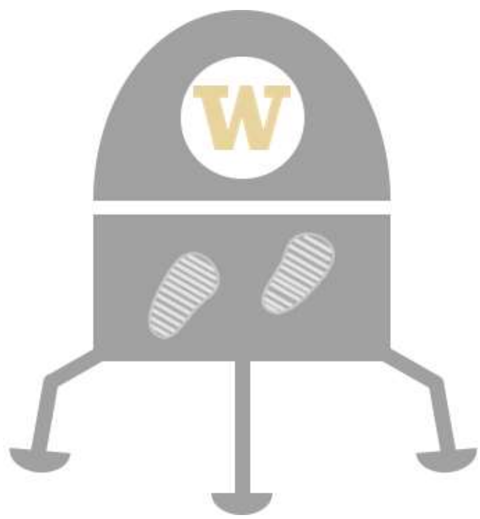
FINAL REPORT

Lunar Lander Simulator

INDE/HCDE 455 (AU 16)



Team Small Steps

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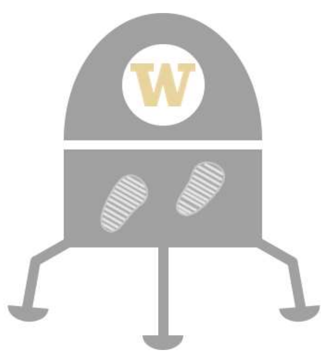
Part 1: Report



The Problem

- What problem are you trying to solve?
  - Our interface is a Lunar Lander Simulator which gives the public the opportunity to experience what it's like to control and land a lunar lander, walk on the surface of a celestial body, and interact with the environment.
- Why is it important?
  - The main goal of the Lunar Lander Simulator is to educate the public about great scientific accomplishments in our history, and engage the public and pique their interest in space explorations and achievements. Only a few individuals have the opportunity to travel to celestial bodies in the space as astronauts - the ,simulator gives this opportunity to general public to have this experience.
- What features will users require?
  - Based on the initial user survey results, the majority of the users preferred to:
    - Have this experience as a ride in an amusement park (22.7%), or at a space/aeronautics museum (36.4%).
    - Have an immersive VR experience with gravity simulation.
    - Have a full body experience (59.1%) along with having touch controls (50%) for controlling the simulator.
    - Use visual (81.8%), auditory (63.6%), and tactile (54.5%) senses along with and gravity simulation (63.6%).
  - The responses for the preferred features suggested that the experience should be realistic and immersive with gravity simulation and give the user the ability to interact with the

environment (for more details, see Phase 2 in Appendix).

Considering these, we came up with these features:

- Have an interactive guide character to provide assistance and directions during the simulation.
- Simulate the gravity on the Moon or other celestial bodies.
- Give the user the ability and freedom to explore during the simulation after landing on the Moon and other solid celestial bodies.
- Give the user the freedom to navigate to a particular celestial body within the Solar System.
- Provide visual, auditory, and tactile feedback during the simulation.

- What supporting research is there?
  - Artificial gravity can be created by application of a force. NASA has used three methods for simulating gravity and training astronauts:
    - Rotational Force: One of the methods is by inducing rotational force in large-scale centrifuges. This method creates a higher level of gravity than Earth's gravity, which can cause severe health problems, like loss of color vision and total loss of vision at higher forces. It can even lead to unconsciousness. The human body has different tolerances for gravitational forces depending on the direction of acceleration. Since high gravitational forces can lead to health problems, astronauts must be trained and multiple simulations must be conducted to ensure that astronauts do not face health problems [1].
    - Linear Acceleration: Another method is by applying linear acceleration. In this method, a reduced-gravity aircraft with fixed-wings follows a parabolic flight path relative to the

center of the Earth, which gives the people inside the aircraft about 20 to 30 seconds of weightlessness. Since this method only provided a short amount of time of weightlessness, it was discontinued by NASA [2].

        - Buoyant Force: The third method is by using buoyant force. The Neutral Buoyancy Laboratory (NBL) is an astronaut training facility operated by NASA and has a large indoor pool of water. Trainees wear suits designed to provide neutral buoyancy to simulate microgravity. Due to the health issues induced by artificial gravity, like loss of muscle and bone mass, NASA has been developing facilities and conducting research studies to make sure that astronauts' health and performances will not be affected on long journeys [3].
        - With the current VR technology and haptic force-inducing devices, creating an immersive environment will not be a big challenge. Devices like the HTC "VIVE," which can track the user's movement, could give us the opportunity to link the image to the user movement, and with use of haptic gloves give the user the ability to control the interface with touch controllers. Gravity simulation was the biggest challenge for our team among other things.

- What design issues does it raise?
    - Complexity of Interface: Real lunar landers have very complex interfaces that require extensive training to use and control. Thus, it was very challenging for us to simulate this complex interface. If the users had to control an interface identical to that of a real lunar lander's interface, it would likely be far too difficult and complex for them, and we would run the risk of frustrating many users.

- Learning Curve: Considering how our users have presumably never used a lunar lander simulator before, it is likely that they will be unfamiliar with the interface. Due to this, users may experience some degree of a learning curve depending on how difficult they find it to use the interface. The users should not feel stressed over learning how to use the interface. Due to this, we decided to have an interactive guide during the simulation.
- Gravity Simulation: It is difficult to realistically simulate gravity with our product. As discussed previously, NASA has used three methods for simulating the gravity. The first is to subject the user to high levels of acceleration in a large centrifuge. The second is to use an aircraft that flies in parabolic trajectories, which would briefly provide an environment of weightlessness. The third is to use a large indoor pool with a crane to allow the user to experience neutral buoyancy. However, each of these three options have large drawbacks. The first and third options will be quite expensive to operate, and they would require a large area of space. The second option would only give the effects of weightlessness for a few seconds at most. Since these gravity simulations were not be feasible for our system and the environment it would be used in, the main challenge was to determine whether gravity should be simulated physically or through virtual means, such as with a VR device.

- What similar systems are there?
  - “Lunar Lander,” one of the first successful games inspired by the 1969 Moon landing, was developed by Atari in 1979 and licensed to Sega. Lunar Lander was a 1-player coin-operated electronic game that simulated landing a spaceship on the moon and used a vector monitor to display vector graphics. The user

needed to land the module safely on the moon’s jagged surface, which only has a few flat areas indicated by points. The user had to overcome the gravity by using the lander's aft thrusters to slow its descent. The user also had the option to rotate the module. Points were awarded based on the safe landing on a flat surface. Fuel was limited and the user could purchase more fuel during the game and change the difficulty level. An online version of the same game and an updated version with better graphics by Atari are currently available online [4].

- Inspired by the “Lunar Lander” video game, there are multiple online gaming programs available for users. Most of them have the same concept as the “Lunar Lander” 1979 game with the same controls but with higher quality 2D and 3D graphics like PhET and MoonLander games. Some games like Apollo 11 incorporated Google Earth for their 3D design. Some games like Apollo Lunar Lander Simulator by Apollo Archive provide a simplified control system to the user with a user manual. The user is placed inside the cabin and can see the moon’s surface from a small window next to the controller. Using a keyboard or gaming controller, the user is given more options for controlling the cockpit system [4].
- Virtual Reality is a revolutionary technology, bringing realistic images, sounds and other sensations that replicate a real environment to the gaming industry. It simulates a user's physical presence in that environment. Users are enabled to interact with this space and any other objects. There are currently two popular VR games regarding Lunar Landers: Apollo 11 and Lunar Flight for Oculus Rift. Apollo 11 is like a documentary. The user watches President Nixon’s speech about Apollo 11 in 1969, then sees the spacecraft leave the Earth. Realistic images and having the user

watch both Earth and the moon from the spacecraft with a 360 degree view is one of the great features this game provides. After landing on the moon, the user has access to the cockpit system to control it and move from place to place on the moon. The graphics of the cockpit details are very realistic. The Lunar Flight game starts with having the module landed on the moon and provides a simplified cockpit system with a user manual for the user to control the lander and move on the moon. The user is located inside the module like Apollo 11. They are given missions to go to different locations on the moon. Both games have very high quality graphics which helps with realistic simulation. However, since the user is not moving physically but instead moving inside the VR environment with controls, this can cause motion sickness [5].

Users

- Who are you designing for?
  - Our target users are young adults who interested in the sciences. To this end, our design is located in the Museum of Flight, which enables the exhibit to be immersive and informative while still having reasonable admission prices. An at-home VR system would be prohibitively expensive for many users, as it would require their own personal VR Device. On the flip side, making the exhibit a ride at an amusement park defeats the purpose of education, and would likely not serve the correct audience.
  - Our persona is that of Sarah Lee, a 21 year old college senior and physics major. Sarah, who is also a CLUE TA, heard her students talking about a new exhibit at the Museum of Flight, a Lunar Lander Simulator. Upon hearing this, she embarked on a date night with

her boyfriend Kevin to the Museum of Flight. For more details, see Phase 3A and 3B in the Appendix.

- Who else is interested in your device?
    - Besides young adults, any other individual who respects science or technological history would be prime candidates as users for our exhibit for similar reasons as those stated above.

Tasks

- What tasks must the users be able to perform?
    - With our system, the users must be able to perform the following tasks:
        - Wear the equipment properly.
        - Select specific destinations to travel to.
        - Use LENI, the interactive system guide, as help when appropriate.
        - Properly use the equipment to interact with the environment.
        - Successfully complete quests
        - Find their location using the map feature.
        - Scan certain objects to learn about their details.
        - Read the gravity levels of the planet they traveled to.
        - Interact with other users who are also using the simulator.
- What non-functional requirements are there? (e.g. environmental consideration, etc.)
    - In terms of non-functional requirements, the simulator must be placed in an area with an ample amount of space, such as a space or flight museum.
    - The simulator should also be surrounded by noise-canceling walls so that users who are inside the simulator do not hear outside

noises that could distract them from feeling totally immersed in the simulation.

Design Criteria

- What were your priorities?
    - Our priorities for the features were based on the user survey results. We wanted to create an interface to include the majority of the user preferences, such as the following:
        - Immersive VR environment
        - Gravity simulation
        - Touch controller
        - Freedom of exploration
    - To include these features, we decided to design our interface in a way that it is:
        - Cost effective
        - Feasible
        - Simple

Your Design

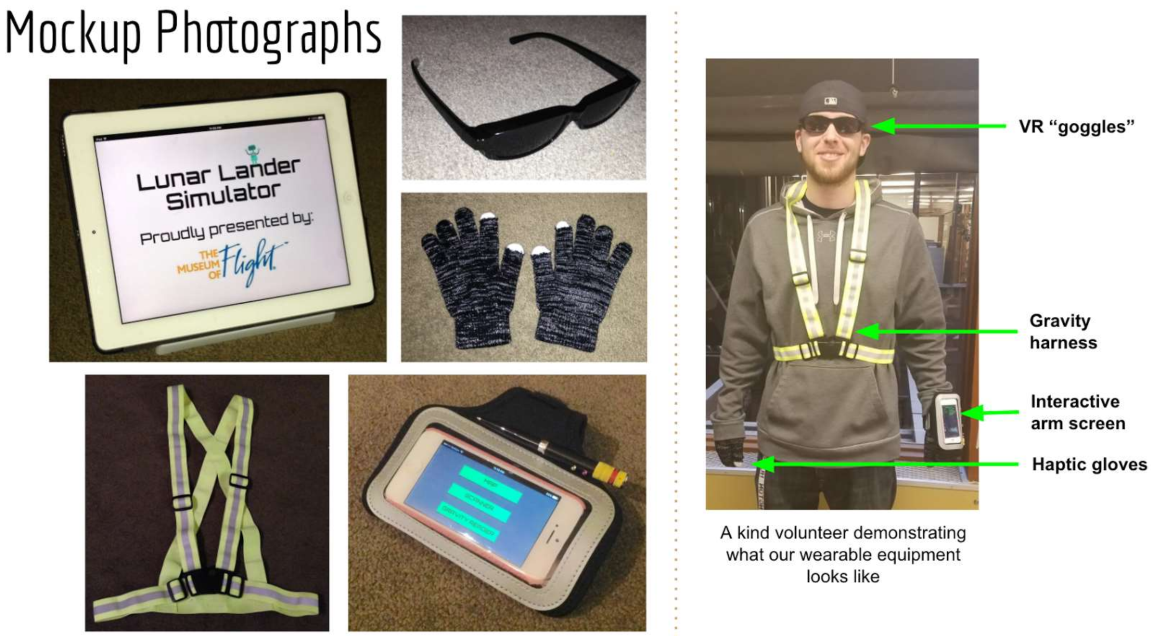


Figure 1. Some images of our high-fidelity mockup

- What can people do with it?
    - With our interface, people can use it to travel to various planets and moons within the Solar System.
- What is the core functionality?
    - Its core functionality is to allow users to experience a simulation of controlling and landing a lunar lander while also being able to explore the surface of the celestial body that they travel to and interacting with their environment via a virtual reality system.
- What auxiliary functionality is there?
    - As for auxiliary functions, we incorporated a built-in simulator guide who we affectionately named LENI, which stands for Lunar Exploration and Navigation Intelligence. LENI is meant to assist the users with certain parts of the system that may be confusing or difficult to get through.

- What does it look like?
    - Our interface has both digital and physical components (see Phase 6A and 6B in the Appendix for images of our mockup's design)
        - The digital components consist of an iPad, which serves as a representation of what the user would see in the "VR world," and a smartphone that represents how the user would have an interactive arm screen during the simulation.
        - The physical components consist of:
            - Wearable equipment:
                - A harness, which represents the gravity harness the users would wear.
                - Tech gloves, which represent the haptic feedback gloves that the users would wear during the simulation.
                - UV driver sunglasses, which represent the futuristic and minimalistic VR headset that the users would wear during the simulation.
                - A fitness armband with a clear cover to hold the smartphone.
            - A colored printout of an image of one of the Apollo U.S. flags on the Moon (see inside flap of binder).
            - A colored printout of a poster that serves as instructions for how to wear the equipment (see inside flap of binder).
- How is it organized?
    - Digital components:
        - iPad:
            - The iPad displays the "main" screens that represent what the user would see in their VR environment.

Since iPads consist of a large touchscreen, users are able to simply tap the screen to activate commands and proceed through the simulator.

    - Smartphone (in armband):
        - The smartphone contains the armscreens that show secondary features that the users would use after landing on the Moon or another planet. The features it shows are “scanner,” “map,” and “gravity reader.”

- Physical components:
    - Harness:
        - Bright yellow with a large belt clasp.
        - Worn over the torso.
    - Tech gloves:
        - Black and white with the touchscreen-sensitive fingertips.
        - One worn over each hand.
    - UV driver sunglasses:
        - Worn like normal sunglasses - also large enough to be worn over glasses.
    - Fitness armband:
        - Strapped snugly onto the user’s left forearm so that they could easily access and view the smartphone’s screen.
    - Apollo U.S. flag printout:
        - It is printed out on a single, colored page. It is meant to be taped to a dark, flat wall to simulate what it would be like for the user to see it in the simulation.
    - Equipment poster printout:

- The poster is also meant to be taped to a wall - however, the wall does not have to be dark since the user would be viewing the poster before entering the actual simulation.

Testing

Table 1. Results from the Paper Prototype vs. Hi-Fi Mockup Field Tests (White = Paper Prototype, Gray = Hi-Fi Mockup)

Evaluation Category	Test 1	Test 2	Test 3	Test 4	Test 5	Average	Std Dev.
Ease of use (scale 1-5)	4	5	4	4	4	4.2	0.45
	4	5	4	5	4	4.4	0.55
# errors made	3	2	3	0	2	2	1.23
	2	2	3	3	3	2.6	0.55
Time to complete Task #1	75 sec	57 sec	70 sec	78 sec	44 sec	64.8 sec	14.13 sec
	60 sec	87 sec	59 sec	141 sec	89 sec	87.2 sec	33.29 sec
Time to complete Task #2	89 sec	132 sec	35 sec	38 sec	59 sec	70.6 sec	40.54 sec
	37 sec	46 sec	47 sec	28 sec	33 sec	38.2 sec	8.22 sec
Time to complete Task #3	131 sec	327 sec	172 sec	77 sec	88 sec	159 sec	101.17 sec
	118 sec	121 sec	79 sec	99 sec	88 sec	101 sec	18.34 sec
Satisfaction (scale 1-5)	4	3	4	5	4	4	0.71
	4.5	4	5	4	4	4.3	0.44

- How did you test your design?
    - We found willing participants to participate in trial-runs using prototype mockups of our design. Specifically, the testing occurred in two main phases. The first phase was the paper prototype, also known as a Flipbook. This phase involved the creation of static screens that represent all the possible interactions with the system a user could take. The flipbook would be oriented in front of the

user, and the user would be compelled to tap on the paper in locations they expected actions to occur. The facilitator running the Flipbook would place an appropriate consequent paper in front of the user to simulate the user moving through the architecture of the program. Additionally, as our project contains an extensive voice guide component, one facilitator would be behind the participant, relaying the words on the page to the participant to simulate a robotic companion helper, LENI.

- The second phase was the physical prototype phase. In this phase, we still had abstraction from the real system. Ideally, the real system would be a full-immersion VR system located at the Museum of Flight, encapsulated in an enterable exhibit, where users would be attended to by attendants, and experience not only visual feedback via VR, but haptic feedback from gloves and simulated weight reduction via an assistive harness. Additionally, in the VR experience, the user would have a simulated arm-mounted information panel. To simulate this experience, we used three components. The VR experience was simulated using a tablet interface, which automatically allowed users to change from screen to screen of the program without human assistance. Secondly were the physical components themselves. We used UV sunglasses, a construction harness, and gloves to simulate the physical feedback a user would receive. For the arm-mounted interface, we used a cell phone in a clear armband to allow for placing controls on the user's arm. Additionally, we separated some components into more standalone pieces. For example, the method we used to indicate to the user how to equip themselves became an explanatory poster rather than a single page of a Flipbook. Of course, our prototype retained a voiceover component, again provided by a facilitator.

The user similarly interacted with the project, traveling through the architecture of the project and accomplishing tasks, but in a more autonomous way than the Flipbook phase.

    - We recorded several points of criteria to quantitatively assess our users. We recorded times of completion, as well as errors made, and had users complete surveys as well to record satisfaction, ease of use, and other attributes.
- Were you able to validate your design decisions?
    - Yes, from the Flipbook to the physical prototype, there were far fewer complaints about components of the interface. For the Flipbook, the participants often complained that going through the initial stages of the interface involved many repetitive taps to continue through multiple screens. As a design decision in our physical prototype, we decided that in addition to the LENI voiceover, the information would advance automatically at its own pace, not requiring the user to experience disruptive interaction.
    - Users were able to wear the equipment much more successfully and without assistance from facilitators, indicating that our approach of having instructions as a poster was beneficial.
    - The interactivity provided by the physical prototype alleviate difficulties of the user. Specifically, before in the Flipbook, the user had difficulty understanding the functionality of the arm screen. The paper screens on their arm were confusing and not well differentiated from the screens showcasing the VR environment. Having an interactive arm-based control panel alleviated these concerns.
- What parts of the design did you test?
    - Physical controls were tested using similar items to real controls
        - Gloves simulated haptic feedback gloves

        - A construction vest simulated a Gravity Harness
        - Sunglasses simulated the sensation of VR goggles
    - The VR environment was simulated using an iPad, with screens representing either pre-surface location selection and settings or the VR environment of the lunar surface
    - Wrist controls were tested using a phone mounted in a clear plastic armband. The user could tap options on the phone, allowing for a control system inside the VR experience.
    - A voiceover for LENI was provided by a facilitator in order to match the user's pace effectively.
- What did your users like?
    - The users typically liked the concept of the lunar exploration and found LENI entertaining. Additionally, they found the controls to work effectively and predictably. As the full VR experience was not available, users were likely not exposed to the more breathtaking examples of the simulator's capabilities and could only imagine the full possibilities of the platform.
- What did your users dislike?
    - Users disliked having to tap through multiple screens in the initial Flipbook.
    - Users found arm controls confusing.
- Did you make changes to suit them?
    - Introduction screens were split up:
        - The equipment instruction screen was changed into an informational poster, essentially making it a passive screen rather than an active screen that needed to be bypassed or confirmed.
        - Explanation and exposition screens were changed to a timed format, rather than letting the user decide the pace.

    - More accurate simulation of a final product was achieved
        - The higher fidelity of the prototype, combined with its greater interactivity, was designed to be easier to use.
- Did those changes work?
    - Users no longer complained about having to constantly tap the screen to advance the screen. As LENI's voiceover is present regardless, having the screen advance at its own pace still felt natural, and prevented the user from feeling burdened by useless taps.
    - Users found the application easier to navigate and understand now that the arm controls had a more established spacial relation to the user, and the general interactivity of the system expedited the user's understanding and navigational ability.
- Why did you test it this way?
    - Building a full VR environment was impractical and far too time, labor, and cost prohibitive to attempt in 10 weeks. Thus, simulating the VR experience using an iPad was the option with the highest fidelity available to us. We attempted to replicate the interaction options of the user to the best of our ability by having a wrist-mounted control panel and equipping the user with equipment.
    - The testing conducted was the closest we could push our concept without building the actual system and acquiring a hosting agreement with the Museum of Flight.

Prototype Evaluation

Critical Deficiencies

After analyzing our results from the high-fidelity prototype evaluations, we noticed the following deficiencies in our interface design:

- Unclear directions for how to use scanner
- Inconvenient location of scanner
- Lack of freedom to explore
    - Not many available destination, mission, and quest choices
- Unclear purpose of the arm screen
- Confusion when switching between main screen and arm screen
- Wordiness of directions

Recommendations

To address the deficiencies as described in previous section, we would like to:

- Provide information about the arm device application at the beginning
- Make directions less wordy and more straightforward
    - Have LENI give a specific task in the Quest Based Exploration mode
    - Show the instructions with a video (e.g. using the scanner, wearing the harness, etc.)
- Put a large button on the virtual scanner so that the user can find it easily

Next Steps to Perfect Design

The next steps that our team could take to perfect our interface's design would be to:

- Design an actual VR Program to simulate the Lunar Surface, rather than using an iPad simulation
- Acquire agreement with Museum of Flight to host the Lunar lander simulator and make it an official attraction
- Develop Gravity Harness equipment to allow for simulated reduced gravity of the lunar surface
- Allow for changing of tour destinations, such as other Moons or other celestial bodies.

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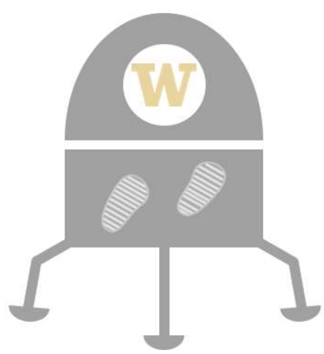
Part 2: Reflections



Reflection: Alex Heilgeist

What did you learn?

- The primary benefit I learned from this class that I have yet to have seen from my other classes was the degree of emphasis on user research in combination with UCD principles. I feel that HCDE 318, Intro to User Centered Design, provided many of the benefits of this class in it’s teachings, and I was exposed to 318 far before this class. However, the user research phase of 318 was much smaller compared to the comparable phase in this class. In this class, we conducted surveys and collected data to back up design decisions in our projects, while in 318 we simply found articles online. That makes this class have some similarity to HCDE 313, User Research, where we conducted extensive user research throughout. Thus, this class felt like a fusion of 313 and 318 to some degree.Overall, I think that this class is much more targeted towards non-HCDE students. Thus, I suppose, why the class is offered jointly with Industrial Engineering, because this class does contain useful information that should be learned, especially for engineers who have not even considered the content before. However, as an HCDE student, the content feels redundant, and I have difficulty picking out anything in particular that I have learned that I have not learned before.

What did you enjoy?

- The team I was assigned worked together incredibly effectively. I felt that we communicated well, delegated tasks well, and did all the assigned work efficiently. I got along with my teammates much better than some groups I had, and there was no friction or personal drama. Working with them throughout the quarter has been a pleasure, and I am glad to have met some great people.

What didn't you enjoy?

- The feeling of having known the content of the class due to previous classes, the sense of redundancy, was the greatest detractor from the class. To that end, I felt myself disinterested in much of the content, as I was not learning much in regard to new ideas. It was simply practice and application of previous knowledge, and while that is not necessarily a negative, it provided the sense of busywork and no actual progress towards greater understanding, and thus was unenjoyable

What was difficult? Why?

- Nothing was particularly difficult. I have handled the class content before, and thus was familiar with the processes and expectations. To that end, I did not feel anything was challenging, simply work to be worked through. The greatest difficulty was simply the quantify of work being non-negligible, and the game Galaga I did for my Arcade Analysis being a difficult game that requires skill and practice.

How was it working in a group?

- As I stated above, my group was fantastic, certainly one of the best groups I have had at UW. HCDE has prepared me well for group work, and I specifically have taken a class on working in teams, so I felt my group was a good culmination of group dynamics. We started with a Teamworking agreement, to outline expectations of behavior and project delivery

Do you think you'll use any of these techniques again? When?

- Yes, these techniques are essential UCD principles, and showcase very well the process for approaching a project from the angle of a user, and what wants and needs a user requires. I envision using these techniques

What would you do differently next time?

- I can't really think of much I would change. The class was fairly standard and practices, so I don't feel I made many mistakes. Perhaps just general improvement, like spend more time on things to polish them or to expand the scope of the project with more work, but specifically, I would not change much.

What would you do the same?

- In continuing with the above, most everything.

What worked in your group's process?

- Most everything, we got along well, outlined clear rules, and contributed effectively

What didn't work in your group's process?

- I found no major issues with my group's process.

How would you improve the course?

- Finding some way to differentiate the class from 318's content would be beneficial. I think the best way to do this would be to add in more low-key hands on activities. Primarily by making the projects readily achievable, smaller scale goals, that can actually be developed. This is the second class I have had that plans out a project without actually delivering, so I think being able to deliver a working product would be an effective class improvement.

Reflection: Bita Astaneh Asl

What did you learn?

- As a civil engineer who had no idea about user interface design, all the material of this class was super useful.
- I believe, we engineers, don't learn how to think critically. What we are taught is to directly go to the problem. It works when you do mathematical problems, but when you are involved in real world problems, you can see some engineers start to see the lack of critical thinking skills. It has been over two years that I have started to train myself to draw maps for my thoughts. The materials of this class was great, and we could apply them to our hands-on projects. Our project was very challenging and I really enjoyed the way I started thinking about it from the scratch and developed it, then mixed it with other group members' ideas.

What did you enjoy?

- The first thing I really enjoyed was working with undergraduate students. I really like the energy they have.
- As mentioned before, I enjoyed applying the knowledge we gained to our hands-on project.

What didn't you enjoy?

- I wish we had more lectures instead of going through some assignments like good/bad interfaces. We could have some real project examples to see how the professionals do the design.

What was difficult? Why?

- I would like to use the word "challenging" instead of "difficult" to answer this question. The topic was very challenging. We did lots of research to understand the lunar lander and relative simulations and then tried to simplify it based on the limited time we had in this class.

How was it working in a group?

- As an old school student, I was really happy to see how the new generation is collaborating on projects online using different available communication and documentation tools like skype, google doc, and facebook efficiently. We basically were working face to face only on Fridays, and then working from home online.
- Team members were very supportive of other's ideas. We didn't face any type of conflict of ideas or interests, and we were trying to improve our design with mixture of everyone's ideas.

Do you think you'll use any of these techniques again? When?

- Of course. Better to say, I will use them in my daily life. It is not just about the user interface design. It is all about how to solve a problem, and map it.

What would you do differently next time?

- I would love to actually design it. As a Disneyland lover who visits the parks only to figure out how the rides are designed, I was thinking of different crazy features to add to the interface like installing jacks beneath the simulation room for simulating the take-off and landing. But due to the time and prototype construction limitations, we had to make it very simple.
- Next time I might try to create the prototype in unity for VIVE and test it.

What would you do the same?

- Creating the VR environment for immersive experience.
- Using haptic gloves

What worked in your group's process?

- As explained before, the teamwork went very smoothly.

What didn't work in your group's process?

- Finding a time to meet up and work on the project together. All of us had jobs besides the classes we were taking, and we had hard time finding a spot to get together. Sometimes we had to work separately.

How would you improve the course?

- As explained before, having more materials in the lectures rather than going through some of assignments like good/bad interfaces.

Reflection: Monica Lee

What did you learn?

- I learned a lot more about the details in the process of user interface design. I also learned about how “interfaces” don’t just refer to fancy gadgets and digital items - as we learned from the 3 interfaces assignment, there’s natural interfaces and also interfaces (like hairbands!) that serve as interesting interfaces to help us interact with our environment.

What did you enjoy?

- I enjoyed that I was able to learn more about and reinforce my knowledge of what goes into user interface design.

What didn’t you enjoy?

- I didn’t particularly enjoy the fact that even though we filled out a Catalyst survey before class about what topics we’d be interested in, we were randomly assigned topics unrelated to any of the 3 top choices that we picked in the survey (I think I chose crime as one of mine, but none of the topics seemed to relate to that).

What was difficult? Why?

- The topic that our group was given - it wasn’t really an interface that you could just design and test on a single screen (err I guess you technically could, but for our group it wouldn’t be ideal). We had multiple screens along with several physical components. This made creating the high-fidelity prototypes quite time-consuming since we had to create interactive screens for a main screen, a phone screen, and also figure out how to incorporate the physical aspects into them. Paper prototyping was particularly difficult since participants just had a really hard time envisioning that they’re in a VR environment with just paper pieces. The high-fidelity mockups alleviated this to some degree, but participants did have to be reminded that they were in a VR environment.

How was it working in a group?

- Our group was one of the few groups with only 3 members instead of the 4 members (due to some confusion concerning the course roster) that most other groups had. While this made the workload distribution a bit more difficult since we didn't have a 4th member to shoulder some of the load, we realized that having only 3 members in our group meant that we had an advantage since it was somewhat easier for us to schedule meet-ups (in-person or online) and make decisions since it was a three-way conversation with three opinions rather than with four opinions.

Do you think you'll use any of these techniques again? When?

- Yes - the techniques used in this class, like wireframing, storyboards, and prototyping, and creating task flows and system maps, are used frequently in the HCDE discipline. I anticipate that I'll be using some of the methods and techniques that were used in this class in future classes as well as in future jobs.

What worked in your group's process?

- As mentioned earlier, since we were a relatively small group (3 members, not 4) it was easier to bounce ideas off of each other and get quick feedback from each other.

What didn't work in your group's process?

- Well, this was kind of inevitable, but our schedules did have a lot of conflicts since each of us had activities or work outside of normal courses. So this didn't exactly leave us with a lot of time to meet up. When we did meet up, it would be in the late evening or at night, which wasn't really optimal since we all had early classes the next day.

How would you improve the course?

- I would try to make expectations and requirements for each phase clearer. It was a bit frustrating at times when we had to look at 3 different lecture slides just to compile everything that was required or expected on an assignment. It would've been nice to just have one or two pages to refer to rather than having to open up several tabs and windows to keep track of everything.
- I would have liked if we had more than just the Friday class to work in-person with our groups. Meeting outside of class is pretty hard when team members have work and other commitments, so it would've been really nice to have at least 30-45 minutes at the end of our Tuesday and Thursday classes to just debrief with teammates and polish up some of the assignments.

Part 3: Appendix Final Phases

Phase 0: Team Identity
Phase 1: Project Prospectus
Phase 2: Project Characterization
Phase 3A: Persona + Write-Up
Phase 3B: Storyboard + Scenario
Phase 4: Task Analysis
Phase 5A: Flipbook
Phase 5B: Flipbook Field Test Report
Phase 6A: Mockups
Phase 6B: Prototype Field Test Report
Phase 7: Presentation Slides

Part 4:

Archive