CPSC470-Final Report

Cameron Howell

April, 16 2022

1 Problem I am solving

The problem I am trying to solve is that the Forest Service wants a VR simulator to allow them to train firefighters safely. Currently they train them with classes, then they go out and start real fires and cut down trees. This requires lots of planning to make sure that it is safe for everyone, but inherently has a lot of danger. By adding in VR training as an intermediate step between initial classes and hands on training firefighters will be better equipped in how to handle real fires and how they spread.

2 Literature Survey

I did search online to find if a similar program was being developed but was unable to find anything that was exactly what I am developing. There are VR simulators that exist for smaller things, such as learning how to put a house fire or a car fire out, but not for forest fire simulations. This is of interest to the Forest Service as they run an internship to develop it. I have been in correspondence and collaboration with Russel A. Parsons in order to develop the VR simulation.

- Section 3 talks about how VR can be applied in different fields such as design, games, films, simulations, visualization and many other domains, but it also allows integration and creation of different learning contexts which make it successful as a training tool. It further talks about how VR can be used to train in dangerous areas without having any risk. [1]
- This article is about medical education and training. The introduction talks about how there has been a shift towards more interactive and simulation based learning. Recently another shift towards VR and AR applications has been happening. The section on interactive VR covers how an interactive VR simulation can provide immediate feedback on how the user did automatically. This allows learners to examine their performance in detail and provides the opportunity for blended learning. [2]

- This article covers the types of VR setups and the benefits of using VR in general in the introduction. Section 3.1 covers First Responder Training, including firefighters. Their findings were that VR and AR training lowers the rate of errors over the traditional PowerPoint approach. It shows a picture of a fire truck control panel that is realistic to how the actual one on the truck looks and operates. [3]

3 Technical Material Necessary to Learn

1. FDS Documentation can be found at https://pages.nist.gov/fds-smv/manuals.html and much of it is the same for WFDS.
2. WFDS Documentation can be found at https://www.fs.fed.us/pnw/fera/wfds/wfds_user_guide.pdf although it is incomplete.
3. Unity Documentation which can be found at https://docs.unity3d.com/Manual/index.html
4. C# Documentation which can be found at https://docs.microsoft.com/en-us/dotnet/csharp/

4 Methodology Used

My methodology is to use documentation, tutorials, and existing projects to help me determine the best way to implement my ideas into the project.

5 Results of the Work

My research question is as follows "Is an interactive VR simulation possible using Unity and FDS?". The answer to that question is, from my testing, it is possible. Sadly due to many unforeseen issues while working on this project I was unable to use FDS. I had to use WFDS, which was also not without issues. WFDS did not have a way to be restarted from a saved point in time as this feature was never fully developed. It was able to output the required files, but when restarted it would output the same fires from time 0, but shifted by whatever time the restart file was for. As an example, a fire is output at 10 seconds. WFDS is restarted at 60 seconds. The expected behavior is that no information is output about that fire again, but instead the same fire will be output at time 70. This is not the expected behavior and it means that WFDS is not suitable for a truly interactive experience. Upon discovering this I attempted to make the switch to FDS and came upon a few issues. The first major roadblock was that FDS was not capable of outputting the file containing arrival times for the fires, which my program relies on. I contacted the Forest Service and they were quick to implement this. After this initial roadblock I began to convert the input file that we had been using. Once I had converted

the file, it took over 15 minutes to be read by FDS whereas WFDS was able to read the same file in a few seconds. I again contacted the Forest Service and they began work on fixing this issue, but it was not ready in time for me to use it. My work on this project has resulted in these issues being addressed and fixed so that FDS may be used in the future.

6 Possible Future Directions in Which the Problem Could be Further Investigated

The next step with this project is to make the switch to FDS, which was recently fixed. The issues that I faced while attempting to make the switch from WFDS to FDS have been addressed by the Forest Service and the program should be ready to use. Switching to FDS will allow for restarts, which is the major feature missing from WFDS. This will make it possible to create a truly interactive program.

Another area that will need work is a better user interface. Much of the work I have done is technical and there is very little user interface.

7 Accessing the code

Code can be accessed at
https://github.com/cwhowell-roanoke/WFDS-Unity-Simulator.
Documentation on how to run the code is available on GitHub.

References

[1] M. Pérez-Ramírez and N. J. Ontiveros-Hernández. *Virtual reality as a comprehensive training tool*. Oct. 2009. URL: https://www.researchgate.net/publication/266020983_Virtual_Reality_as_a_Comprehensive_Training_Tool (visited on 02/24/2022).

[2] J. Pottle. *Virtual reality and the transformation of medical education*. Oct. 2019. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6798020/ (visited on 02/24/2022).

[3] B. Xie et al. *A review on Virtual reality skill training applications*. Apr. 2021. URL: https://www.frontiersin.org/articles/10.3389/frvir.2021.645153/full (visited on 02/24/2022).