Operation:

OPERATION

CSV2A - Group 0
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Objective

Operation Context

People in need of CPR do not always get the best help available in their situation. This might partially be caused by the lack of training preparing first aiders for realistic situations. STARK Learning has tasked us with improving this by developing CPR training that uses Virtual Reality to create realistic training environments to expand existing CPR courses. The goal of the project is to create a prototype of an interactive learning event (ILE) (Kapp, Blair, & Mesch, 2014, p. 2) to show the possible use of VR in CPR training courses and potentially do basic research into its effectiveness.

The ILE is to be used as a component of an instructed CPR course in a classroom, but with as little work for the instructor as possible. The playtime should be around 10 minutes, to give every course participant the opportunity to use the simulation.

Reconnaissance Goals

The goal of the ILE is to expand on the pre-existing CPR training and teach the participants to perform proper CPR in unknown and stressful situations. This can be divided into two aspects, firstly we need to make sure that the user performs proper CPR and constantly measure his performance, and secondly, the user needs to be challenged by unknown, unexpected situations and brought into a state of stress, at which point they should still be able to perform CPR as per the first point.

Additionally, the client suggested to us to add the use of an AED into the ILE, because it is a very successful tool in increasing the survivability rate of CPR patients and is also a part of all CPR courses today. As our goal is to increase this survival rate the use of AED is key to a useful training, we decided to implement the AED in our simulation so that the user will remember and be able to use an AED in a real scenario.

Since these learning goals are mainly about practical application of previously learned knowledge, we decided to create a simulation for this project. Simulations work well when paired with another module in which the user learns the basics and can then use the simulation to practice and apply the learned skill in different situations, consistently (Kapp, Blair, & Mesch, 2014, pp. 58-63). Since this is exactly what we are trying to achieve, we chose to create a simulation in which the user actively applies a skill, in which we use metrics to measure the user’s performance at this skill, and

where we place the user in a realistic context in which he applies the skill. (Kapp, Blair, & Mesch, 2014, p. 250)

Targets

The client did not specify a target audience for us, so we did not put much focus into deciding who to design for and decided to make a game concept first and then see who it would fit best for and adjust it in that direction. The theme we chose fits best with a target audience between 18 and 35, and will probably resonate more with males than females, as soldiers are still predominantly male. After discussing the concept with the client they arranged a meeting with a Dutch army officer, after which we decided together that it would be interesting to target soldiers in training, as they can be confronted with many difficult situations in the field, requiring good and realistic training in first aid and other things. This means adjusting the simulation to implement military protocol and also increase the stress of the player and give more complex tasks, for example in a care-under-fire scenario where the user has to perform tasks besides CPR such as suppressing fire or radio communication.

Briefing

For this simulation we decided on a concept that places the user in a battlefield situation in the Middle East, where he then has to perform CPR under stress. There are going to be several scenarios that will increase in difficulty and focus on different aspects of CPR. Through different distractions we will try to reach a certain stress level in the user. The user will get audio feedback from NPCs in the scene based on his current performance as well as an evaluation at the end which details his performance and gives specific advice on mistakes and improvements.

Equipment

We used several devices, such as the Oculus Rift, Leap motion and a real CPR-Dummy to give the player a realistic game experience by having multiple realistic feedbacks, such as looking around in the game environment, virtually seeing the own hands and actually feeling a body by pushing it down. With such sensation the player will get an overwhelming game experience, which is not granted by playing the usual console game.

Oculus Rift

As per the project requirements we will use an Oculus DK2. The use of Virtual Reality allows us to create an immersive and realistic environment. We will also use the head tracking as a small input method to track the user's vision.

The immersive experience of virtual reality will improve the user's experience and hopefully increase the stress level.

LeapMotion

The LeapMotion is a device that tracks the hands of the user. It can also be mounted to the front of an Oculus and can then be used to display the user's hands in the VR environment. We will use this as our only input device, because it is very realistic and intuitive, and also to allow the user to see his own hands when performing chest compressions.

CPR Dummy

In order to measure the user's CPR performance we use a CPR dummy that has an analog output and then convert this to digital data using a webcam. We will use this performance data (Chest compression depth -> Rhythm) to evaluate the performance and give appropriate feedback to the user. In addition the dummy

can give some feedback on the position the user applies pressure to, although this is very difficult to interpret without seeing the exact way the user is positioned above the dummy.

The advantage of the dummy is that the user gets realistic sensory feedback from his compressions, as their hands are actually moving the necessary 4-5 cm in real life, not just in the simulation. Furthermore, the realistic shape of the dummy's chest allows the user to feel out the correct location for the compressions, which is another important part in performing effective CPR.

Mechanics

Compressions

Throughout the course of each scenario the user will have to perform chest compressions on the CPR dummy. This will be the input method that the feedback is based on.

Feedback

In the earlier, easier missions the user will get feedback on his CPR performance from an NPC that is present in the scene by playing different voice lines asking the user to press faster or slower, or to apply more pressure. This allows the user to immediately apply the feedback and learn the proper technique and rhythm.

Additionally, the user will get feedback at the end of each level on his performance, giving tips for the future and positive reinforcements in the area the user is good at.

Story/Narrative

The game is set in a warzone, possibly somewhere in the Middle East, in which the user takes the role of a soldier and has to perform CPR in different situations, ranging from the medical station in the basecamp to right in the middle of a firefight. There is no overarching storylines as the user spends only short play sessions in the simulations and situations should always be more important anyway. There will be recurring characters however, as an emotional connection can possibly increase the stress of the player.

Aesthetics

Since our game should represent a real life situation involving CPR, we focused mostly on creating realistic aesthetics. We used lots of photos from real military environments to base our aesthetics on. In addition all of the sounds are based on army lingo and desert recordings.

We chose to go for a realistic feeling throughout the game since this fit well with the hardware we utilized.

Art

The 3D models were made based on references the client gave us and on the sources we gathered through research and interviews. We spent a lot of time creating assets, which gives the game scene a realistic feeling, for example within the medical container there are beds, a sink, medical instruments, such as syringes, monitors and AED’s.

We wanted the player to really feel like they were inside a military camp, in a situation where they have to save the lives of their comrades whilst being shouted at by a superior.

Due to time problems, we had to make 2D animations as an introduction, instead of making a short 3D clip. However, those were also careful made with details to reach a certain quality.

Sound

Many sound files were created, which adds to the realism of the game simulation. Unfortunately, not all were implemented. However, we had voice acting of a soldier, which gives instructions to the player. Furthermore, we have completely voiced the AED, similar to real-life AED voice lines, so that the player becomes familiar with the AED operating procedure.

Fine-tuning these sounds was essential to the final product, since audio feedback is an important thing within the game design.

Implementation of the Learning Goals

For our ILE we wanted to focus on teaching the user to always execute the correct compressions, no matter the distractions and stress. With the compressions we focus on the correct depth and rhythm, whereas the number of compressions is secondary, as we decided not to implement ventilation in the ILE. This is done by giving the user direct feedback while he is doing the compressions, so that he can implement them immediately. Furthermore, we decided to also teach the user about AEDs, as they can greatly increase a person’s survival rate if they have one of the heart rhythm an AED can treat. The importance here lies on the fast use of an AED, so our main goal here is to make sure that the user remembers to use the AED when available, but we also want the user to get some experience in using an AED, but this is of secondary importance as AEDs are aimed at amateurs in their handling, so that very little training is required for their operation. Nevertheless, knowing the procedures from training can reduce the user’s stress in a real situation as he can fall back to what he learned during the training.

Missions

#1 - Base Camp Medical Station

The first scenario takes place in a medical container at the army base. At the beginning of the scenario the user watches a short cutscene about the preceding events, where a soldier is evacuated from the battlefield with a helicopter and brought to the medical station. The scenario then begins in the medical container with the officer in command of the medical station giving some small advice, including for the user to show their hands, so that they know that they can use their hands in the game as a controller. They are also asked to look around, so that they get accustomed to the new possibilities the Oculus gives them. After that, the officer introduces the patient, shortly after which the patient gets a heart failure and the user has to start the resuscitation. The plan is to have the user do some chest compressions first and add the AED after a short while, but at the moment the AED is present right at the start and the user has to use it in order to proceed. The user then goes through the standard AED procedure and depending on a randomized value the AED either shocks the patient or does nothing, after which the user has to perform chest compressions in both cases. During these chest compressions the user gets feedback from the officer based on his compression speed and pressure. After a certain time a team of doctors and nurses/soldiers comes in from the back of the container and orders the user to stop, at which point the scenario ends.

The goal of this scenario is mainly to get the user introduced to Virtual Reality and the LeapMotion controller in a relatively safe environment, as well as making sure that the user has understood the basics of CPR and AED usage from the preceding instructed course. If the user does not understand the basics at this point, going further into stressful and complicated situations and environments would be useless, as the user’s skills have to be built up gradually from the bottom.

#2 - Battlefield Scenario

The second scenario takes place on the battlefield, with gunfire and explosions all around the player. At the start of the scenario another soldier gets hit by an explosion and flies through the air, upon which his heart stops, which is the first thing the user will have to discover. Upon realizing that his companion needs immediate medical attention, the user has to make sure they and the patient are safe and determine the course of action based on the injuries of the patient. In order to do this the user can use his radio system to order an armored vehicle to come between themselves and the opposing combatants in order to provide cover for them and the patient. This method is used, as it involves no movement of the user or the patient, which is beneficial for VR and necessary when using the CPR dummy (Oculus VR, 2015).After making sure that both they and the patient are safe, the user can start to look after the patient, in this case it would involve performing CPR. Before doing that however, the user first needs to radio for help to get a medevac helicopter. After that the user needs to remove the patient's bullet-proof vest so that effective chest compressions can be performed. During the CPR the user might have to switch with his partner in doing the CPR and providing suppressive fire, in order to both simulate real military practices, but also teach the user to be able to think about other stuff while performing CPR. How many different actions the user has to perform in addition to CPR depends on the chosen difficulty setting. After a certain time, which again depends on the difficulty, the requested helicopter will arrive and the user will see short 3D animation of the patient being loaded into the helicopter, after which the screen fades to black.

After finishing the scenario, the player can either return to the main menu or go directly into the following scenario #3.

#3 - Helicopter Scenario

Scenario #3 takes place on a medevac helicopter, essentially following directly after scenario #2. Here, the user has to make sure that the patient survives until arrival at a medical care facility, mainly by performing CPR and using the AED on board the helicopter. In addition to that, the player has to deal with lots of distractions, both visually, like explosions in the background, and auditory, such as communication over the helmet radio. Aside from these continuous challenges, not much happens in this scenario, it ends with the helicopter landing and the patient being moved into the medical station.

We chose this scenario because it connects nicely with the previous scenario and allows us to move the user without causing much simulation sickness, as a constant, non-accelerated movement in combination with a fixed environment object (the helicopter) works well in virtual reality (oculus motion page). In this scenario the player learns to deal with distractions while performing CPR and also has to use the AED in a more stressful environment where the player cannot hear the voice instructions over the sound of the helicopter.

Final Notes

Feasibility

During the course of the project, some aspects have proven more usable than others. For instance the army theme has worked out nicely so far, and the concept of stationary VR with minimal player movement is also good and has prevented simulation sickness. However, the LeapMotion and the CPR dummy have not been quite as successful as anticipated. The low range of the LeapMotion has made it impossible for the user to see their hands during CPR and we had to compensate by adding virtual hands instead. This removes half the reason for having the LeapMotion in the first place, and its use needs to be reexamined with this in mind, especially regarding its often unreliable tracking and the difficulty many users had in its use. In addition to that, the webcam technique we used to read out the CPR dummy has not been of a sufficiently high framerate, so that the program would get only very few values per compression, leading to difficulties in the analysis. This could be changed by using a digital dummy, but the technology currently in use in the prototype is not capable of providing the needed data for the simulation.

If this product were to be used commercially, a different solution for both hand tracking and pressure measurements would have to be found. Digital CPR dummies exist but are much more expensive to purchase. Such an investment could prove a barrier of entry for smaller CPR training providers, but would likely be acceptable for a military application. For the motion tracking the use of the Microsoft Kinect could be tested as a system to track the user’s motions. As an alternative the SteamVR system might also prove useful with its hand controllers that could be used to control most of the game and the room based setup allowing for more player movement which could improve on the non-CPR aspects of the simulation. The CPR would then be done without visible hands, relying on the user’s sense of touch to find the correct spot on the dummy and their general knowledge of where their hands are.

Changes throughout the Project

During the course of the project we made very little changes to the game design, we mostly added detail where it was needed and did little to improve on the initial design, since we first wanted to test it with a prototype. Most of the changes we did were done fairly early on, mostly due to technical limitations or feasibility. We removed an earlier scenario idea that would begin in the base camp, as creating an entire base camp for just a small scene seemed too much for now. We also had to add the virtual CPR hands as the LeapMotion's limitations became apparent.

Conclusion

Overall, we were mostly focusing on creating a technical prototype in order to see if the technology we chose is usable in a CPR simulation. Furthermore we did some research and designed a simulation that would use this technology to achieve our learning goals. In the end, we learned a lot about the used technology and its applications as well as its limitations. Based on our findings we could now take the good aspects and combine them with some new ideas to create an even better prototype. In regards to the game design we have seen a positive response to the military theme and to the mechanics we used in the game to achieve the learning goals. We think that the general concept is very useful regardless of the technology and is applicable to both normal users and military personnel with few changes.

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