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Experiment to outfit classroom with sensors

JOANNA GAN/Daily Bruin
Electrical engineering graduate student Philipp Steurer, working under Mani Srivastava, explains how their table top senses devices placed on top of it.

By **Christian Mignot**
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Electrical engineering Professor Mani Srivastava's seven-year-old daughter Megha provided the initial inspiration for a research project that may provide groundbreaking results in the fields of education and computer science.

Srivastava's purchase of a wireless educational toy that allows parents to survey their child's interactions through a PC spurred him to imagine the larger implications.

Along with his team of faculty assembled from the departments of electrical engineering and computer science and the Graduate School of Education and Information Studies, Srivastava plans to outfit an entire first grade classroom – from inanimate objects like wooden building blocks and tabletops to the students themselves – with tiny electronic sensors.

"We want to use these devices in a classroom setting to see what we can infer from student's interactions and how they are associated with academic performance," Srivastava said.

The sensors are part of a new generation of devices that create sensor networks to sample physical environments and collect data.

The lessons this experiment may provide – including potential insight on teaching techniques, the speech of children, and the application of software and hardware in novel environments – have been deemed important enough for the National Science Foundation to provide $1.8 million in funding grants.

Students will wear caps with sensors called "iBadges" pinned to them, Srivastava said. These badges will track the location of the child and the physical orientation of the child's head, as well as capture their speech with small microphones.

Objects, such as puzzle pieces or board games, will be wired with sensors and used on task tables with magnetic systems under them to track location and usage. This will enable researchers to study the processes a student uses to complete tasks set by instructors.

In addition, a series of microphones and cameras will be placed at various locations around the classroom to further monitor students' activities. Srivastava said sound

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clips gathered from the microphones would enable researchers to study the speech of children – particularly those who are bilingual.

"With the microphones we can tell, for instance, when the students will switch from using English to Spanish or vice versa," he said.

All data collected by sensors, cameras and microphones is routed through a central computer system utilizing software called Sylph, designed by computer science professor Richard Muntz.

"This isn't the traditional kind of data – it is both multimedia and sensor data which is not very precise," Muntz said. "Capturing it and being able to process it is a complex problem."

Muntz said the program is designed to collect queried data from sensors, store data and query archived data once it has been stored. Most importantly, he said the program includes data-mining capabilities, which implies distinguishing patterns among collected data.

"Data mining has been a growing field in the last decade," he said. "Data collections are too overwhelming for humans to study so we are now using programs to help in the assessment."

Researchers from the UCLA Center for the Study of Evaluation of the GSE&IS, which assess the quality of education and standardized testing in the United States, have also been working with Srivastava to determine how the classroom application of sensor technology will affect student learning.

"It's like developing a new thermometer to measure kids interaction," said Gregory Chung, a senior researcher for the CSE.

Chung added that sensors would allow teachers to pay attention to the problems of individual students through the assessment of their performance in small group interaction scenarios.

"The problem for teachers is that they cannot usually pay attention to each student across all groups," he said. "The feedback will allow teachers to better instruct their students."

Full deployment of the sensors in a classroom will begin next spring, Srivastava said. As of now, only preliminary testing with groups of four or five subjects has occurred.

Srivastava said the project itself has further implications for the future of computers in the life of humans.

"This will be an example of how humans will use computers to create smart environments," he said. "The use of sensors in this manner will allow people to talk and interact with the physical world."

CREATING A "SMART" ENVIRONMENT

Professor Mani Srivastava and his team of researchers plan to outift an elementary school classroom with sensors designed to monitor the environment's physical state. Information about the interaction of students with their classroom and about the speech patterns of students may provide insights leading to changes in educational practices.

Location	Description
Students Heads	Sensors located in a badge ("I-Badge") to be placed on CAPS which are worn on the students heads. These capture the orientation of the childs head, the location of the child in the classroom; it also measures the temperature and humidity of the classroom. The badges also contain microphones to capture the speech of the children.
Ceiling	Nodes to be placed on the ceiling of the classroom which emit radio signals communicating with the I-badges. These track the position of the children and relay the data to the central computing system.
Innate Objects	Innate classroom objects such as building blocks are outfitted with magnetic sensores. Students use objects such as the blocks for designated activities on the tables in the classroom. These tables are outfitted with magnetic systems to track location of the objects and determine which objects are used.
Various	In addition, there are wireless cameras and wireless microphones placed at various places in the classroom to monitor student activities.

SOURCE: Professor Mani Srivastava, Project Coordinator