WiiLab: Introducing Computational Thinking Through 3-D Interaction and the Nintendo Wiimote

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Premise

Computing power has become increasingly pervasive in modern society. A primary obstacle to harnessing such power is understanding the interface to the computing system itself, namely how to interact and design computational solutions.

How do we foster an increased appreciation for computational thinking throughout the engineering curriculum?

Area: Teaching Leading Edge Knowledge

Introduction and Objectives

- Possess a basic understanding of foundational computational thinking concepts
- Be able to apply computational thinking concepts in domain-specific environments (MATLAB, Java, C#, etc.)
- Understand and be able to articulate limits of computation with respect to real-world problems

Developmental History

We have developed WiiLab, a new, engaging, and intuitive interface for interacting with computational learning materials via the Nintendo Wiimote. WiiLab supports the capture of 3-D motion, a natural means of gesturing for human learners and includes a variety of modules to promote collaborative exploration of computational principles.

WiiLab Learning Materials and Activities

Through a NSF CCLI grant, we have developed the WiiLab suite of tools which includes the core MATLAB support for the Wiimote as well as various design tools and example lab materials. The platform is based in Microsoft Windows with support for MATLAB, Java, and C#. Example materials range from MATLAB and C# skeleton code to full, design environments (WiiDoRF) that include the ability to instrument interactive materials. All code is made freely available via Subversion and zip file forms. Platform support includes Windows Vista and Windows 7 as well as 32 and 64 bit variants of each.

Modules for WiiLab can be employed for either augmented lectures or hands-on laboratory materials at a variety of educational levels. For instance, a lecture might demonstrate arrays utilizing the Wiimote and a large wheel from the Price is Right. Conversely, students might explore and design algorithms exploring concepts such as sorting with twists incorporated for bottlenecking and scaling.

http://netscale.cse.nd.edu/WiiLab

Moving Beyond Local Adoption

The major issue with respect to WiiLab is how to transition and get the materials in front of educators who would like to incorporate the tools into their curriculum. Although we have seen reasonable popularity in terms of individuals accessing the material (approx. 50 downloads / month), we would like to transition the material beyond Notre Dame.

We would like to gather feedback about what modules / frameworks are appropriate beyond our Engineering curriculum at Notre Dame and the extent to which other devices may be needed. For instance, is there enough interest in Kinect for a simple port? Is there interest in Arduino-based frameworks to teach computational thinking?

We are also curious to gain insight with respect to deployment / usage obstacles. For instance, how might one make the Wiimote accessible? Is it through a central lab administrator, student purchase, or other alternate means? What is the minimum lab setup that would be viable and are licensing issues such as MATLAB an issue?

Assessment / Results

We are currently in the process of finalizing the release version of WiiLab and conducting student testing with regards to computational thinking. The pool of students are primarily freshmen and sophomore Psychology / Engineering students drawn from our Intro to Engineering and Into to Psychology courses. Results will be submitted for publication in the spring of 2012. Prior results have been published in FIE regarding WiiLab and WiiDoRF.

Preliminary Results / Conclusions

The reaction to WiiLab has been far beyond what we had expected. While we had envisioned the tool primarily as one oriented towards teaching, the vast majority of the applications have used the simplified interface for a variety of applications. Example abound ranging from measuring the force for CPR to instrumentation of Wii games for cystic fibrosis to incorporating the Wii balance board for stroke rehabilitation.

The work is currently funded by NSF and will be finishing its evaluation for publications in FIE and Trans. Education this coming year.

This work was funded in part by the National Science Foundation through grant DUE-0942067.

2011 Frontiers of Engineering Education Symposium

Irvine, California
November 13 - 16

Sponsored by:

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