The Virtual Engineering Sciences Learning Lab (VESLL) project* is establishing an online interactive learning environment built around a functional laboratory designed to introduce students to engineering concepts through visualization and collaborative problem solving. Our long-term vision also includes creating a virtual version of a science museum such as the California Science Center in Los Angeles that provides virtual visitors the opportunity to delve into engineering concepts and maintain a sense of excitement about the concepts they experience.

**Objectives**

Virtual learning environment that provides
- Interactive visualization of basic engineering concepts
- Collateral pathways through the material supporting
- Diverse learning styles
- Diverse subject interests
- Immediate feedback to the student
- Wide access to
  - Course materials
  - Related assessment results

**Expected Measurable Outcomes**

- VESLL, a virtual laboratory classroom providing access to
  - To these materials
  - Related assessments
  - Assessment results,
  - Internet portal providing
  - Assessment results
  - Information about accessing VESLL

**Assessment**

We are developing assessments to evaluate both student performance as they learn about the behavior of logic gates and the efficacy of using the interactive virtual objects to augment classroom lectures.

**Formatative Evaluation**

(in part) summer workshops, where students will provide feedback on Lab activities.

**Summative Evaluation**

1. Workshop attendees will be assessed at the end of the workshop.
2. Students in undergraduate engineering and computer science courses using VESLL activities at LMU will be assessed at module boundaries.
3. Faculty members will be asked to judge VESLL’s effectiveness in helping students understand and apply abstract concepts.

**Logic Gates Lab**

Various gates, such as AND, OR, and XOR, are being created as scripted objects that can be connected to each other to design a circuit. The final output of the circuit will control an event such as making a waterfall or a fountain flow or triggering a similar event. The objects communicate by sending messages on specific channels to other objects which together implement each gate, with the output from one gate being fed as input to a subsequent gate.

**Digital Logic Lab**

The objective of the Digital Logic Lab is to explain simple digital logic concepts to students using interactive objects in Second Life. Students interact with objects to observe their behavior then manipulate the objects in response to problems posed by a virtual lab "instructor" or in experiments assigned by the real life instructor. We are implementing a variety of experiments, such as conversions between various numbering systems (binary, octal, decimal, hexadecimal), notations (two’s complement, excess eight), and logical operations (AND, OR, NOT, XOR). Some activities are implemented entirely in Second Life. Others utilize objects that communicate with a server program outside SL where the conversion is performed and the result returned to a display panel. The user will specify the conversion to perform. The panel can be used in a standalone fashion or coupled with a second panel where the student inputs her answer to a problem and subsequently verifies that she has the correct result.

**The Engineering Island Shuttle**

What is an island without transportation? The Engineering Island Shuttle is designed to give visiting avatars a tour of the S/HE Cafe, Sculpture Garden, Virtual Engineering Sciences Learning Lab, the engineering workshop, and other sites on Engineering Island.

The shuttle is implemented as a Second Life object powered by two scripts. The primary script is activated when an avatar sits on the shuttle, at which time the shuttle and passenger begin to move around the island to set destinations. Each destination is defined by three-dimensional Cartesian coordinates. At each destination, the shuttle rotates so that the bottom of the shuttle is facing downward and the front of the shuttle is facing the next destination. The primary script then sends the location number in a message via a hidden chat channel to the secondary script, which then outputs a narrative description of the location from a list of strings to the public chat channel. The shuttle idles at the location, with the wait time based upon the character length of the narrative. The shuttle's movement is not affected by intersecting environmental objects, and intermediate locations are added with a zero-character description. While the built-in coordinates and descriptions of the locations are part of the script, it can be easily adapted for tours and transportation in other areas.

* August, Stephanie E. and Hammers, Michele L. IEEC: Encouraging Diversity in Engineering through a Virtual Engineering Sciences Learning Lab. NSF Proposal no.0935100, 2009