**Virtual Reality Design for Science**
**Assignment #5: Final Project**

Our final project for this class is to design an interactive virtual reality model for analyzing a scientific problem, the topic drawn from the work we have done with Profs. Gatesy and Crisco, with an emphasis on efficiency and efficacy of design. The first step is to determine a specific subject: you can continue work on a problem that you have already done for an earlier assignment, expanding and developing the representation of data, the interactive toolset, the animation and navigability of the model and the accuracy and density of the data visualized. Alternatively, you can move to a new topic, which can be configured in relation to a hypothesis of your own devising, but which grows from the interests of Steve and/or Trey. In this first development phase, we will be asking our scientist collaborators to comment on the potential usefulness or interest of the basic subject matter of each project.

**5.1 Subject and Hypothesis**
**Due Tuesday, 11/10**

Lay out your subject as a hypothesis: a certain interaction of forms and forces that might produce a certain result. This result could be medical (leading to a pathology like arthritis), evolutionary (leading to a change between or within species), evidential (like the shape of a fossil track) or mechanical (contributing to efficiency of locomotion or other movement) or any other outcome or area of interest you can envision. Your model should be constructed to allow efficient and fruitful study of your subject, but does not need to pinpoint any particular conclusion. In fact, if your model ends up disproving your hypothesis, ideally suggesting an alternative way of thinking about the subject, that is also valuable.

You should expect to do some further research as you configure your subject: first looking through the research materials provided to us by Steve and Trey, and then if necessary looking beyond through the internet, library or other sources. Within limits, our collaborators will be available to respond to questions about the science involved, but you should try to do as much on your own as possible.

By next week you should have a written proposal, which can include visuals, outlining your subject and hypothesis. You will present this orally to the class, but expect to hand-in the written version. Changes to the subject or hypothesis based on our discussions will be fine, but you should do your best to present a solid idea in this first iteration.

Virtual Reality Design for Science
Final Project
Assignment 5.2 Interaction Storyboard

Overview

Your storyboard should follow a Wizard of Oz performance you imagine giving of your Final Project, showing the explorations of a user navigating the VR space of the Yurt using the your devices and strategies to investigate and compare the features you include in your planned visualization. You should devise a user interface to facilitate the selection and use of the various visualization devices within the model. The interface might include real objects, such as wands, buttons etc. and also virtual objects such as color palettes, pull-down menus, etc. Your interface, real and virtual, might simply be an adjustment to the existing tools in the Cave, or it might more unusual, following a design metaphor—such as driving a car—in order to be more intuitively understandable for the imagined user. However, since Part B of this assignment will involve actually enacting the whole thing in the Yurt you should avoid impracticality of implementation or distracting complexity (for more info, see "Interface Design Details" below).

Your interface should be designed to legibly show complex data relating to the scientific hypothesis you have proposed. Because it is unlikely that all this information can be shown at once in a 3-D environment, you should devise an interactive selection strategy, including a visual "script" or "menu" for user choices, and various tools for exploring the visualization. Imagine the best way to visually highlight or isolate specific relationships, segments of data, or cause and effect "events" for study.

Procedure

Step 1. Choosing Features and Tools
Using lists and quick sketches, decide which features you are going to include in your storyboard sequence and how they might best be visualized. Maintain a priority for legibility and effective interaction between features you might want your user to compare in the visualization. Take into account moving forms, virtual 3-D space and time sequence. You should project yourself imaginatively into the VR experience, anticipating visual factors and interactions that might occur in the Cave. Your choices can certainly draw on your responses to previous assignments (or other people's responses).

As you refine your list of data features and tools, imagine your user conducting an exploratory process in a narrative sequence. The narrative sequence might follow one of these two options:

1. Connected Chain: a cause and effect sequence of force and consequence that supports a hypothesis and a revised hypothesis.
2. Pairings: an exploratory process of selection, combination and comparison of factors in pursuit of an answer to a posed question or hypothesis.

An example of a hypothesis/revised hypothesis that could provide narrative structure for your sequence could be:
Hypothesis: Lead foot entry deepens as trailing foot withdrawal forces increase.
Revised Hypothesis: Lead foot is pulled backward as trailing foot withdrawal forces increase.
Ideally, the sequence does not answer the question, but poses several possibilities, each with merit, for comparison. The science involved in your hypotheses or questions need only reflect you current understanding of the problems we have been studying.

Step 2. Interface Design Details
The tool set can include real objects and actions (wand, hand gestures, voice commands or physical objects) and virtual objects (color prism, 3D icons, etc.) All interaction will be simulated through the Wizard of Oz technique. Your interface should be as simple as possible, yet sufficiently detailed that our collaborators can meaningfully consider its utility. It should be intuitive in the sense that it can be easily learned, and later operated without a

"guide book." However, it should also be complete in providing a means to accomplish the required exploratory science. It should enhance the user's sense of connection with the virtual environment and the "realness" of the environment in the visualization.

You might try to imagine a "real world" metaphor for the "mood" of your interface (i.e. "scuba diving," "dissection lab" or "swamp") to give the experience a vivid, comforting, or otherwise evocative character. Concentrate on meaningful functionality and do-ability. Any metaphor is great as long as it's not distracting from the focus on visualization of the force and form. You must also strive for optimum usability by scientists exploring the real data. You might try to make commonly accessed functions easily or intuitively activated.

You can draw on earlier assignments for techniques and visual elements that you use here In addition your menu can suggest options that you do not fully explore in this story board. For this week, choose a set of actions and visualization techniques that will work well together in a short narrative sequence, even if that means leaving some things that you have in mind out for now.

Look over the readings on the course site:

J.J. Gibson: The Meaningful Environment; Affordances.
3D User Interfaces by Doug A. Bowman, Ernst Kruijff, Joseph LaViola, Jr. & Ivan Poupyrev; Three-dimensional menus: A survey and taxonomy, by Raimund Dachselt and Anett Hübner. Browse through Bill Buxton's page.

Step 3. Constructing the Storyboard
Draw/write a storyboard describing the various components of your visualization strategy and how they would be activated, deactivated, compared and studied by a user. The storyboard should follow a narrative sequence (as explained in Step 1 above). Begin with very simple diagrammatic sketches to develop a strategy for presenting your toolset and its use in time and VR space in at least 10 FRAMES. An excellent approach for planning your storyboard is to do many drawings on separate sheets of paper, and then "mix-and-match" the various frames, deleting and filling in gaps, until you get a sequence that works. For example, it is difficult to predict how "jump cuts" between frames will work until you actually see them together.

When you have your sequence, you can paste your sketches onto a piece of illustration board (18" x 24" or larger) and develop them as drawings, or redraw them in place on the board. Alternatively you can make your storyboard digitally and print it out at least 18"x 24". If you are going to use photos, it will probably be easier to sketch with a pencil, make your decisions, and then set-up to take the photos.

The storyboard itself should be fully understandable and even evocative of the actual experience in the Yurt. Captions are fine, but the pictures should really tell the story. It is important to think of the storyboard itself as a design project. It should be legible and visually involving. Think of possible strategies for suggesting the sequencing of narrative events. Frames within frames can show scaled-up details of the action, "cutaway shots" or inset images can connect the user's actions with their result, or with the aspect of the model the viewer is concentrating on. Continuity is an important factor. Study the "Murder" video or the storyboards in Fritz's slide show for techniques that might allow the viewer of your storyboard to understand the pacing and sequence of the action, as well as its narrative content in relation to the data set in the model. Comic books, movies or TV ads can also provide a model for interconnection of narrative through "montage" or sequential juxtaposition of images.

Your style of depiction is completely up to you. You can utilize a fully naturalistic drawing or a photographic strategy, or simplify the scenario to a diagrammatic representation. You can also integrate these two approaches, but the result must be narratively comprehensible, and include a role for the 3-D time-based character of the visualziation in the environment of the Yurt. Digital images or screenshots from the Yurt itself are fine, but should be printed out and pasted onto a real board, or integrated into a fully realized storyboard in digital form.