Project Name

Science and Engineering Everywhere, at Anytime, and for Everyone

Principal Investigator Monica Bugallo

Campus Stony Brook University

Year of Project 2012

Tier Tier One

Project Team

- Helio Takai, Brookhaven National Laboratory

Overview Summary

Pilot program to engage undergraduate students in authentic science and engineering by developing and using modern cybertools. Supports and engages high school and at-risk students in STEM based learning.

Outcomes Summary

Exercises to promote STEM understanding are in the report, along with links to web resources.

Project Abstract

The information age that we are immersed into is characterized by the ability to transfer data freely and to have instant access to knowledge that would have been difficult or impossible to obtain previously. Regardless the level of use of cybertools in our lives, acquiring computer literacy and use it to obtain further knowledge has become an essential part of our educational process.

This project aims at creating an instructional innovative pilot program for engaging undergraduate students in authentic science and engineering by developing and using modern cybertools in an easy and attractive way. Motivated by the mission of building, operating and analyzing data of an experiment designed to investigate

the relationship between cosmic rays activity and climate changes, we plan to offer research projects and seminars for undergraduate students who will help building a webportal and the necessary hardware and software instrumentation for offering science and engineering everywhere, at any time and to everyone.

The project is naturally aligned with the vision of the IITG Program and has three interconnected goals:
- Establish a collaborative environment to explore forefront science and engineering by effective use and development of cybertools (webportal, hardware and software tools).
- Stimulate students into science, technology, engineering, and mathematics (STEM) careers through science and technology-oriented hands-on activities.
- Assess the effectiveness of the program and disseminate it to broader audiences.

The experiment welcomes the participation of students in various fields. Engineering students will develop tools for data acquisition (electronic circuits based on Arduino's to measure weather-related parameters); Computer Science and Engineering majors will implement the webportal and software applications; and Physics students will analyze data. Other sciences are welcome to participate, learn about the experiment and develop cybertools. We will offer a menu of activities in the form of Senior Design Projects in the Electrical and Computer Engineering (ECE) department (academic year); academic- and summer-long projects offered jointly by the ECE and Physics departments and Brookhaven National Laboratory (academic/summer offering); two-day seminars for undergraduates in any Science or Engineering major (two per semester); and four-week seminars (WSE 187) through the Women In Science and Engineering (WISE) program (two in the Spring semester).

The core of the project will start with the implementation of a new webportal that will combine two paradigms: social network and content management system. The system will be geared towards the science and engineering educational/research environment with some of the initial data and tools already established by the PI-team through previous initiatives. The underlying development tool will be based on the open source softwares Drupal/Elgg, which are popular frameworks for content management webportals and social networks. Some services of the new webportal will be:
- Public interface with general information about the project and basic materials to participate.
- Participant registration management to gain access to data, documents, and discussion forums.
- Services for data upload and download.
- Online tutorials to guide data analysis and development of cybertools.
- Online research journal where participants will submit research findings and reports.

The new webportal will provide dynamic reporting and logging of activities. Students will update their profiles with postings, questions, comments and results in a way similar to that of Facebook or Twitter. The PI-team through previous initiatives has a system based on the concept of wiki used to keep record of the experiment's progress. We plan to modernize this service to establish a social network engine server for better communication among participants. We also plan to develop open-sourced collaborative and visualization tools including a wiki-based document editing software to produce high quality PDF outputs and an interactive online document exchange system. A server already located at Stony Brook University will host the webportal.

The second important task will be the development of application software (apps) for the webportal as well as for mobile computing devices to facilitate data analysis. Inspired by new trends on computing where tablets are interfaces for remote computing, the apps will provide user-friendly access data from the experiment. The goal will be to make analysis possible from any location with either a simple connection to the Internet or through mobile devices. The apps will serve as interface with the data repository to obtain data and download results. The use of mobile computing will also facilitate the delivery of seminars at any location using our portable data distributor, data on the go.

Students participating in the project will be involved in understanding the science experiment and will contribute to the creation of the webportal through their interests (i.e., creating apps, developing the web, programming data collection algorithms, implementing sensors, or analyzing data.) Students will need to learn

the problem and technology at hand and offer the best solution for their contribution.

As result of this initiative we expect to have a complete set of cybertools available through the new webportal that will allow students to access data and perform analysis from anywhere and at anytime. Other outcomes will include materials and presentations for delivery of seminars and for assessment of the program and communication of findings.

We believe that the proposed work can easily become a platform for informal learning for broader audiences and we will make it available to other SUNY institutions with the cooperation of faculty in engineering and science schools. We also plan to pursue different means of financial sustainability.

Reports and Resources

- Project website
- Course overview
- Project description summary

Instructional Design

- Student Engagement