MUSHI: Demonstrating A Multi-User Simulation with Handheld Integration

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ABSTRACT

Recent advances in handheld and Tablet based technology have paved the way for a unique style of simulation. Drawing upon Participatory Simulation research at the University of Michigan and the MIT Media Lab [1], the Multi-User Simulations with Handheld Integration (MUSHI) framework provides a powerful simulation medium to address issues of scale and emergence, and to facilitate collaboration among students. This multi-device framework allows multiple users to employ handheld computers to simultaneously view and interact with a simulation environment at different levels of granularity. This demo will feature MUSHI-Life: a simple natural selection simulation built using the MUSHI framework.

Keywords

Modeling, animation, handheld computers, natural selection, evolution, inquiry learning, collaborative learning

INTRODUCTION

Educational software development is no longer limited to developing single-user applications for deployment on desktop computers. Miniaturization and wireless communication advances have given us an ever-increasing array of portable devices, each with unique capabilities and form-factors. They range from small, lightweight devices, like cellular phones and handheld computers, to larger and more powerful machines, like laptops and Tablet computers.

Even with the multitude of devices, most educational software still only targets one form-factor or another. There is no reason however, why applications cannot be built that *span* different devices, taking advantage of the different display size, portability, and computational power characteristics of the different devices. The MUSHI framework does just that, allowing 4-5 students to independently observe and manipulate a shared simulation. The students view and manipulate a small piece of the simulation using their handhelds while simultaneously viewing the entire simulation on a laptop or Tablet style pc (see Figure 1).

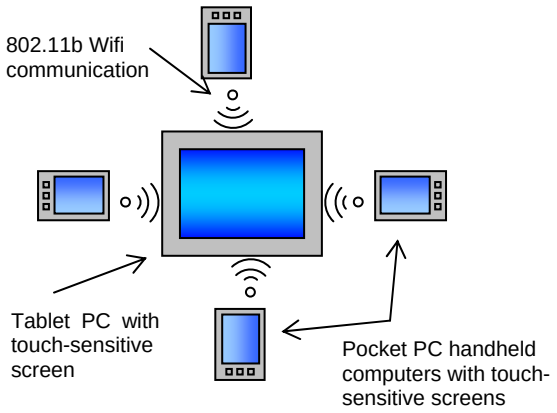

Figure 1: Topology of MUSHI system.

Imagine that a group of students is trying to learn about phase changes in matter. The global display would depict the material undergoing a phase change, for example, a melting block of ice. The students could gain additional understanding of the process by simultaneously inspecting the block of ice with their handheld devices. The devices would depict the water molecules breaking from their crystalline structure into a more amorphous form.

Prior Work

Other educational software has attempted to address complex systems, most notably StarLogo, a language / simulation engine that allows students to program a simulation from scratch [2]. Run on a desktop computer, only a single student ever works on a simulation at a time. The AgentSheets simulation environment [3] allows a

classroom of students to run the metabolic systems of a simulated human body. Each student has a handheld that controls a different metabolic function. A human body is projected onto a screen, so the students can see how their individual contributions impact the body's systems. StarLogo, AgentSheets, and MUSHI are based on similar principles, and all support students in making connections between the local- and global-level phenomena in complex systems. Our system, however, divides the classroom into small cooperative groups, which better facilitates inquiry learning and collaborative interactions.

Figure 2. Illustration of student using a Pocket PC to inspect creatures in the MUSHI-Life environment running on the Tablet PC.

Overview of MUSHI-Life

MUSHI-Life is a survival / inheritance simulation built to explore the benefits of the MUSHI paradigm. The simulation runs on a laptop or Tablet PC, and depicts an environment populated with insect-like creatures that eat, fight, and breed according to a simple rule-based system. Each creature possesses its own unique genetic makeup, which gets expressed as different phenotypic traits that can either help or hinder its survival depending on the environment. Handhelds are used as "microscopes" to inspect the creatures or their environment in a high level of detail. Students can work together to develop a variety of experiments using the MUSHI-Life environment.

DEMONSTRATION DESCRIPTION

In this demo, we will show the major features of the MUSHI framework by demonstrating a sample inquiry learning task that would be given to students using the MUSHI-Life simulation and curriculum. Before students can come to grips with the long term results of survival and inheritance, they must first understand how an organism's phenotype can affect its ability to survive. Thus the demonstration will present the first few learning tasks that revolve around building this understanding in the students.

Demonstration Use Case

A Pocket PC is turned on, and the MUSHI-Life client application started. It auto-detects the presence of the Tablet PC, using a wireless connection. The user is prompted to enter a login, and a "zoomed-in" view of the environment is presented on their Pocket PC. Simultaneously, a rectangle appears on the Tablet screen to indicate the region of the simulation environment that is being displayed on the Pocket PC. The user can "steer" their view through the simulation by pressing the directional pad on the Pocket PC. By pressing the select button the user can "lock on" to the nearest creature. Once locked-on, the creature remains centered in the Pocket PC window, and the view follows the creature as it moves through its environment. This way, the user can observe the physical and behavioral charateristics of the creature. Pressing the select button press allows the user to "pick up" the creature, which allows a deeper examination of the creature's phenotypic characteristics (such as its mandible type). The user can then "carry" the creature from one location to another, and "drop" it elsewhere in the environment, perhaps within the proximity of an environmental element it might interact with.

Demonstration Learning Task

As part of the learning task, the student(s) is prompted to make some predictions about their species. He or She must then use observations (and minor manipulations, such as moving a creature elsewhere in the environment) to find support (or contradictions) for their predictions.

FUTURE WORK

As a new educational software paradigm, we plan to test MUSHI on a host of usability issues, with single users (to assess the degree to which the dual-display is comprehensible) and groups of users (to assess the degree to which the MUSHI framework facilitates cooperative inquiry learning). We are also curious to see how well the MUSHI framework works in both formal classrooms as well as in an informal learning setting, such as a science and technology museum.

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