60 The Demo

“What is it indeed that gives us the feeling of elegance in a solution, in a demonstration?” - Henri Poincare

Introduction

To recap: the demo will help convey a sense of urgency using both vibration and heat to nurses who are training in Virtual Reality. This chapter covers the development of that demo. In order to go from concept to demo, nurses were interviewed to help gather the levels of urgency as well as how these levels feel to them on a physical level. A VR environment of an ICU room was created to simulate a nurse's training simulator. Then hardware and software were built to connect the senses and the virtual environment.

Urgency Analogies

In order to better translate the idea of urgency through pressure and heat, a brief study was conducted with nurses at Erasmus EMC in Rotterdam, the Netherlands. The aim of the study was to an "embodiment" of three different levels of urgency. The embodiment is a description of the physical sensations nurses experience at certain moments, matched up with how urgent those moments are.

These analogies point to a clear path for helping people in VR experience the three different levels of urgency sensation. Using these different sensations, nurses who are training be able to understand the difference between the levels, they will also be able to "feel" or experience the urgency of a level based on the experiences of real life nurses.

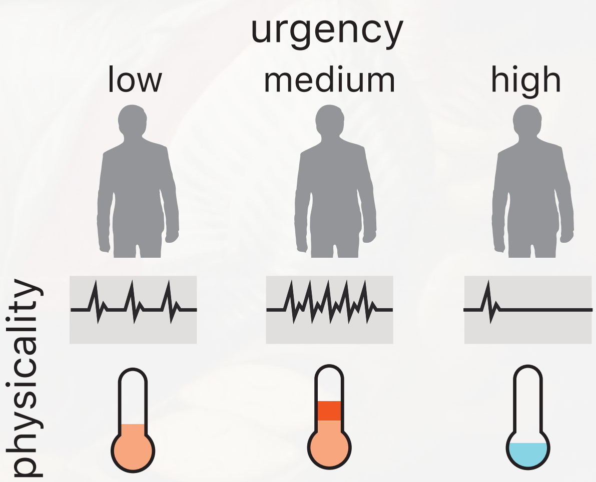

Figure 60.1: The three physicalizations (based on temperature and vibration) for ugrency shown graphically.

Technical Set-Up

Hardware

Using the Google Cardboard as the VR head mounted display, dramatically simplified the development process, at the cost of immersion and interaction possibilities. This tradeoff was necessary in order to fit into the scope and timeframe for this graduation.

Figure 60.2: A Google Cardboard VR viewer (Google)

Microcontroller and Actuators

The microcontroller used is an ESP-8266 based board. This handles both WiFi communication and controlling the actuators. Additional hardware was needed to ensure the system could tolerate current and voltage requirements: a power module and two H-bridge controllers. A schematic is shown in Figure 60.3. The power module takes a 5 volt USB input at provides the necessary 5 volt and 12 volt rails.

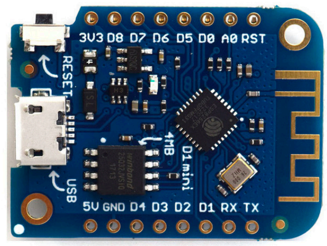

Figure 60.3: The original ESP8266 based microcontroller.

Actuators

Vibration comes from a modified blood pressure measuring cuff. A Peltier device both heats and cools the user, depending on how the voltage is applied.

The pressure cuff not only provides the pump and bladder, but is also a convenient embodiment and attaching mechanism for the entire demo device.

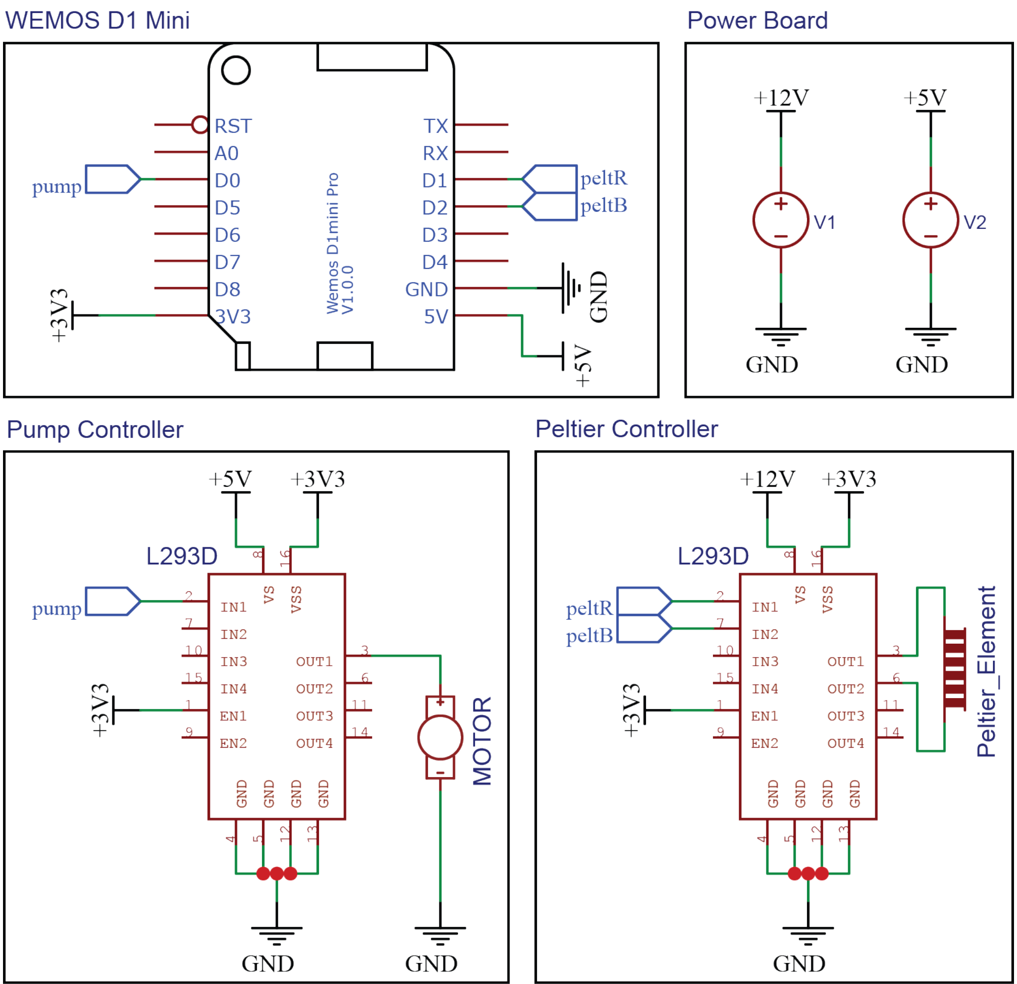

Figure 60.4: The schematic for the actuator electronics that power the demo device.

Software

A simple mock-up of the ICU was made in Unity 3D (as this was the software the author was most familiar with). Models for the environment were created based on photos of the ICU patient rooms at Erasmus MC in Rotterdam. This was kept bare bones and slightly abstract due to time contraints. The view of the user is shown in Figure 60.4

Bridging

In order to show how easy it is to integrate the solution into existing VR and AR projects, it was decided to not only integrate the demo into Unity 3D, but also give the possibilities to add the demo into any number of programs using OSC. Open Sound Control (OSC) is a commonly used protocol for addressing sound equipment and it's adoption by the Arduino community makes implementation a lot easier. Thus, the generalized software solution is shown in Figure 60.5

This allows for easy integration into a variety of software platforms ranging from professional VR installations to simple Android phones.

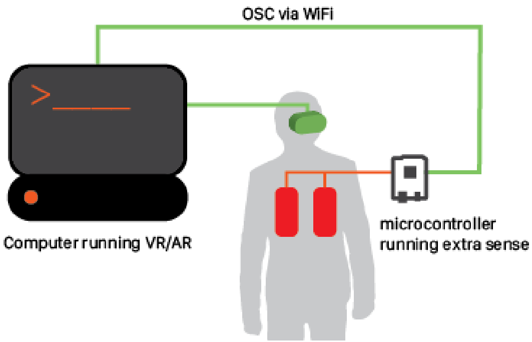

Figure 60.5: a simplification of the simulation and control system.

Microcontroller Code

The implementation of this is rather trivial, with the Unity software being responsible for most of the heavy lifting computationally. The microcontroller simply listens for OSC messages that tell it to actuate the senses. A call to the address "/cooler" tells the controller to turn off the device (case 0), cool the user (case 1), or heat the user (case 2). The address "/pressure" simply sets the motor to the given state (0 or 1). The full code can be found online at: github.com/womei/VR-Nurse-Training-Hot-Cold1

Figure 60.5: The user's view of the VR enviroment.

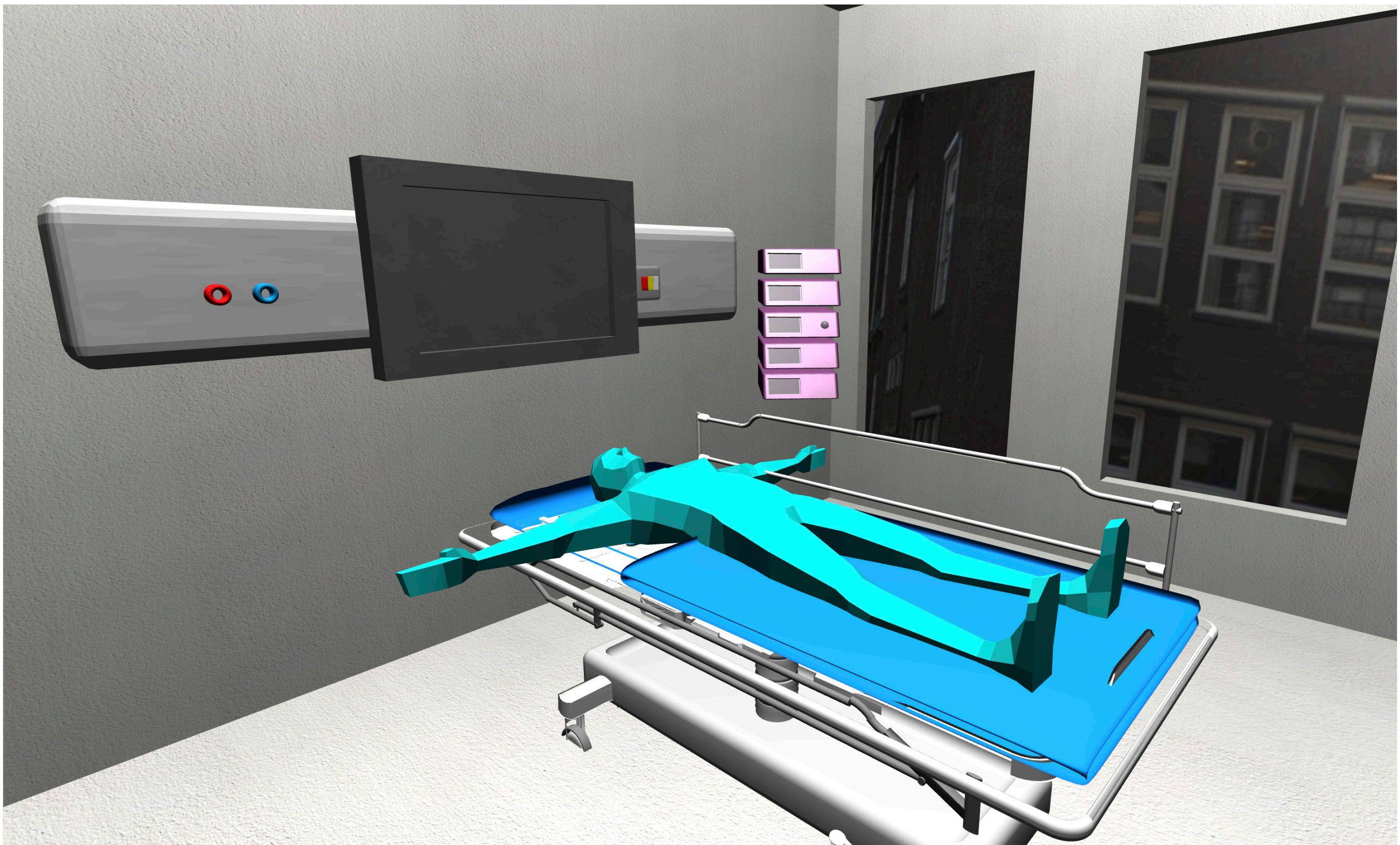

Figure 60.6: The final prototype of the Demonstrator used for testing during the graduation.