virtual environment

SPACEMISSION

UNIVERSITY OF FLORIDA

Gator Engineering

Overview

The purpose of this project was to create an innovative virtual experience. We created a virtual environment where the user is the flight commander of STS-115, on a mission to save the crew aboard the station. The journey takes the flight commander from the launch pad at T minus 12 seconds to the International Space Station. The flight commander has to interact with the mission control center via the onboard computer and dock at the space station using a joystick.

The Story Behind

The crew inhabiting the International Space Station is in the middle of a terrible crisis. Your mission is one of crisis management. Six hours ago, toxic and corrosive fuels disseminated into one of the quarters. Nitrogen Tetroxide was released into the atmosphere and is quickly spreading. All crew members have been isolated into a habitable volume in the station. There is enough oxygen left to keep them alive for 12 more hours. Your mission is to retrieve the crew until the toxic gases are released and counteracted and to deliver two units of oxygen and re-pressurize the space station.

Innovations

Motion Platform A motion platform was designed and built to simulate the effects of thrust during shuttle launch and of the G-forces during ascent. This platform is made up of a rocker with 2 DOF and sliding rails that add an additional 2 DOF. The rails are mounted on boards which are attached to the rocker. A large board sits on top of the rail boards and is attached to a ground board from two sides using thick rubber bands. This setup gave the platform the aerodynamic feel we were aiming for. The platform provided an affordable means to effectively simulate the motions of the shuttle. The ideas behind the design were original and based on basic physics.

Figure 1 - Setup showing motion platform, inflating cylinder, visual displays

Shakers Bass shakers have been used to create vibrations before and they are usually attached to seats. We attached two shakers to the platform. Our motion platform design gave us the opportunity to create the kind of vibrations we needed. This is because the seat is bolted to a board that is elevated above the ground and has 4 DOF, so when that board shakes, it not only moves the seat, but the control board, the user's legs, etc.

Figure 2 - Bass Shaker installed underneath the motion platform

Interaction The controls on the control board are made of wood tops and the inside of ball point pens. We placed a real keyboard underneath the main panel (hidden from the user), made holes through the panel where we slid the pens. The springs allowed for realistic push button motion.

Figure 3 - Control board having keyboard mounted underneath

Challenges

Physical Setup Creation The physical setup was probably the most challenging task for all of us, as none of us had expertise in this area. The design of the platform evolved as we went through the whole creation part. We incrementally kept on adding things to cater for issues like make it secure that it does not tilt over and provide good experience.

Sliders Aligning the sliders was tricky because we have 3 rails for each direction and they have to be perfectly parallel otherwise it doesn't slide when weight is put on it. But this is nothing compared to joining both wooden pieces of the sliders together because there is no place to insert the screwdriver and we want the limited motion for both direction at the same time.

Vega We used Vega Prime for rendering the scene and most of us had never used this software before. It was challenging to animate the motion of the clouds during ascent since Vega is not meant to do animations.

Tracker Tracking commonly has inaccuracies and jitter which were exaggerated in our case due to bad light. It was very hard to reduce the jitter of marker tracking using webcam. We had to try a lot of various mechanisms to handle to an extent where it becomes reasonable.

Briefing Video We had to render 3D animations for the video and we wanted the renders to be as realistic as possible concerning light and shadows. The skylight is enabled but with 20 rays of shadow turned on, ray-tracing took us a lot of time to come up with a comprehensive instructional video.

Future Work

Absence of Gravity We wanted to simulate absence of gravity in some way. We had an idea of hanging some objects in mid air using fishing wire. We already tried it by placing them behind the screen to give a real like effect but were not able to execute it on the demo date due to lack of resources.

Interactive Control During Flight Adding interactive control of the space ship during the flight can also improve users involvement. For example, if there's an asteroid heading towards the space shuttle and flight commander has to take a diversion from the path.

Studying Presence We would like to study how much each of the various components used contribute to the overall sense of presence. For instance, if there is no briefing video, or disabling tracking of the motion platform. Reducing some of the sound/vibration outputs etc. Similarly, apart from the environment itself, how much do props contribute to the experience, like providing a helmet or strapping the person to the seat for improving security.

Figure 4 - Motion platform showing rocker and 2-way sliding base

Equipment and Software Tools

Digital Worlds Institute (for NAVE)
http://www.digitalworlds.ufl.edu
NASA (For video footage)
http://www.nasa.org
Multigen Paradigm (for Vega)
http://www.multigen.com/
HITL Washington (for ARToolkit)
http://www.hitl.washington.edu/artoolkit/

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