken to a menu where they can enter a session using coordination that generates a code for the trainees to join the mentoring session. This is a 3D space where all trainees can see each other and have the same medical setup next to each other while the mentor is positioned in front of them with his interactive display. From this session screen, the trainer can view the virtual room with the nurses and their avatars to see their changes/movements and modify the "shared" heart and its settings or switch between cameras to more closely see the trainees' responses. The communication options can happen through voice and/or text channels where the trainer can mentor the trainee verbally.

Modules:

Module 2 16.5 Spatial Sounds – Aya

Module 7 21.1 Mutual Presence – Aya

Module 7 21.2 Coordinating – Aya

Module 7 21.3 Voice Communication – Chris

Module 7 21.6 Cloud Anchor – Phil

Module 4 18.4 Buttons and dials? - Chris

Module 5 19.3 Flexible Controller – Phil --

Module 6 20.1 Heart rate monitor – Phil -- Pacing simulation, 3D Assets

Module 6 20.2 Vibration display - Chris