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Touching the Untouchable

This issue focuses on a LA EPSCoR outreach project funded by the Board of Regents Support Fund for the development of a new way to reach out and touch science at the LIGO (Laser Interferometer Gravitational Wave Observatory) Science Education Center in Livingston, LA and two public schools.

Imagine being able to see what would otherwise remain invisible. To make the untouchable, touchable. To understand connections linking science at scales 1/1000th the size of an atom's nucleus to the trans-galactic.

Imagine K-12 students being able to do that, learning science in much the same way they play multiplayer video games.

Thanks to a research team developing a kiosk with interactive technology for the Science Education Center at the LIGO facility in Livingston, LA, that prospect is in late stages of design. It will soon become a reality at LIGO and, within the near future, two public schools, one in south Louisiana, the other in north Louisiana.

"In a good science classroom students have hands-on lab experiences with subjects like biology and chemistry. The LIGO challenge is that they are working with physical scales that normally remain inaccessible to direct physical experience," says Dr. Brygg Ullmer, LSU Assistant Professor of Computer Science, who leads the kiosk design team.

Three children in Louisiana demonstrating the long-range collaboration capabilities of the kiosk project's new technologies by jointly controlling a hurricane visualization with two children in North Carolina.

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"As context, our LSU research group under the auspices of a National Science Foundation (NSF) EPSCoR grant, has been developing physical tools for scientists to collaboratively manipulate visualizations of phenomena like the flow of fluids in complex domains, storm surge predictions and the movement of hurricanes, to name a few.

They allow individuals with diverse experience to visualize complex results in understandable images and manipulate underlying parameters that profoundly enhance scientific discussions on the data.

"With the LIGO scientific context and Board of Regents support, we have

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A Word About LIGO

LIGO, a facility that opens a new window onto the universe by delving into the fundamental nature of gravity, is actually two widely separated U.S. installations—one in Livingston, LA, the other in Hanford, WA—operated in unison as a single observatory.

LIGO, acronym for the Laser Interferometer Gravitational Wave Observatory, is a scientific collaboration of the California Institute of Technology and Massachusetts Institute of Technology.

Funded by the National Science Foundation (NSF), it is dedicated to the detection and measurement of cosmic gravitational waves—ripples in the fabric of space and time produced by such violent events as the collision of two black holes or shockwaves from the cores of supernova explosions.

NSF, through cooperative agreements with Cal Tech and Southern University in Baton Rouge, funded a Louisiana-based educational partnership to build the LIGO Science Education Center (SEC) in Livingston. SEC exhibits and programs have been developed by, or in consultation with, the San Francisco-based Exploratorium®, www.exploratorium.edu, described by many as "the best science museum in the world."

SEC's goal is to communicate physics and math concepts to students and teachers through interactive science exhibits, teacher workshops, outreach and professional development. LA GEAR UP (Gaining Early Awareness and Readiness for Undergraduate Awareness) and LaSIP (Louisiana Systemic Initiatives Program), under the Board of Regents, partner with SEC to reach students and teachers from economically-challenged schools.

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been pursuing ways to bring these kinds of tools to much younger hands and minds, and make a real impact on broader audiences."

On recommendation of Dr. Kerry Davidson, Director, LA GEAR UP (LA Gaining Early Awareness and Readiness for Undergraduate Programs), the team received $150,000 from the Board of Regents to design and deploy the interactive kiosks to LIGO and two state middle schools, one in the south, the other in the north.

Referring to the efforts as a new way for students and teachers to reach out and "touch" scientific content, Dr. Ullmer describes the project as an ambitious mix of content development, physical interaction, and software design.

The areas of concentration are sciences related to LIGO, the Exploratorium® exhibits (see *A Word About LIGO*, pg. 1) and the Louisiana EPSCoR 12 million dollar CyberTools project funded by NSF's EPSCoR program.

A stationary kiosk for stand-alone use, as well as a mobile platform for easy movement between schools, are in development. Among other activities, the in-school kiosks will be used to support pre- and post-LIGO Science Education Center visits.

"Our primary target is middle school students. At this stage, students have accumulated some scientific background, but not yet reached the high school years when many 'turn off' to science," continues Dr. Ullmer.

"We believe these installations hold a strong potential for a new level of engagement at this critical moment in their lives— one that could positively impact the number of students entering the science pipeline at the high school level."

Dr. Ullmer, who holds a joint appointment with LSU's Center for Computation and Technology and is a member of the CyberTools Visualization Team, cites

A working prototype of the handheld interaction tablet, which combines an embedded Internet tablet and a physical knob to engage children to interact with the interaction kiosk.

two innovations that differentiate the LIGO outreach tangibles from other efforts:

"We are using multiple PDAs—phone-like computers with physical knob input—allowing two or more students to interact with the science content of the kiosk and to interact and compete with each another. They can, for example, look at images from the popular Powers of Ten science movie or the Hubble space telescope and estimate whether an image is at the scale of a cell, a tree, or our solar system.

"We also employ electronic radio-frequency identification (RFID)-tagged physical 'menus' that provide both teachers and students with new ways to access interactive content, as well as automatic evaluations and scores in response to the integrated questions. 'Hooks' for extending games to remote competition with other cities, states, or countries are also being built in," he continues.

"My dream is to have students in Ruston, New Orleans, Baton Rouge and, for example, the Czech Republic, interacting with one another through these new physical/digital devices."

The system's design and content were developed by a team of undergraduate and graduate students in computer science, electrical engineering, graphic design, physics, and philosophy, with minors ranging from fine arts to economics.

Noting that the project is now assembling a science advisory board of both university and middle school scientists and educators, Dr. Ullmer adds that his team hopes to leverage the Board of Regents support for the future development of kiosks targeting undergraduate students.

"We aspire to develop a compelling, evaluated proof of concept that could eventually result in statewide, or even regional or national, deployment."

"This unique LIGO science education center project, developed by Dr. Ullmer as a dimension of Louisiana EPSCoR outreach program, adds a fascinating facet to Louisiana's school reform landscape," concludes Dr. Davidson.

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