

# SUMMIT

Sponsored by  
Engineers of the Future Program of  
the New York State Education Department

Polytechnic University  
Mechanical Engineering

Project URL: [mechatronics.poly.edu/summit/](http://mechatronics.poly.edu/summit/)

# ORIENTATION



SUMMIT

Funded by The New York State Education Department

# Project Director



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# Project Instructor

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# Laboratory Etiquette

- E-mail checking, chatting, web browsing, listening to music, singing, and running around not permitted in the lab
- Do not touch experiments unrelated to your work
- **No Food and drink**
- Keep this room as clean as the work allows
  - after experiments, put all components in their original place with the same original condition
- Sign on the attendance sheet

# Laboratory Safety Guidelines

- Do not work alone or unsupervised
- Do not operate any equipment with indication of damage
- Do not let wires hang loose
- Do not touch unshielded wires
- Do not subject components to power higher than their ratings
- Do not touch components subjected to excessive power
- In the case of safety hazards or serious injury:
  - Warn others
  - Inform instructor or technician
  - Remove yourself from danger

# Schedule

Start Date	July 16, 2007 (Monday)
End Date	August 10, 2007 (Friday)
Period	4 weeks (Monday–Friday)
Time	8:30am–5pm
Lunch Time	12:30pm–1:30pm
Location	RH514B

	Mon	Tue	Wed	Thu	Fri
1 <sup>st</sup>	July 16	17	18	19	20
	Registration & Opening	Lecture, Lab, and discussion			
	Orientation	Lecture, Lab, and discussion			
2 <sup>nd</sup>	23	24	25	26	27
	Lecture, Lab, and discussion				
3 <sup>rd</sup>	Lecture, Lab, and discussion		Brain storming for project		
	30	31	August 1	2	3
	Building the project, report preparation, and presentation slides				
4 <sup>th</sup>	6	7	8	9	10
	Building the project, report preparation, and presentation slides				Presentation

# Lecture Schedule

	Topics		Topics
Lecture 1	Resistor	Lecture 10	Thermal sensors
Lecture 2	Mechatronics	Lecture 11	Robotics
Lecture 3	LED	Lecture 12	Infrared sensor
Lecture 4	Button	Lecture 13	Transistor
Lecture 5	Capacitor	Lecture 14	Relay
Lecture 6	Optoelectronics	Lecture 15	H-Bridge
Lecture 7	ADC	Lecture 16	DC motor
Lecture 8	Servomotor	Lecture 17	RC filter
Lecture 9	555 timer	Lecture 18	Op amp

# Making Groups

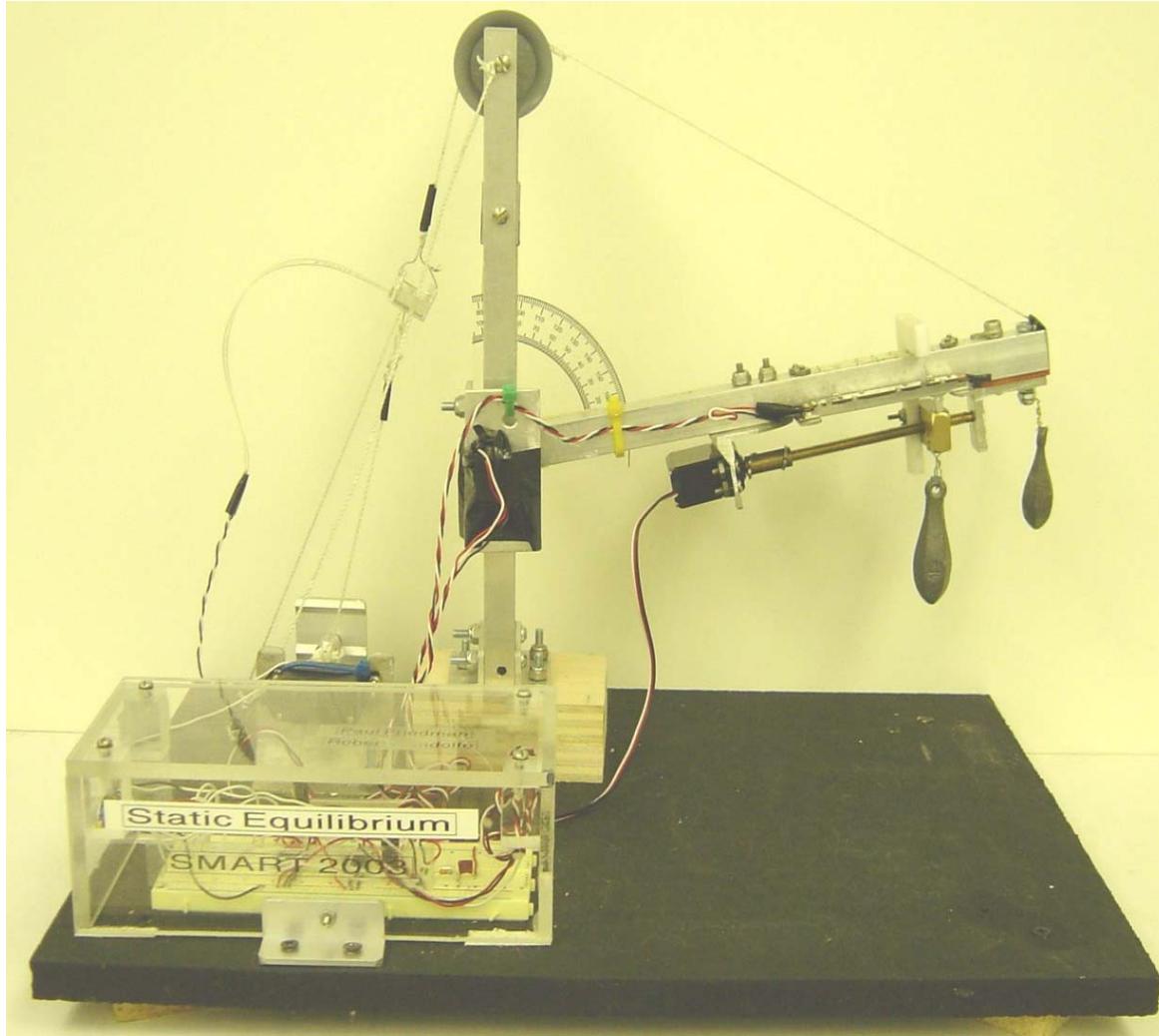
- Make 10 groups
- All structured projects and final projects will be done in the same teams

# Ice Break

- Name
- School
- Specialty
- Hobby
- Goal for the SUMMIT program
- Others

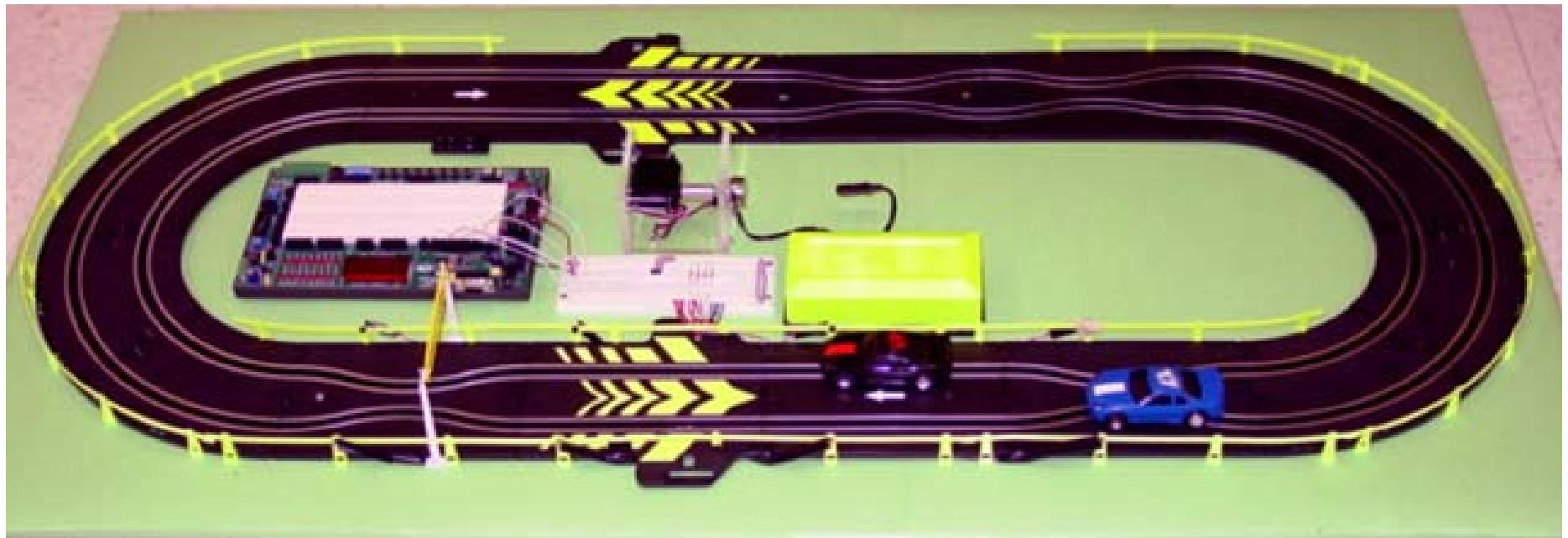
# SMART 2003 Projects

# Static Equilibrium



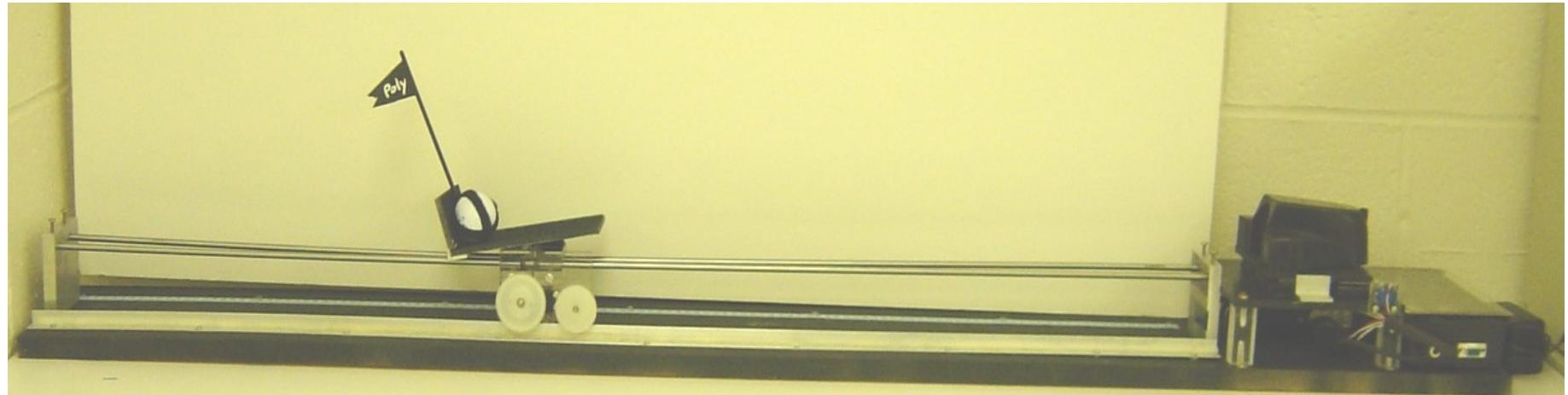
Teachers: Robert Gandolfo & Paul Friedman

# The Smart Road



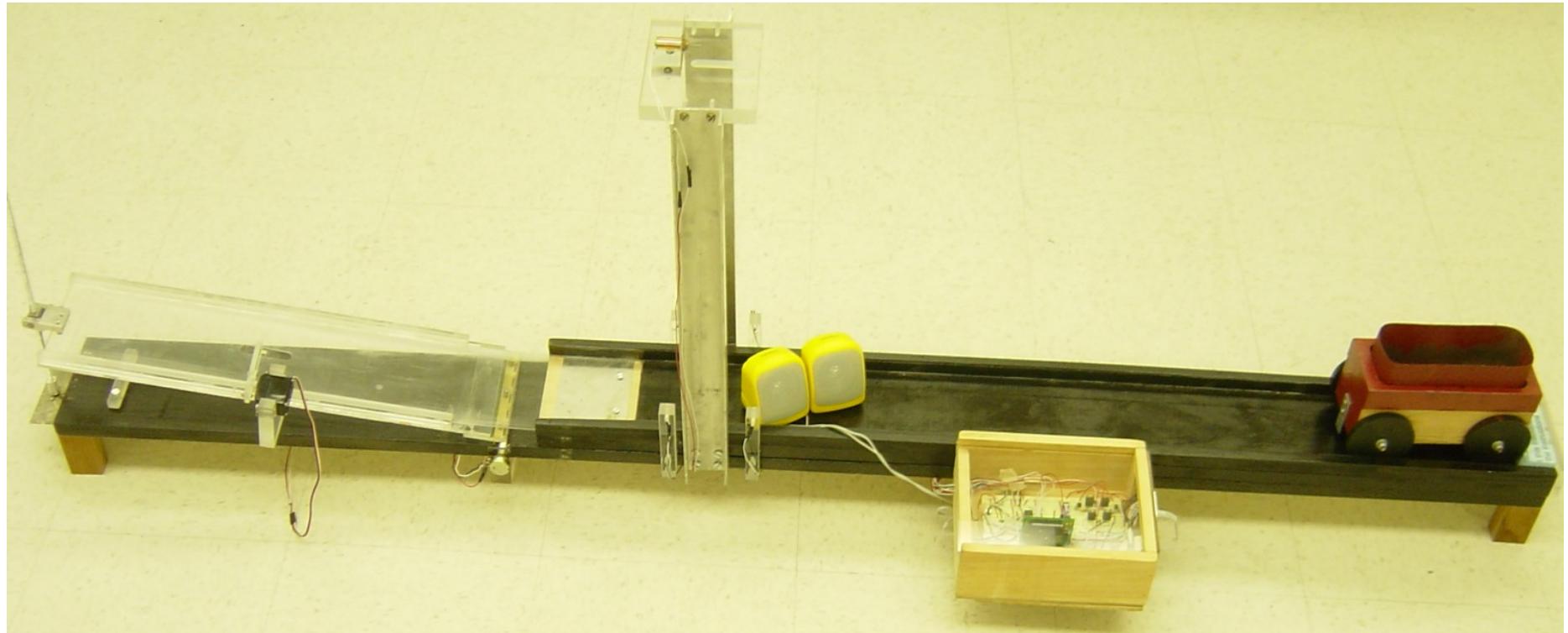
Teachers: Clay Davis & Richard Balsamel

# Catch Me If You Can



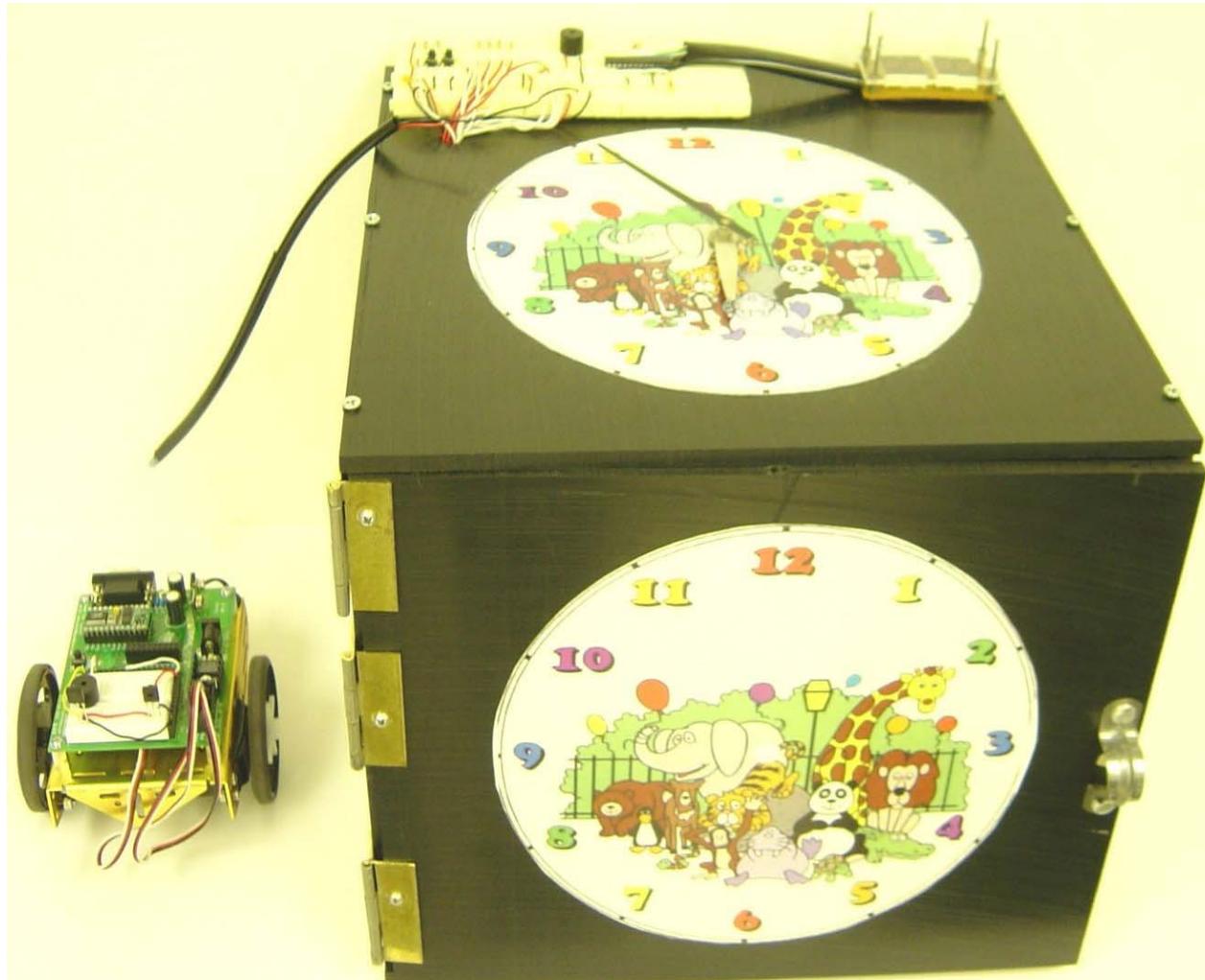
Teachers: John Luvera & Michael McDonnell

# The Physics of Projectile Motion



Teachers: William Leacock & Marlene McGarry

# The Ro-Boe-Clock

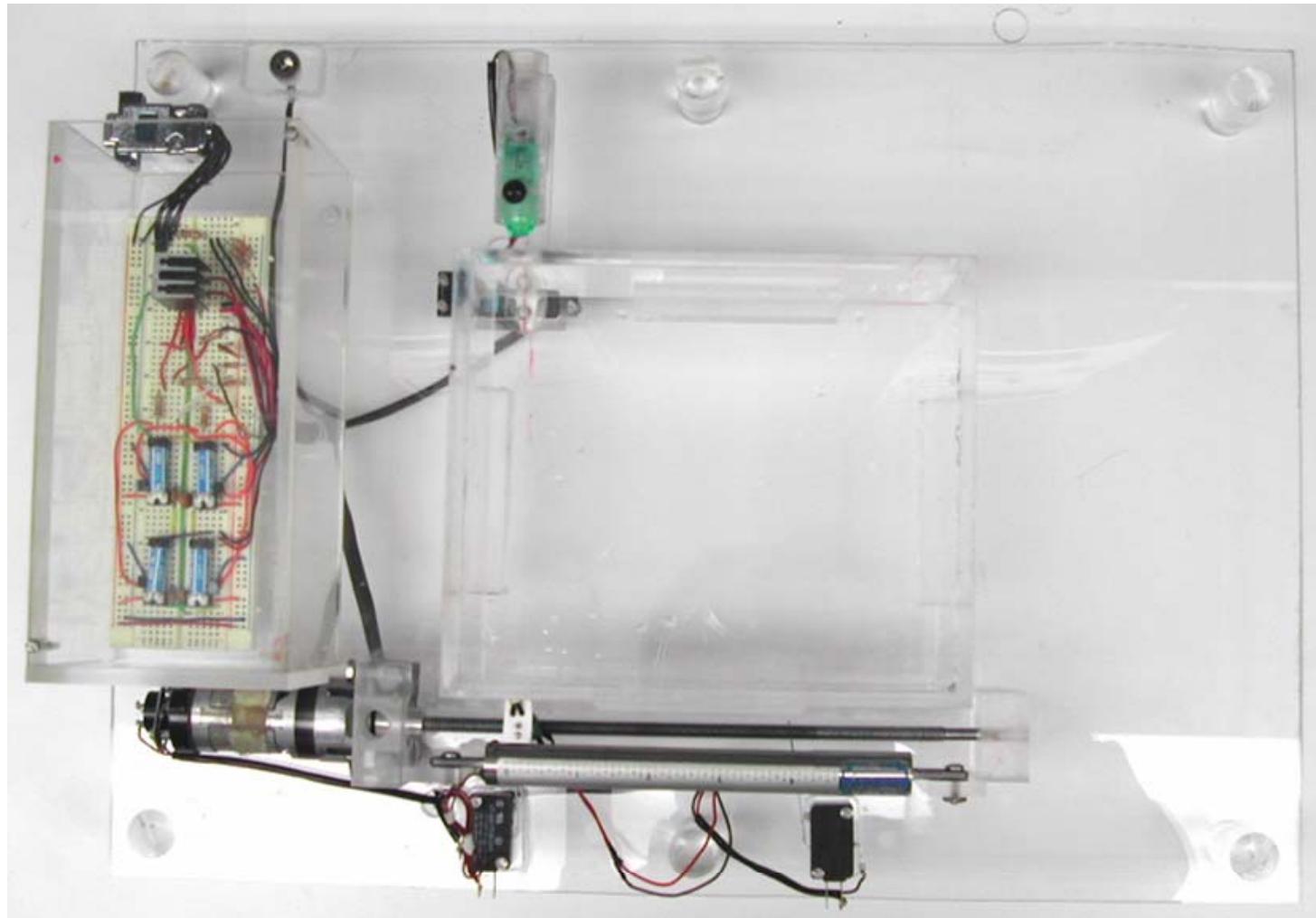


Teachers: Michelle Carpenter-Smith & David Deutsch

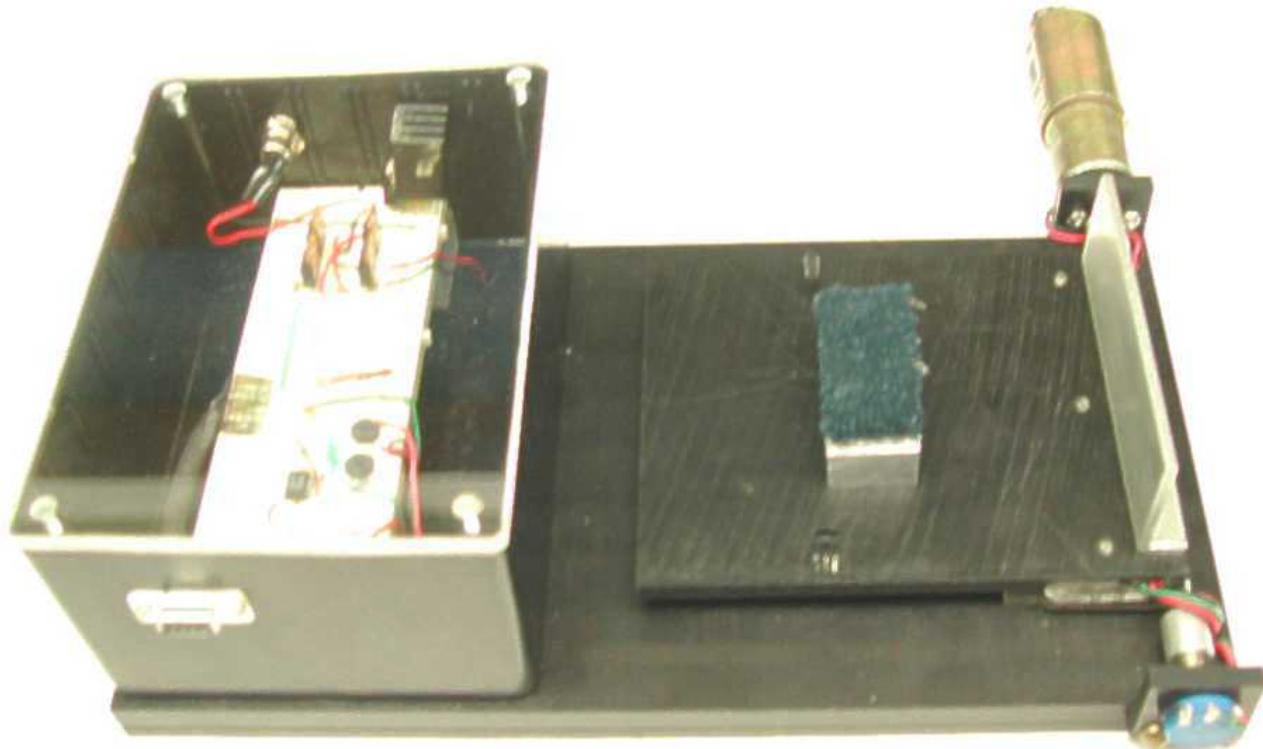
# Reflection Experiment



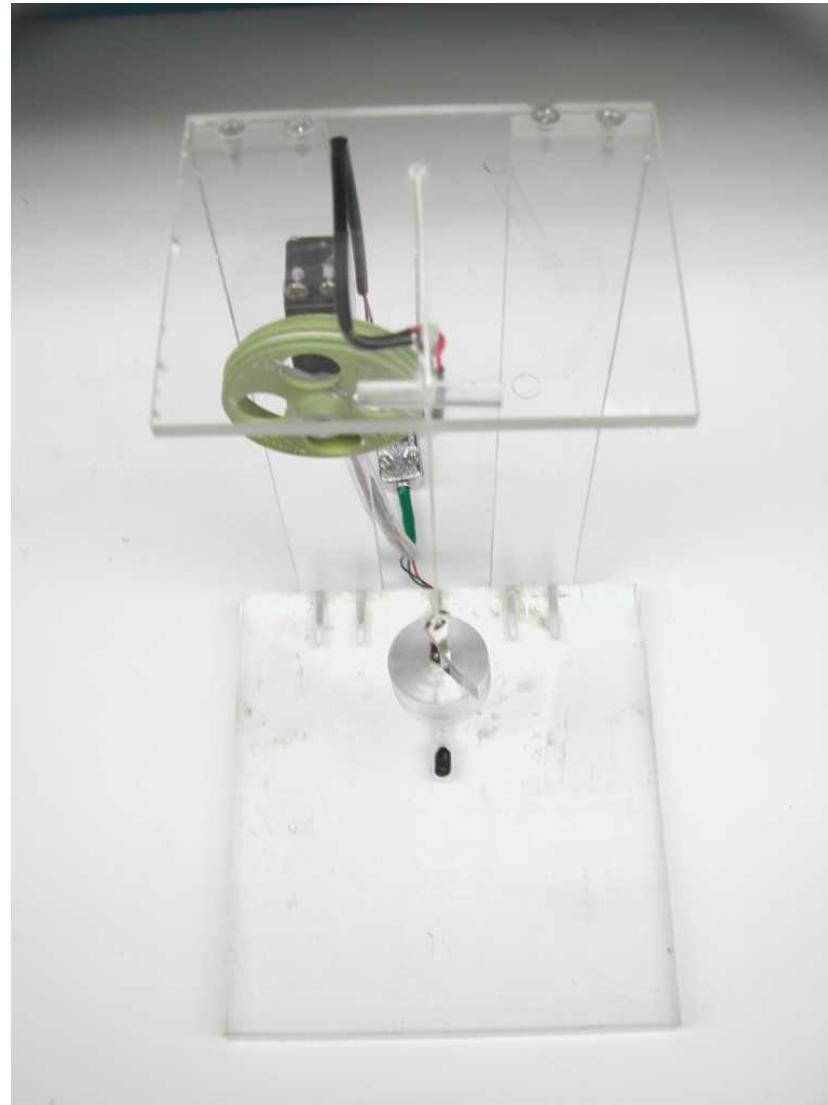
# Refraction Experiment



# Static Friction Experiment



# Pendulum Experiment

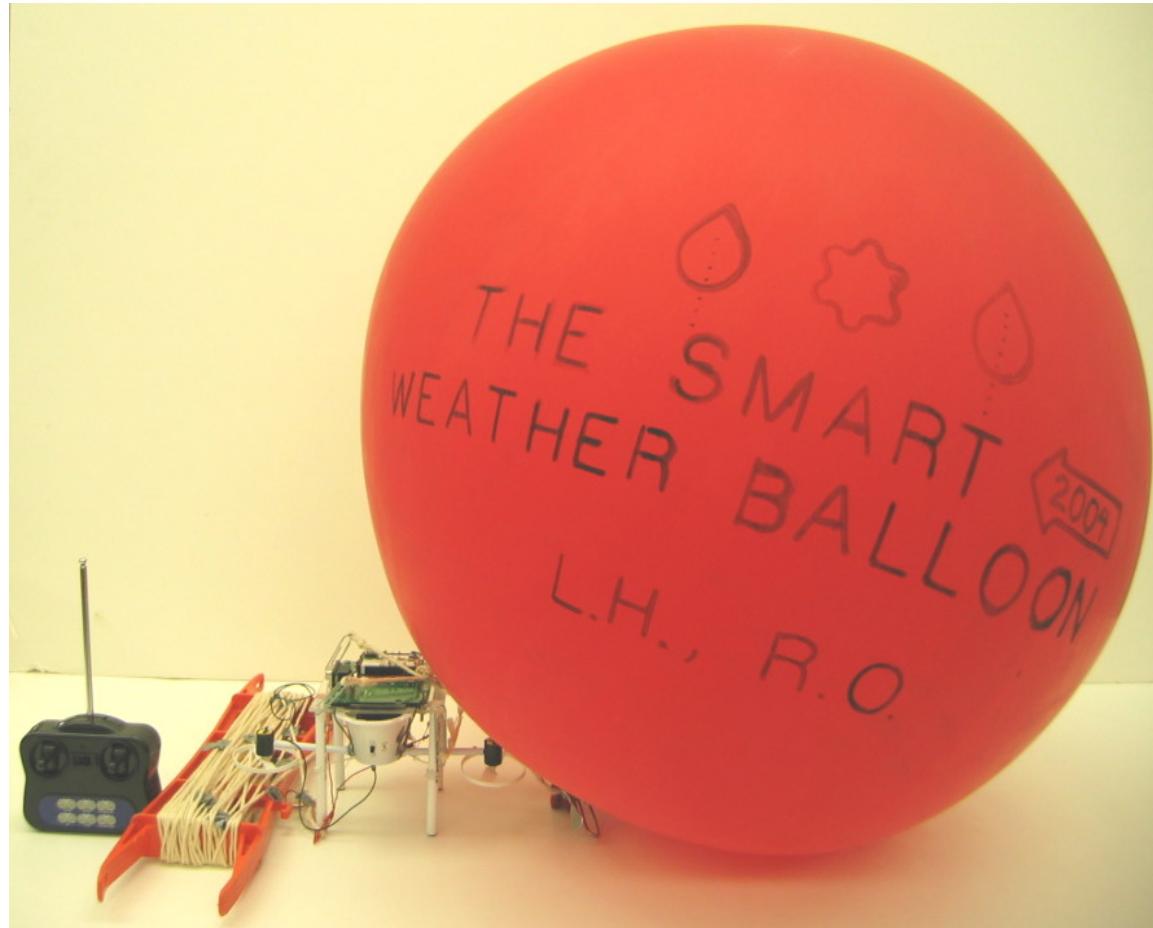


# Heat Conduction Experiment



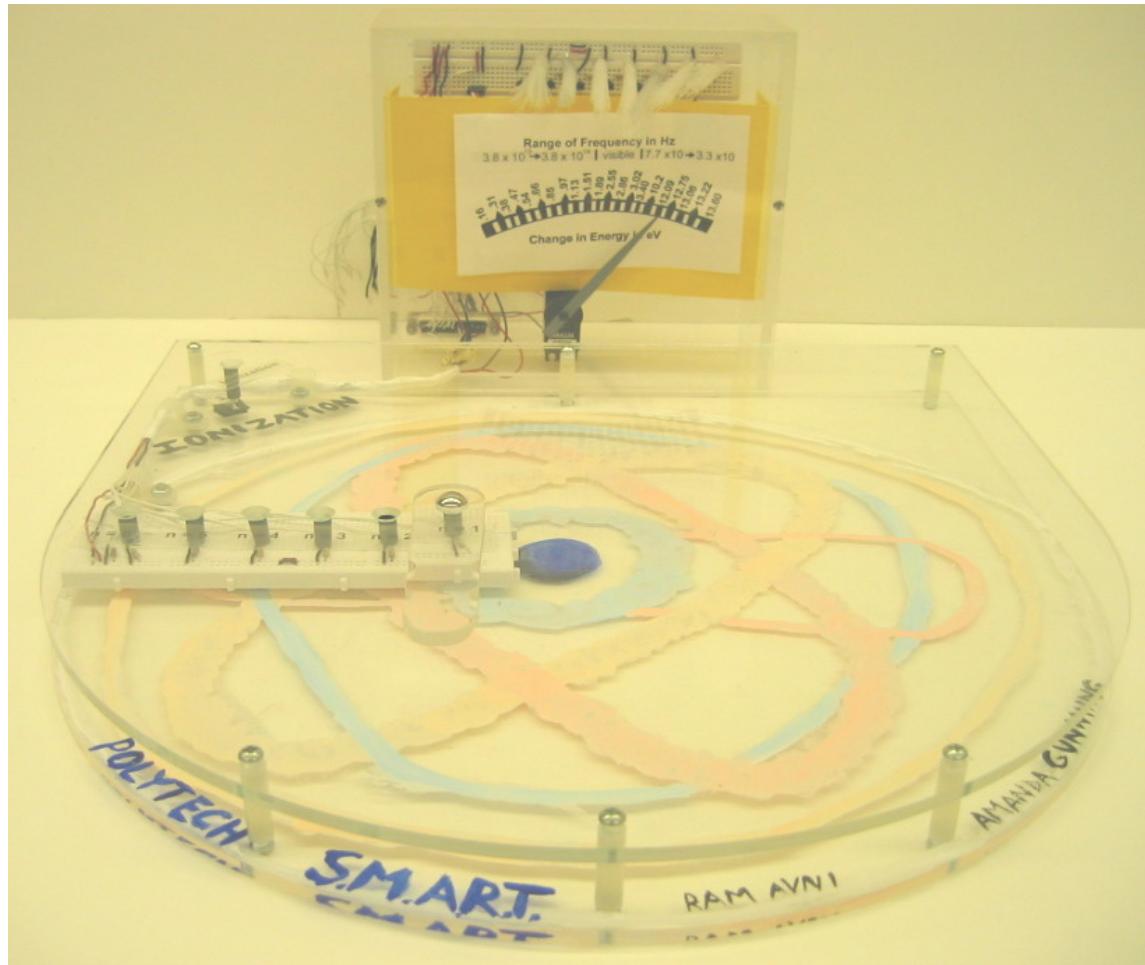
# SMART 2004 Projects

# The SMART Weather Balloon



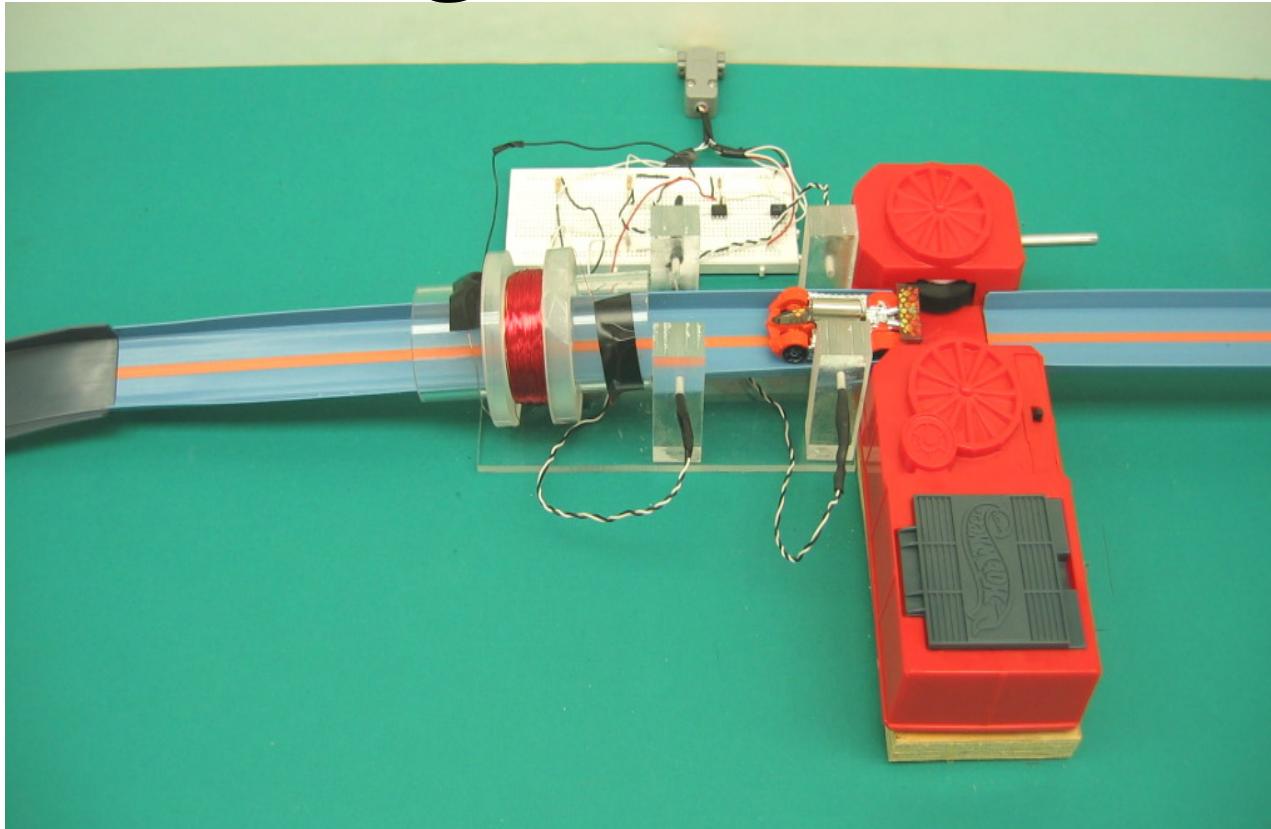
Teachers: Ronald Occhiogrosso & Lennox Henry

# Quantum Leap



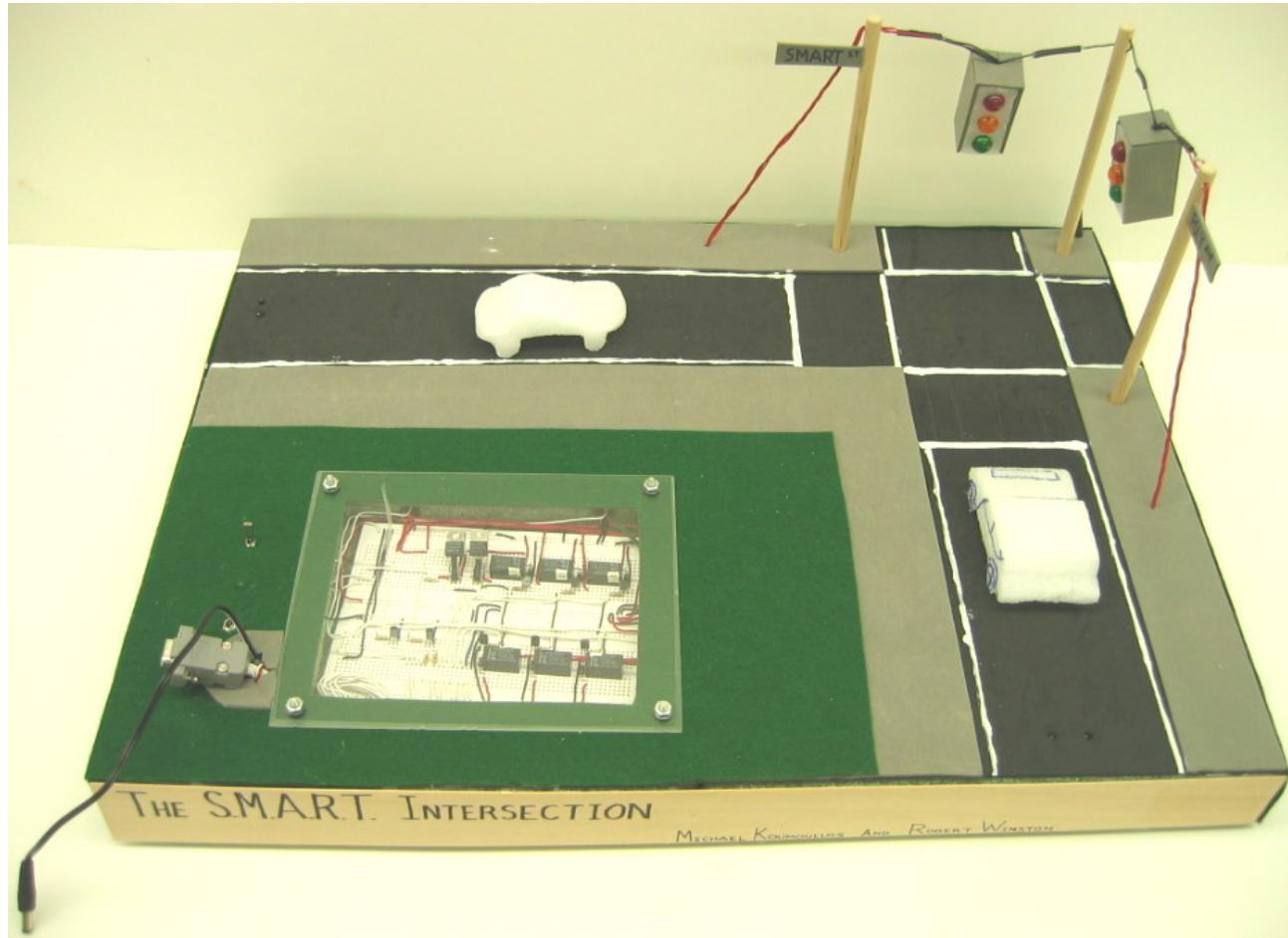
Teachers: Amanda, Gunning, & Ram Avni

# Velocity Monitoring via Magnetic Interaction



Teachers: Vincent Pereira & Steven Scharf

# The SMART Intersection



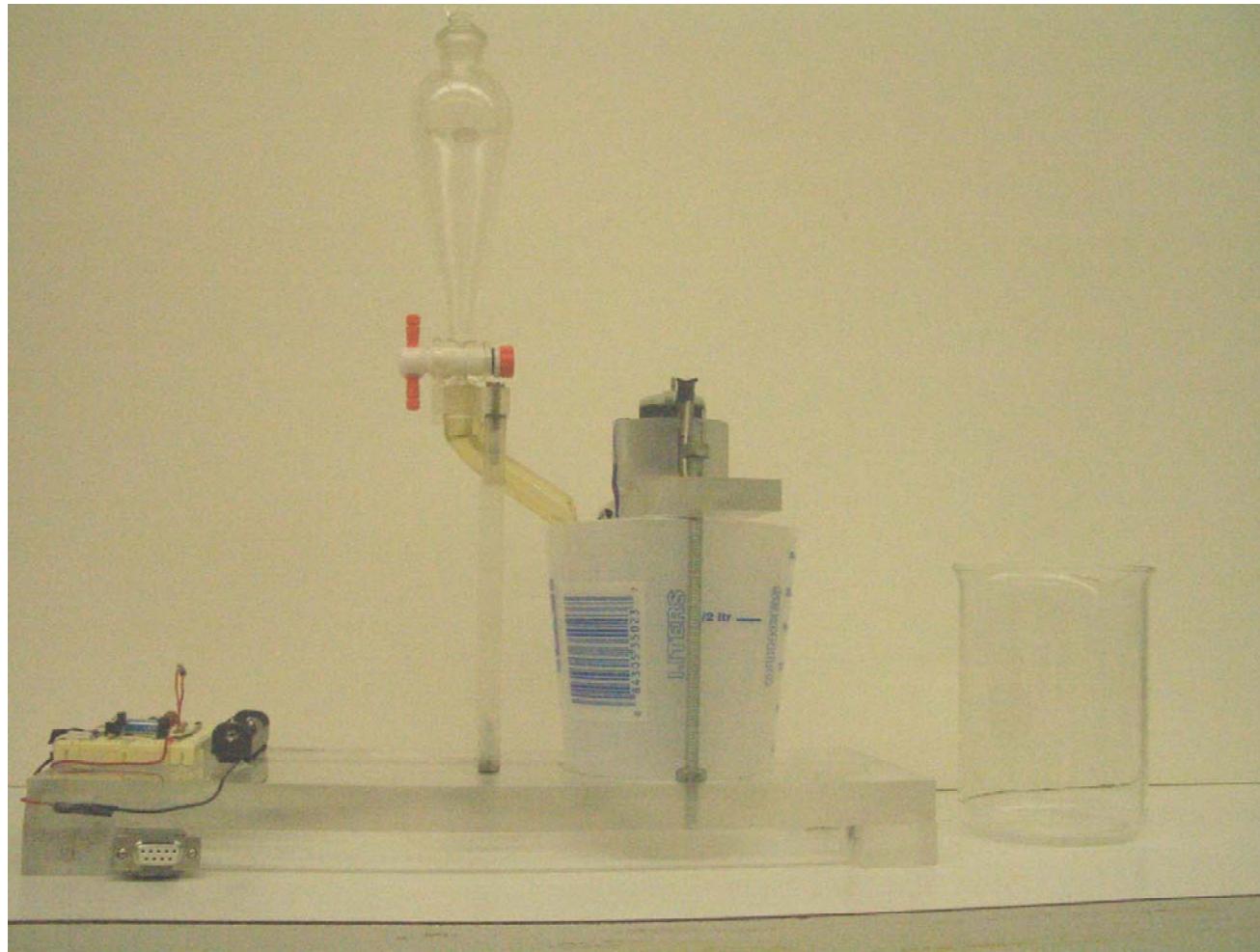
Teachers: Michael Koumoullos & Robert Winston

# I Push! You Push Back!: Newton's 3rd Law in Action



Teachers: Dvora Geller, Ed Gruber, & Denise McNamara

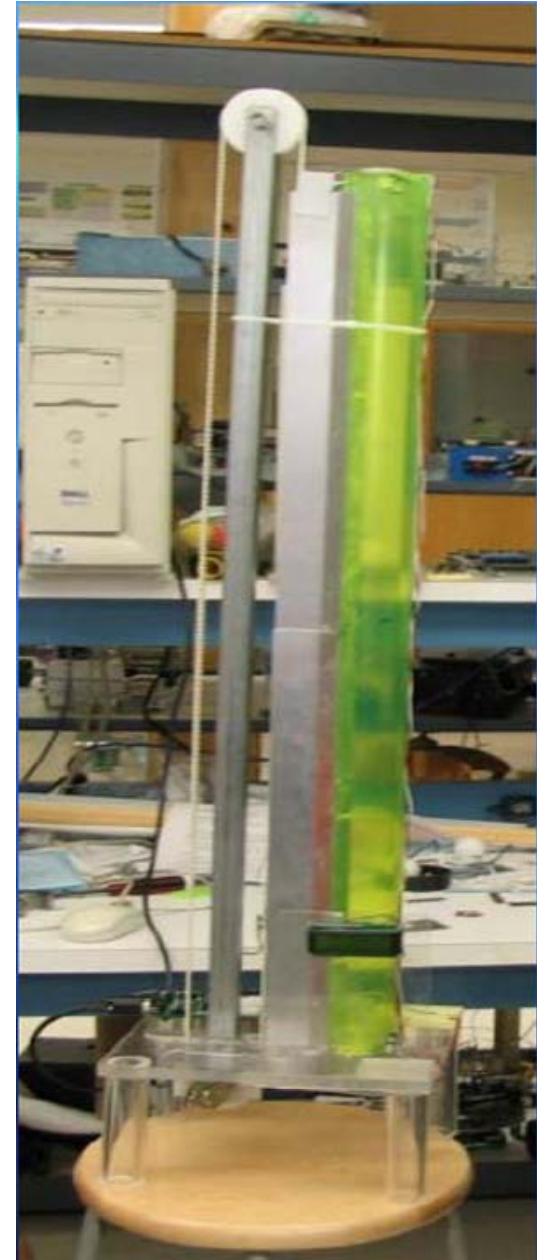
# Conductivity Experiment



# SMART 2005 Projects

# Coefficient of Restitution the Bouncing Ball

Teachers: Lennon Safe and Carol Obler

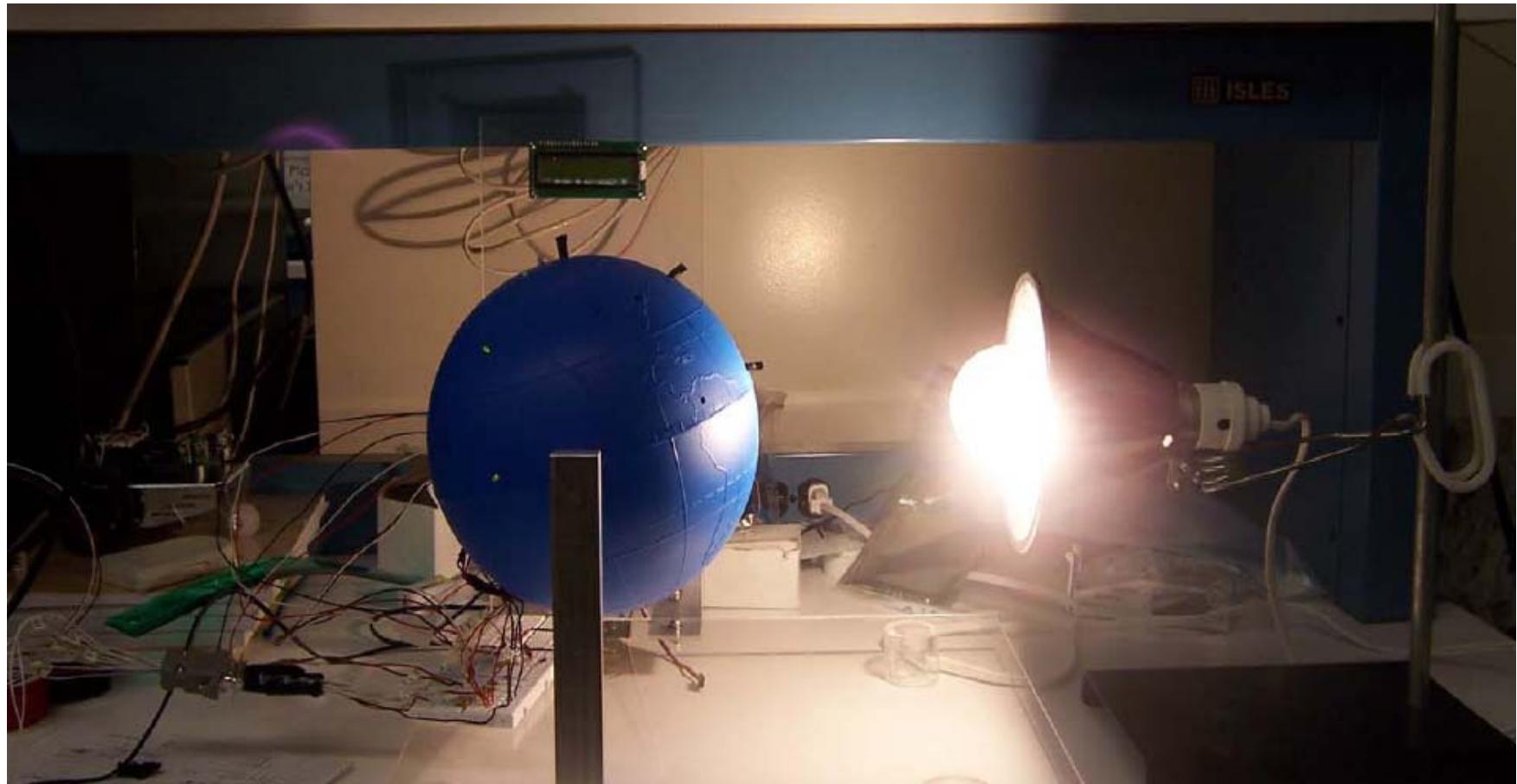


# Vehicle of Revolution



Teachers: Henry Penna, Michael Fishenfeld, and Douraine Stewart

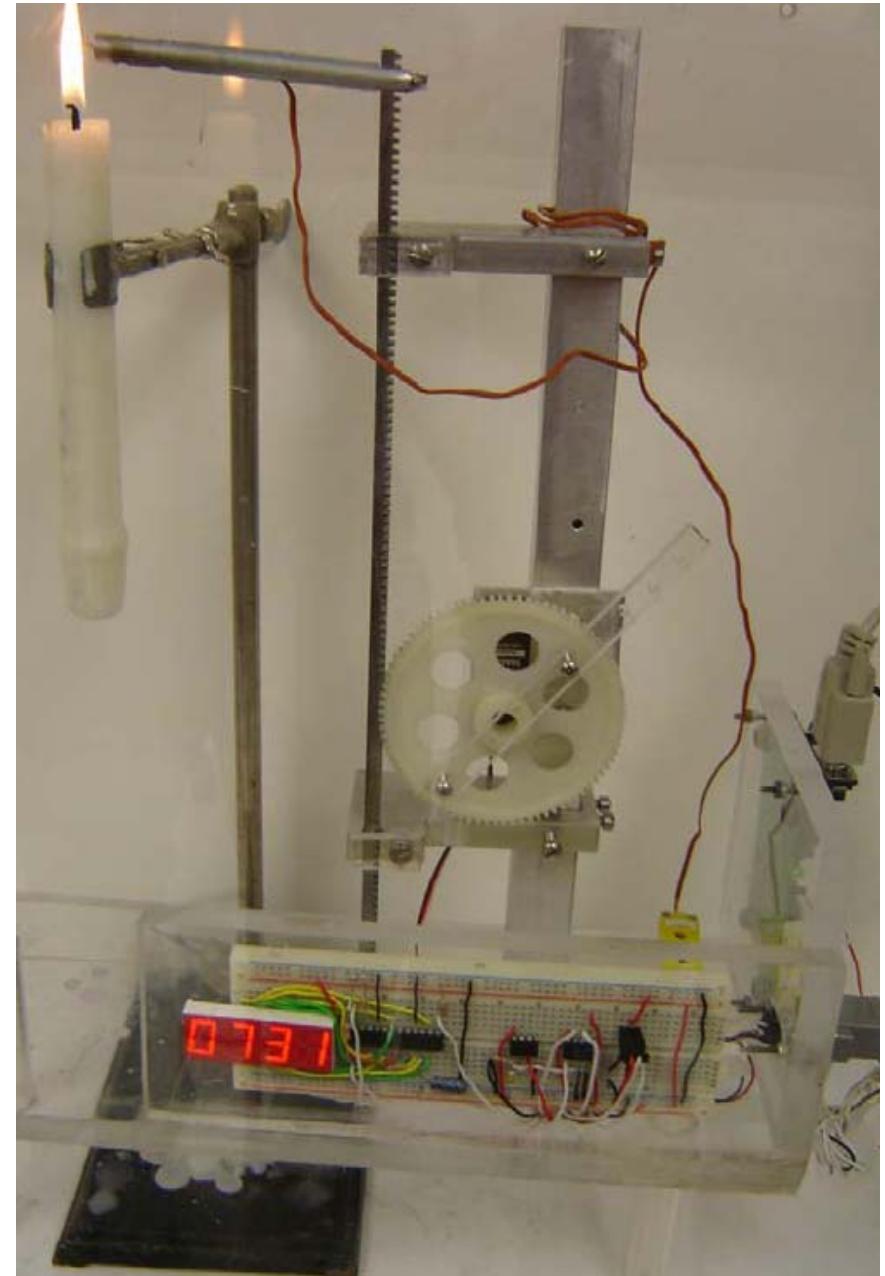
# Earth's Seasonal Heat Absorption and Climate Regions Model



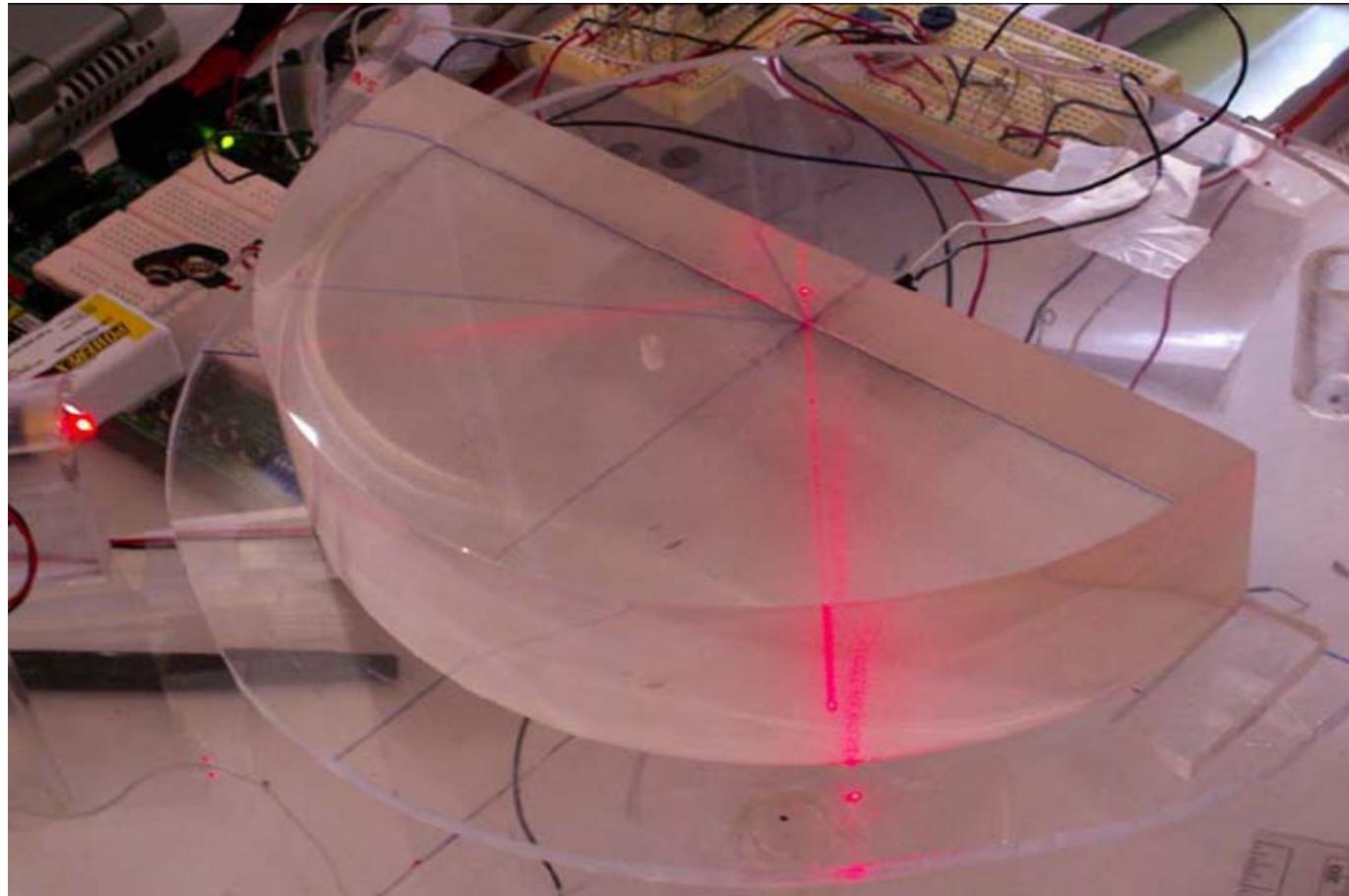
Teachers: Joseph Renna and Rodolfo Vera

# The Heat Seeking Flame Probe

Teachers: Michael Francesco and  
Fady Ishak

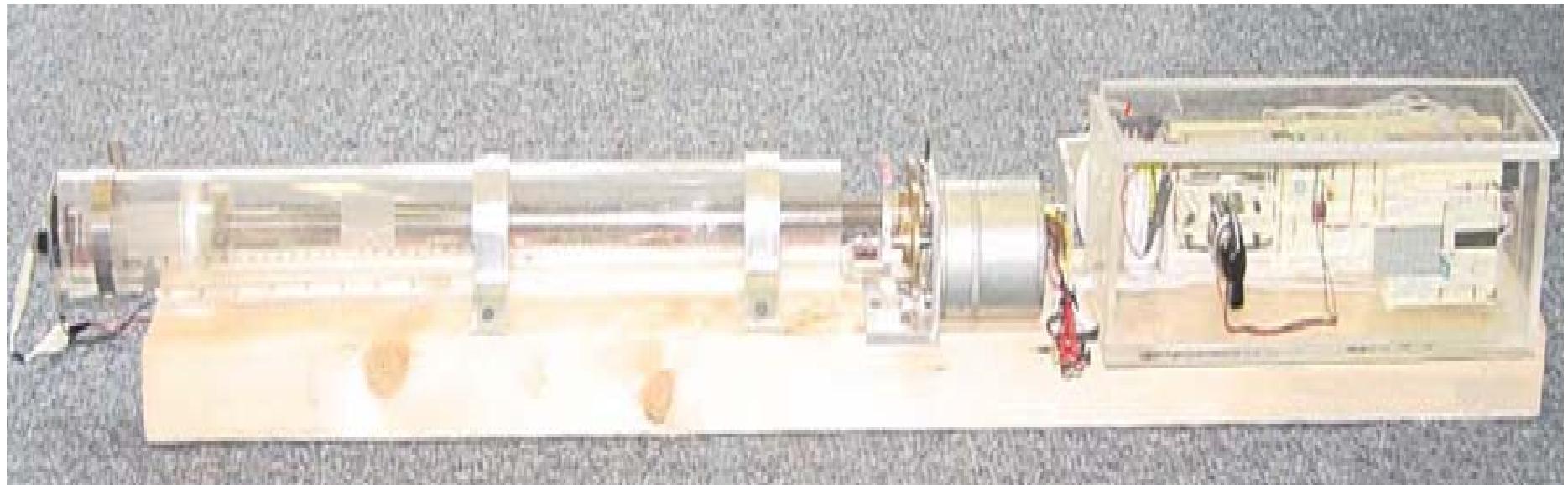


# Finding the Critical Angle of a Prism



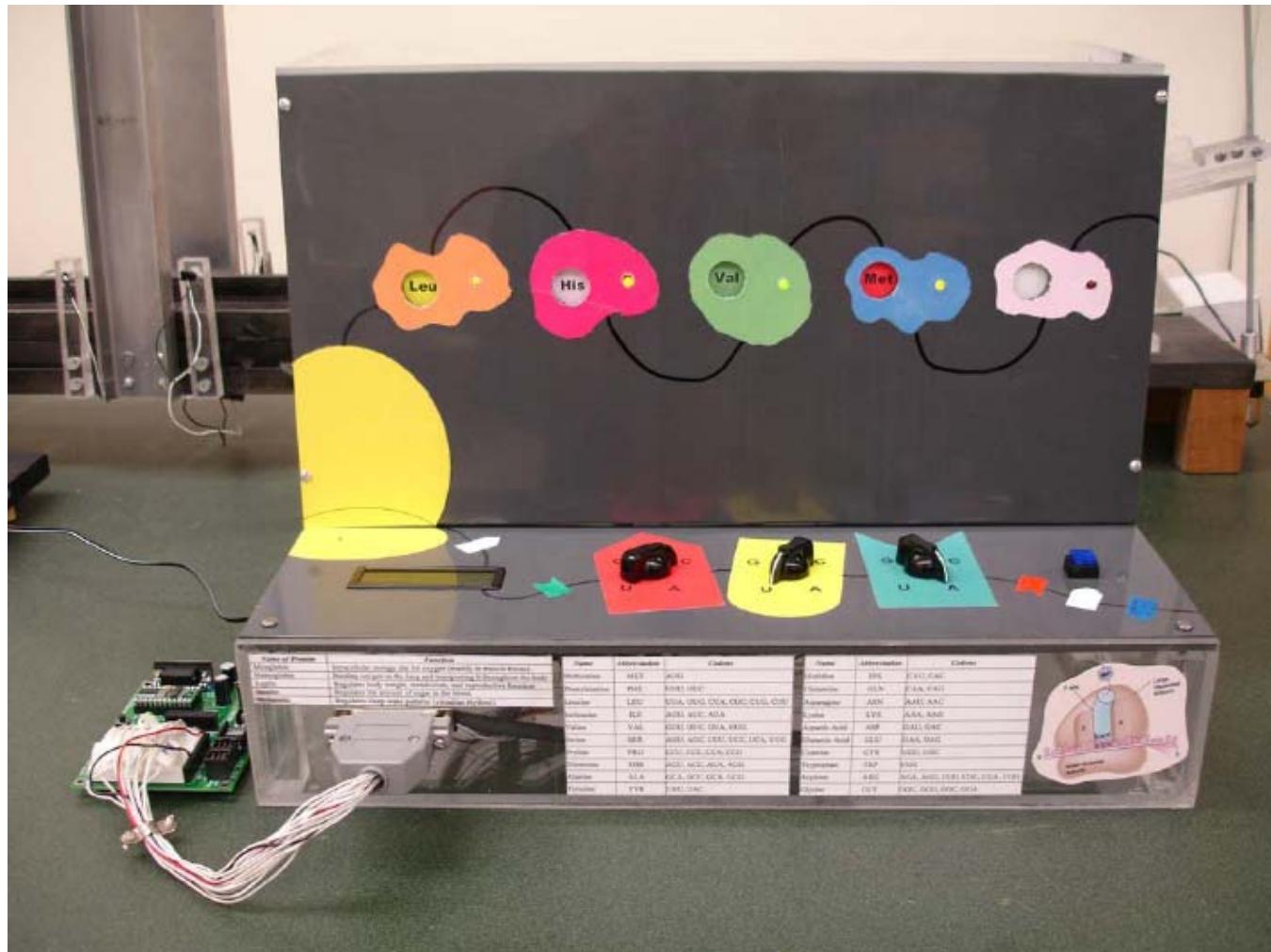
Teachers: Mustafa Kilic and Thomas Byrne

# The Smart Resonance Tube



Teachers: Joe Rodichok and Robert Morris

# The Codon Decoder



Teachers: Vera Mihalcik and Cameron Jahn

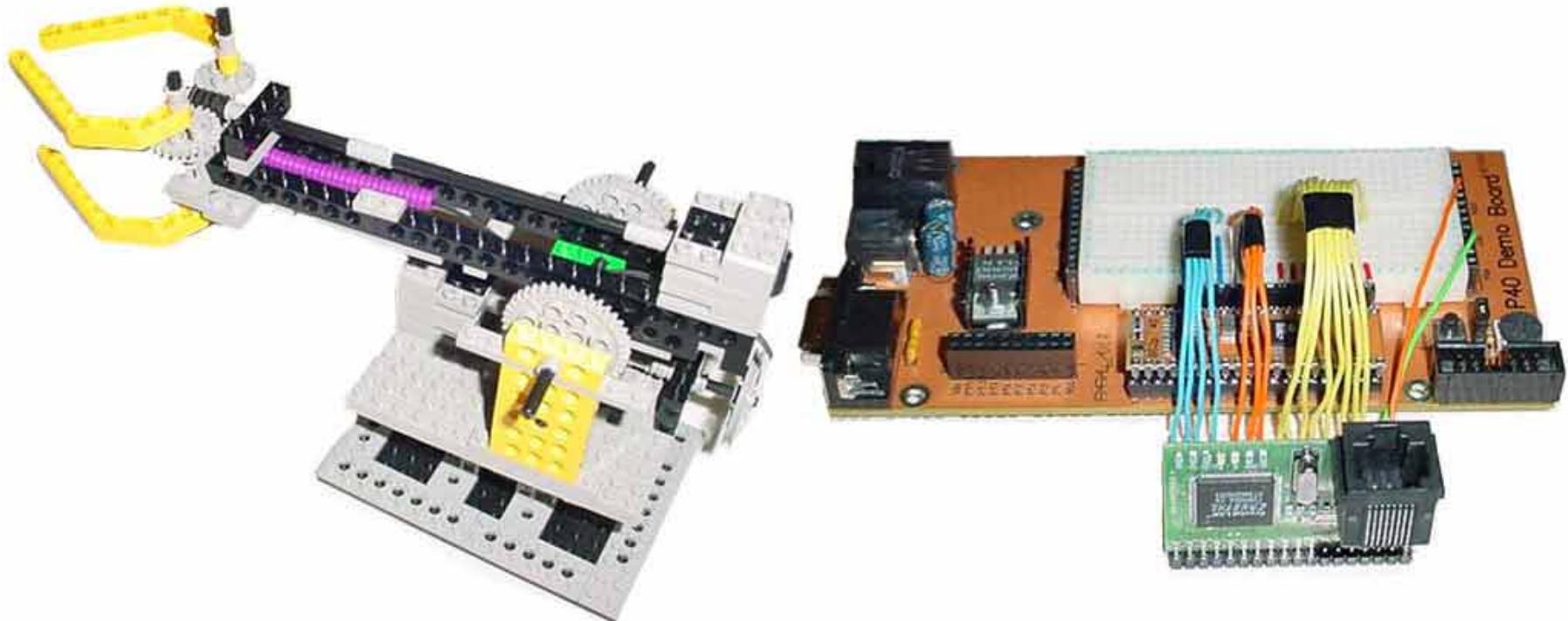
# Robo Submarine

Teachers: Joy Hinds and James  
Kevin Mcmahon



# Sample Mechatronics Projects

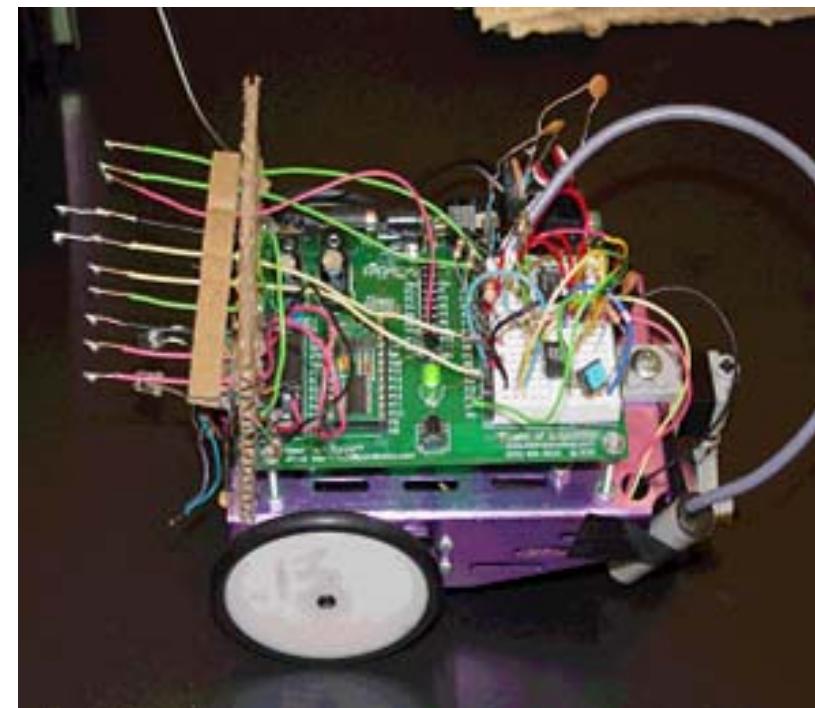
# Remote Robot Arm Manipulation



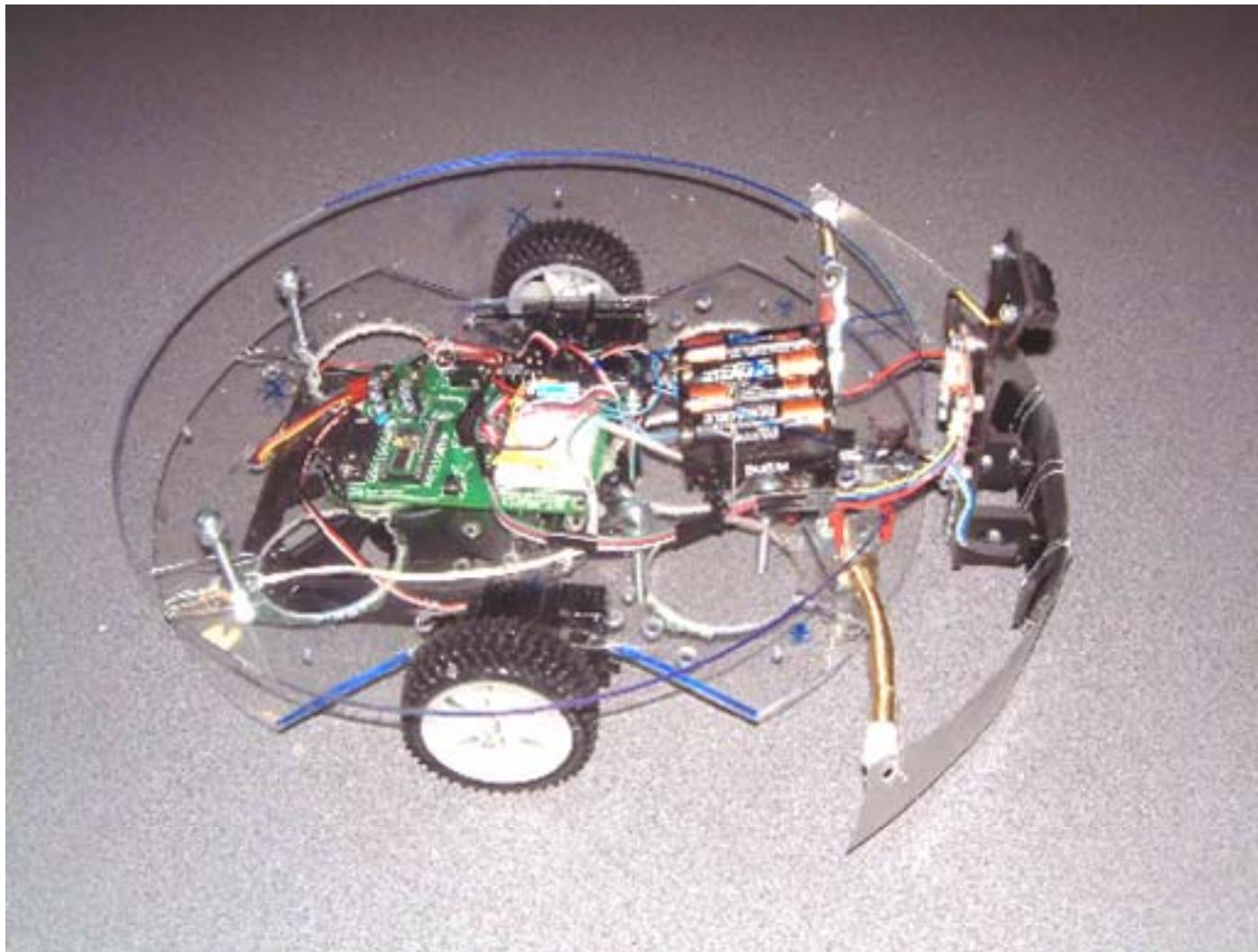
# Remote Emergency Notification System



# Smart Irrigation System



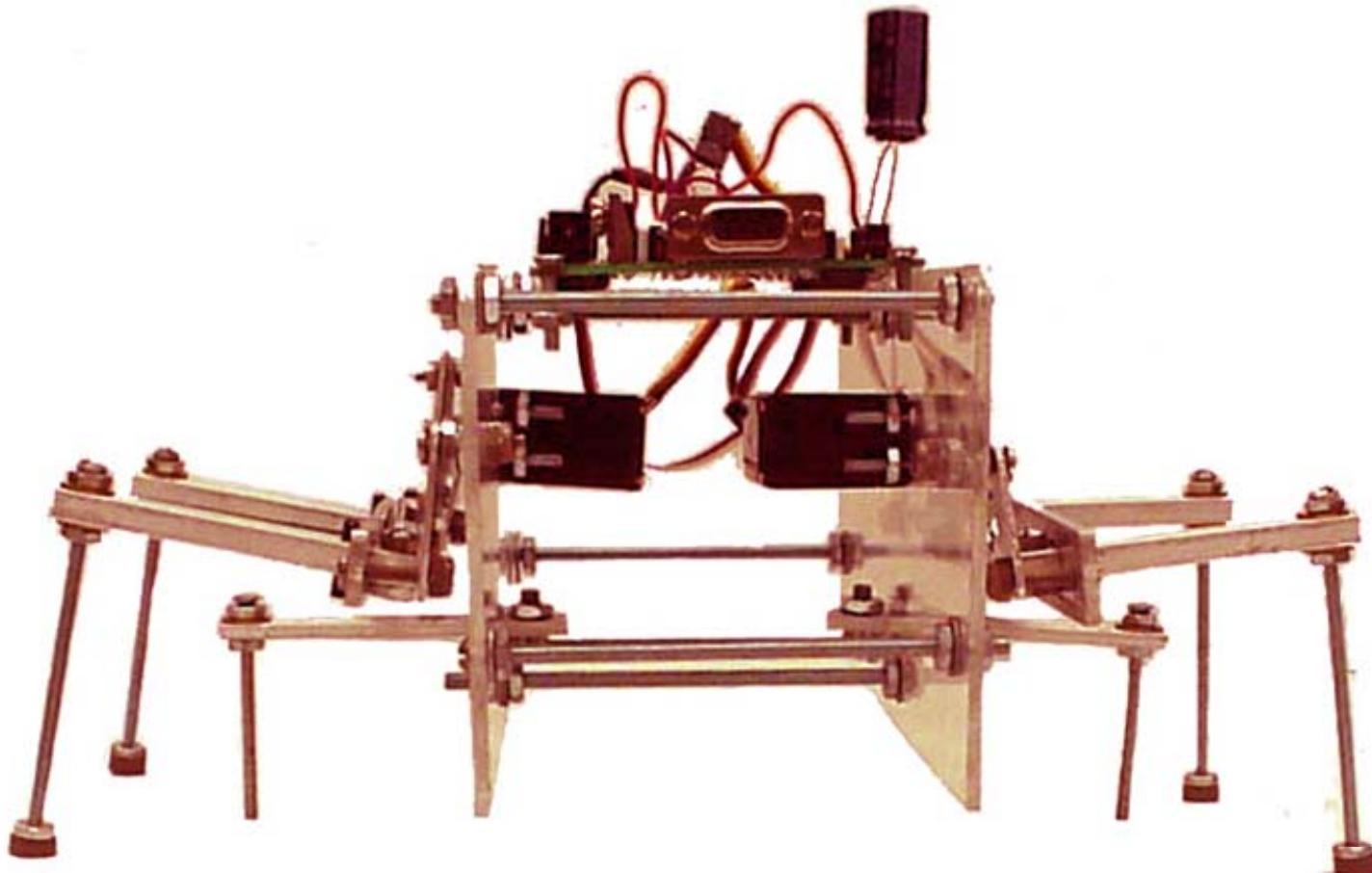
# RoboDry



# Smart Cane



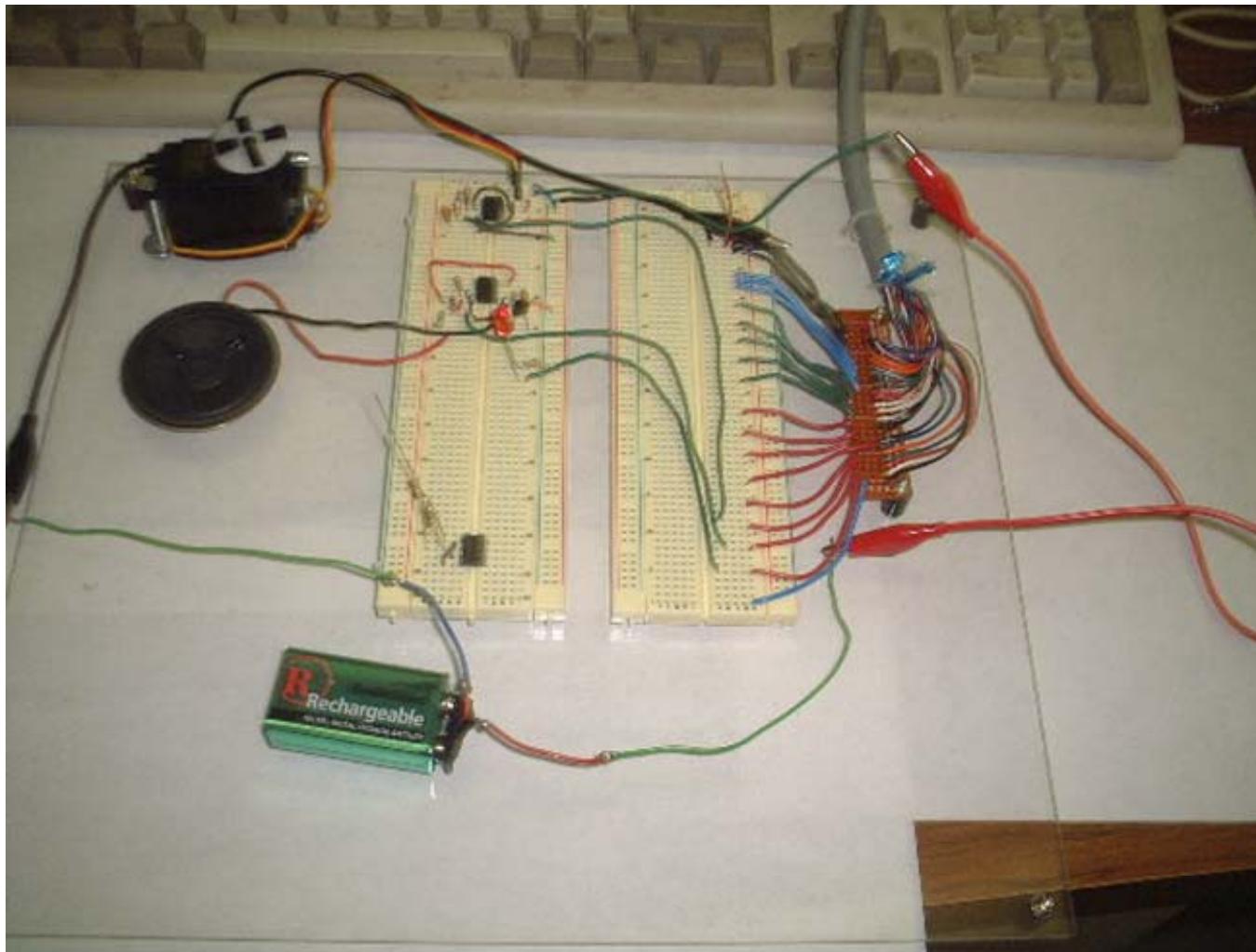
# Four-Legged Hexapod



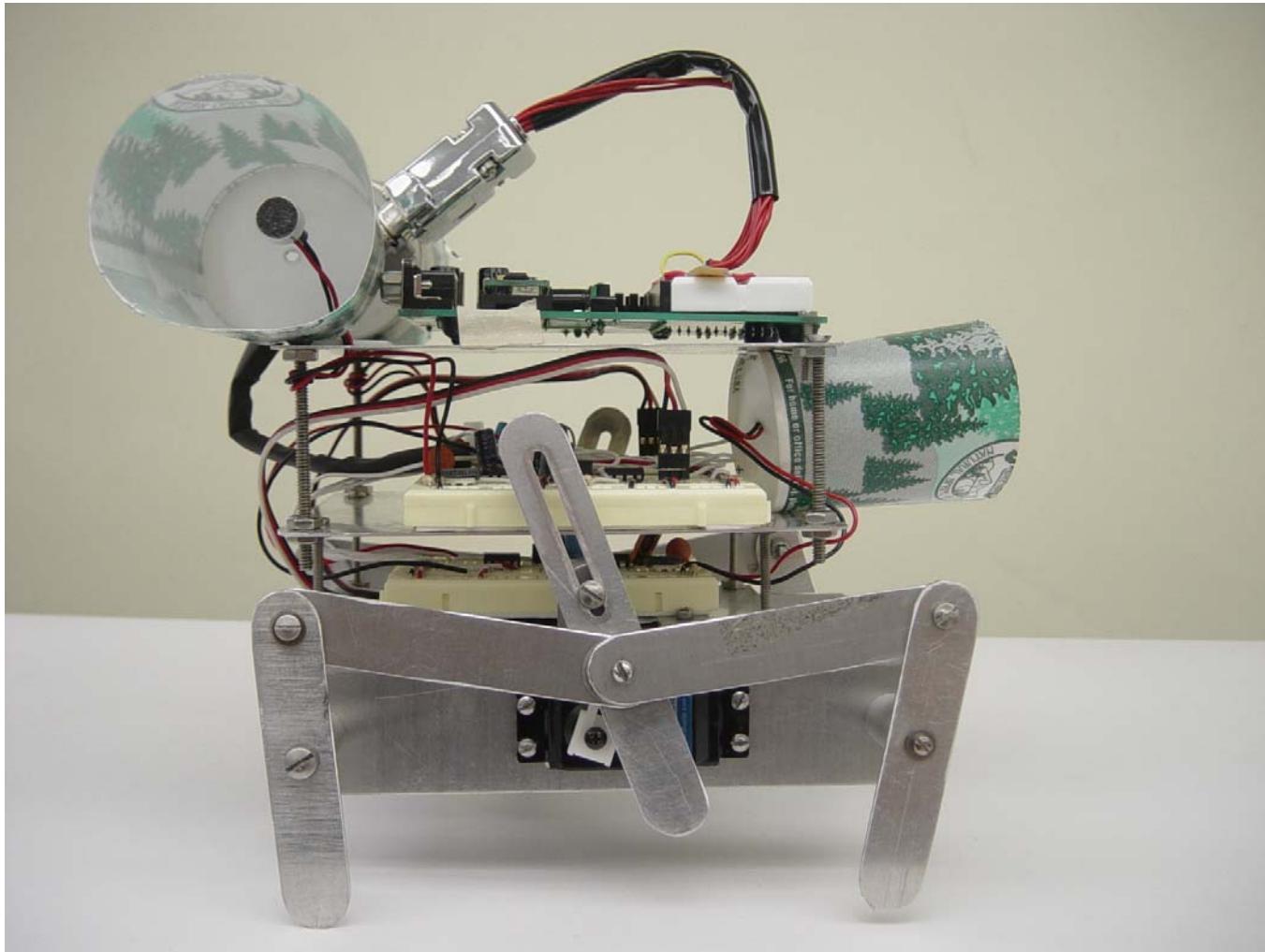
# Robotic Vacuum Cleaner



# Remote Control using the Parallel Port of a PC

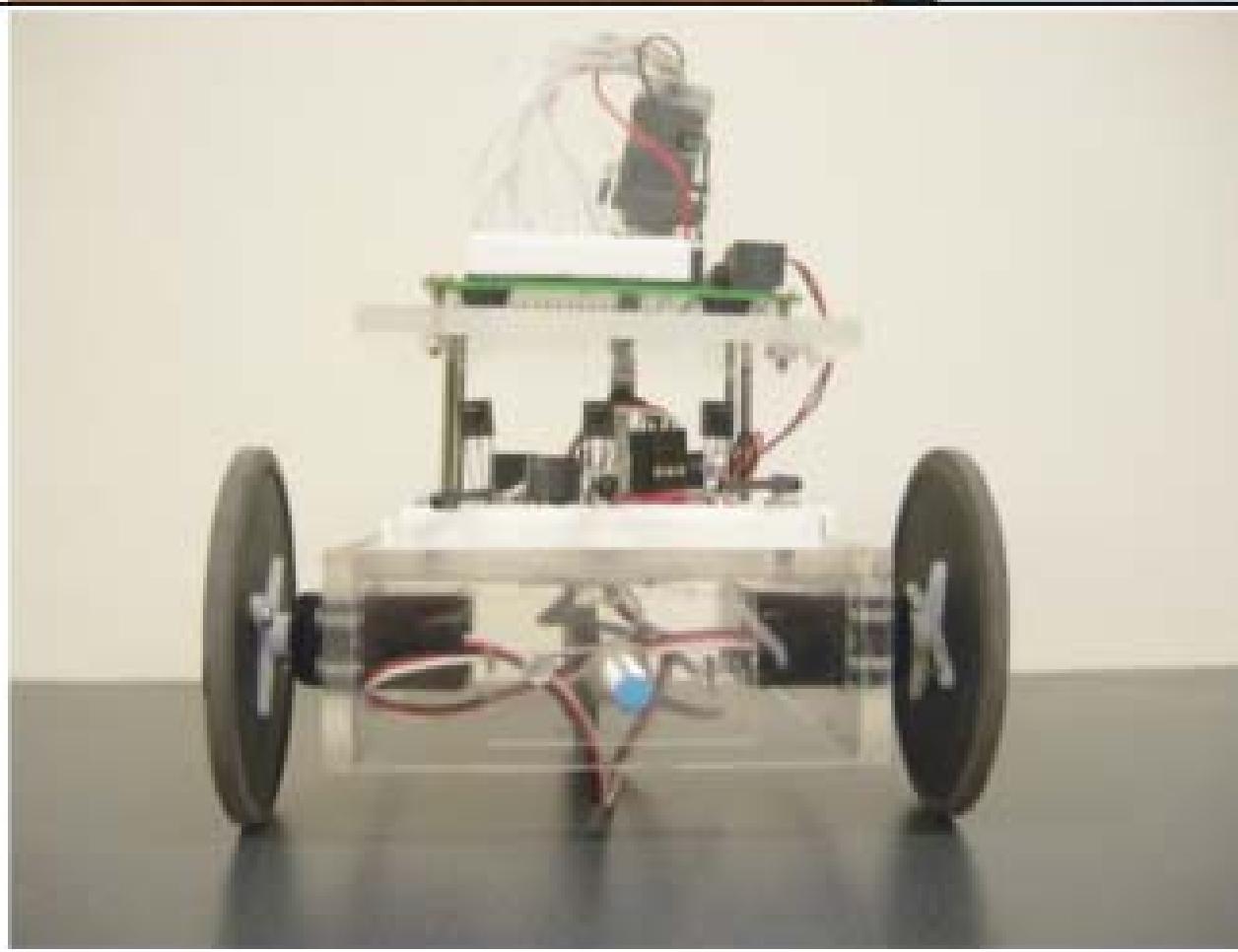


# Audio Enabled Emergency Hexapod

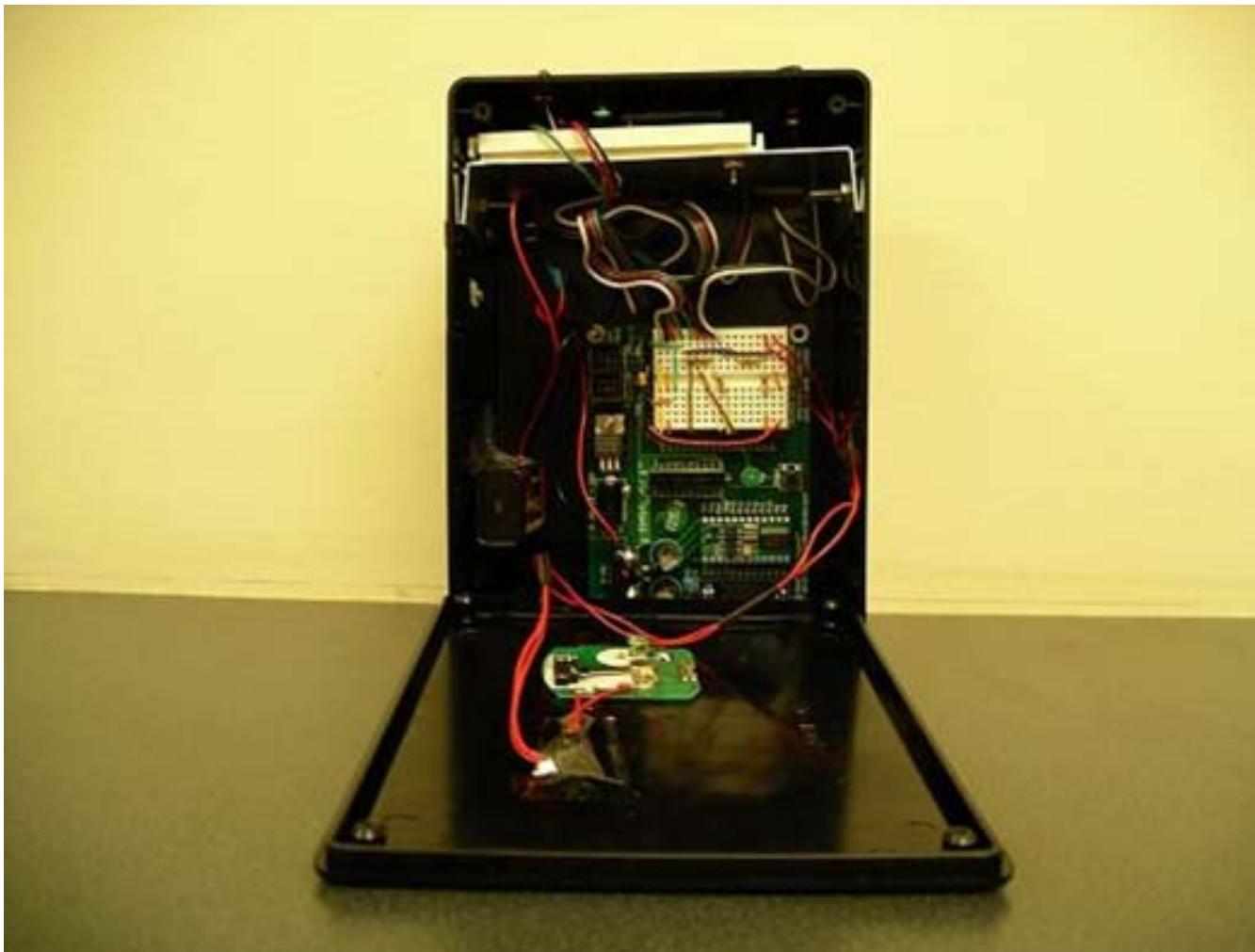


# Automated Distinguisher

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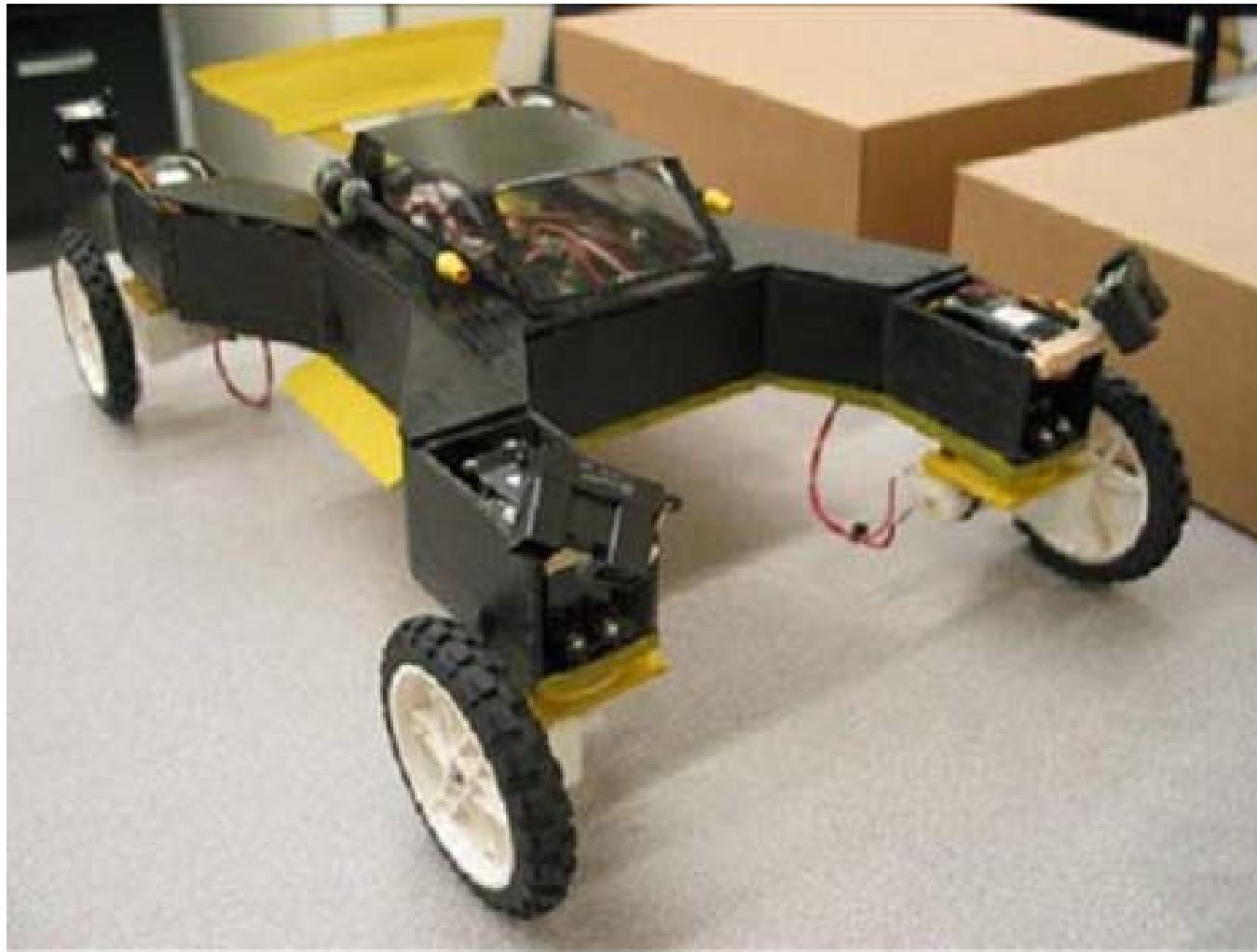
# Local Navigation System



# The Safe 'N Sound Driver



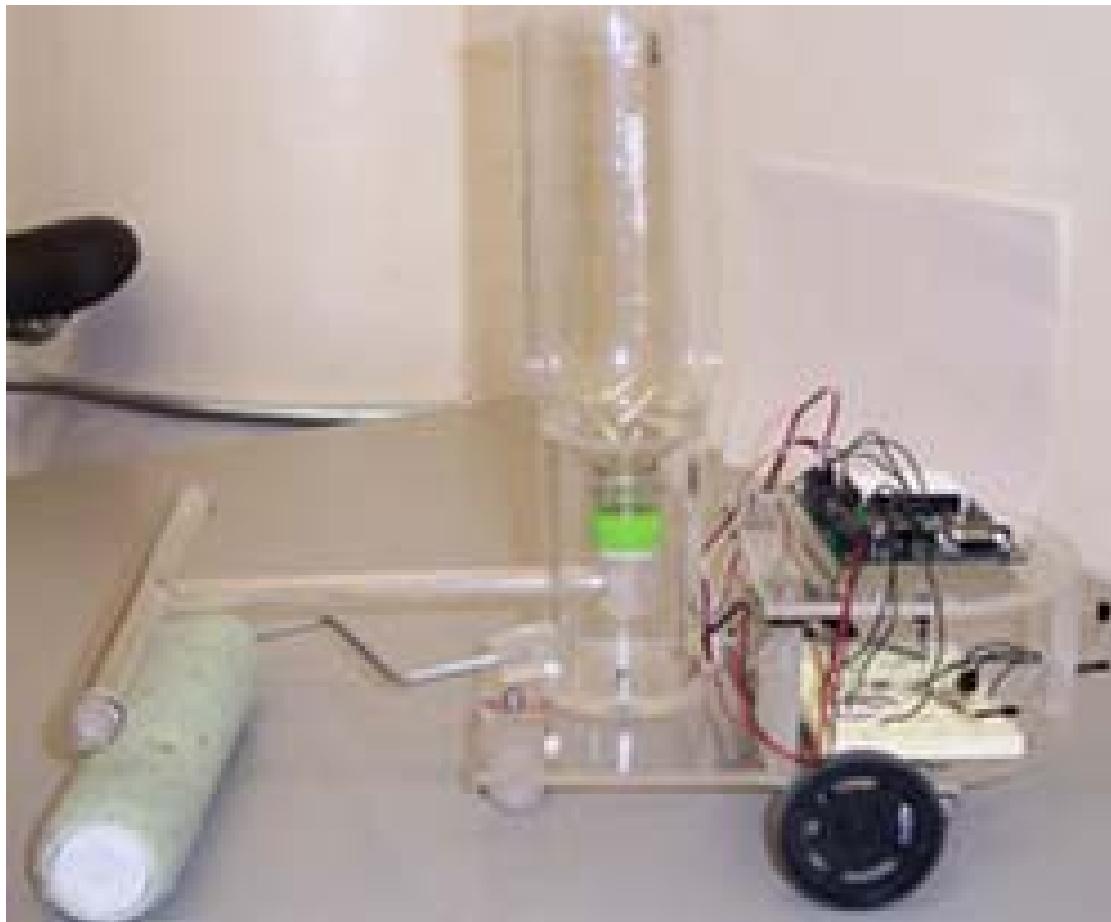
# Type X



# The Smart Walker



# Autonomous Polyurethane Applier



# SMART Teachers' Accomplishments

Grants					
Richard Balsamel	Science High School	Newark, NJ	\$4,000	School district	Mechatronics research club
David Deutsch	Manhattan Center for Science and Math High School	New York, NY	\$3,000	School and through the Children's Aid Society	After-school mechatronics club
Paul Friedman	Seward Park High School	New York, NY	\$1,500	School's alumni association	After-school program
William Leacock	W. C. Mepham High School	Bellmore, NY	\$1,500	School district	Hands-on activity in AP Physics class
Marlene McGarry	The Christa McAuliffe School	Brooklyn, NY	\$1,500	Online grant agency	7th Grade class
Michael McDonnell	Midwood High School	Brooklyn, NY	\$300,000	VATEA	Robotics curriculum
Denise McNamara	High School for Health Professions and Human Services	New York, NY	\$1,600	School	Obtaining LEGO Robotics and Parallax Kits
Articles					
Robert Gandolfo	Plainedge High School	Massapequa, NY	SMART experience in his school district newspaper		
William Leacock	W. C. Mepham High School	Bellmore, NY	Article, "A SMART Program for Teachers," on TechLearning		



## Teachers Use High-Tech Methods To Help Students Pursue Engineering, Electronics Careers

JULY 21ST, 2003

*Some New York City teachers are hoping to bring all sorts of high-tech concepts into their classrooms next school year to inspire more students to pursue careers in engineering and electronics. As NY1 Tech Beat reporter Adam Balkin explains in the following story, students won't just be hearing about those concepts, they'll be building them too.*

Classrooms have certainly come a long way since the abacus and the quill. How far? Polytechnic University in Brooklyn is running a new program this summer, educating area high school teachers on how to bring mechatronics into the classroom. It's a program funded by the National Science Foundation called SMART.

"SMART stands for 'science and mechatronics aided research for teachers,'" says Vikram Kapila of Polytechnic University.

"Mechatronics is marriage of mechanical engineering, electrical engineering, electronics, computer science and computer engineering to make smart products."

These projects aren't just designed to look neat or be like high-tech erector sets - they're built to actually do something eventually in the real world. A hexapod, for example, could be used for disaster recovery. After a building collapse it could be sent in to look for possible survivors.

"These could be robots, smart jet engines, automotive hybrid systems, rockets, missiles, or what have you," says Kapila.

"This is like a simulator for a jet pilot, and what they'd do before they actually become jet pilots, but most of it has to do with the fact that I'm controlling the helicopter basically by using sensors," says Clay Davis of Manhattan Comprehensive Day/Night High School.

The teachers all agree, students are more eager to learn when they can use concepts and equations to actually make something they can touch and use.

"It's tangible," says Paul Friedman of Seward Park High School. "You look at a differential equation and it's a differential equation. It just sits there, and this is real. It's live, and it has applications."

Michelle Carpenter-Smith of Packer Collegiate Institute says, "I think this is a way for me to bring projects back that will interest females as well as male students so that hopefully more female students will go into engineering, go into math and science professions, and they'll bring their way of viewing engineering from a creative perspective, from an artistic perspective, so that there can be more representation from both genders."

The program runs for four-weeks. After it's over, each teacher is given supplies to build some of these projects back at their high schools. For more information on the program, including a list of which high schools are participating, visit [mechatronics.poly.edu/smart](http://mechatronics.poly.edu/smart).

- Adam Balkin

**COVER STORY**

# Brooklyn Daily Eagle

& DAILY BULLETIN

Volume 49, No. 141, MONDAY, OCTOBER 27, 2003 E-mail: [edit@brooklynagle.com](mailto:edit@brooklynagle.com)

Founded in 1841 by Isaac Van Anden

## Science-Oriented Kids from Across The U.S. Gather at Polytech Conference

Gathering Held in NYC for First Time; Students Housed at Marriott

By Raanan Geberer  
Brooklyn Daily Eagle

**DOWNTOWN BROOKLYN** — What are 16- and 17-year-olds interested in? Usually: dating, sports, music, movies, homework, friends. The teens who were at the National Consortium of Specialized Secondary Schools in Math, Science and Technology conference at Polytechnic University this past weekend are no doubt interested in these things, but they're also interested in biotechnology, engineering, computer technology, robotics, physics and more. And they're part of a select group of about 300 that were sent from high schools

around the country to the conference. While the conference has been around for many years, this is the first time it's ever been held in New York City. The kids were housed at the New York Marriott at the Brooklyn Bridge, four to a room.

For many, it was the first time they were in New York City. "Things we take for granted, they're amazed at," said Shad Ahmed, a Bronx High School of Science student.

"One girl, from Alabama, was surprised that we cars keep honking their horns and not getting off," said one person said. "I feel sorry, I said, what?" He soon figured out, of course, that it means "I understand you."

The goal isn't necessarily to recruit the students to Polytechnic, said Dr. Noel Krifcher, former superintendent of Brooklyn's Staten Island High Schools and one of the organizers of this year's conference. "We just want to get them to New York City and see what it has to offer."

The topics of the seminars would be daunting even to most adults. Here are just a few: "The Role of Standards in Improving Student Quality"; "The Physics of Optics"; "Lego Robotics as a Learning Strategy"; "Redevelopment of the Manhattan Waterfront Using Recycled Plastic Pylons"; and even "Prepare for Mars Travel".

This reporter sat in on two seminars. In the first, "The Internet and Recorded Music," a Polytechnic student demonstrated how he recorded a CD onto his computer hard drive, using Windows Media Player. He played it at a normal size, about 20 MB.

He then played it at different levels of compression until he reached the smallest, 8 KB. By this point, it sounded like mud, recorded underwater.

Student seminar, Sang-Hoon Lee, PhD mechanical engineering student at Polytechnic, showed the some robots he had constructed. One of these was the six-legged, radio-controlled "Hexapod." Another ran on a track, similar to the slot cars of yester-year.

For student Kristin Beck, of High Tech High School, Los Angeles, this was her second year at the conference. "Last year, at school, I did a project that was based in part on one of the seminars I saw here."

"This year, I'm sure I'll also be able to work on a project inspired by



Sang-Hoon Lee, a PhD student in mechanical engineering at Polytechnic University, left, demonstrates his "hexapod" robot to a visiting high school student at one of the seminars given at the National Consortium of Specialized Secondary Schools in Math, Science and Technology conference. See story, below.

Eagle photo by Raanan Geberer

Plainedge Union Free School District  
Volume XXXI, Number 2

# Plaintalk

Plainedge Public Schools Community Newsletter

November 2003

Plain Talk • November 2003 • 4

## Engineering Teacher Constructs Mechatronics Device

*Continued from page 1*  
some of the seminars here," said Ms. Beck, who hopes to study computer science and electrical engineering in college.

Polytechnic students acted as guides and house-study leaders for the seminars. Those who were recruited, Jeffrey Chiu and Nercy Escobedo, said they enjoyed working with the high schoolers and giving them a taste of what college life is about.

When not in seminars, the kids were taken on tours of the city — with a teacher as their escort. Some of them visited "Brooklyn's Waterfront Architecture and Engineering"; "Field Study in Prospect Park"; and "Rehabilitation of the Williamsburg Bridge."

Teens from five New York City schools were represented — Stuyvesant, Brooklyn Tech (a co-sponsor of the event), Brooklyn Tech, Staten Island Tech, and the High School of Math, Technology and Science at CCNY.



Introduction to Engineering teacher Robert Gandolfo demonstrates a mechatronics device operated by computer commands, that he and another teacher built as part of a summer research program.

Plainedge teacher Robert Gandolfo demonstrated a mechanism that combines concepts of mechanical, electrical and computer science engineering to his students in the Introduction to Engineering class. The device was designed, built and programmed by Mr. Gandolfo and Mr. Paul Friedman of Seward Park HS as part of a summer research program at Polytechnic University.

The device is a visual demonstration that simulates the motion of a crane or a human elbow and has applications to the engineering problem solving activities that the Introduction to Engineering students will be doing over the school year.

The mechanism, a cantilever beam supported by a cable (string) at one end, is operated by a programmable micro-processing chip. Servomotors driven by the chip set the angle of the beam to the desired value. All of the measured and calculated data is displayed on the computer screen allowing the student to make changes and instantly see the effect.

During the summer Mr. Gandolfo and nine other teachers from Long Island, New York City and New Jersey spent four weeks participating in a National Science Foundation funded research program at Polytechnic University in Brooklyn under the direction of Professor Vikram Kapila. The goals of the program are to train teachers in the area of engineering called mechatronics enhancing high school instruction and thereby attracting more students to the engineering profession.

**Board of Education**

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**Plaintalk**  
Plainedge Public Schools Community Newsletter  
[www.plainedgeschools.org](http://www.plainedgeschools.org)      Alice Mateos, PlainTalk Editor  
516-992-7452

**BROOKLYN HeightsPress**  
& COBBLE HILL NEWS

**ROBOTS ARE PART OF NEW INSTRUCTION AT POLYTECHNIC**

*By Roxanne Gelber*

Traversing nowadays, says Debra Goff, is not as easy as it used to be. The Museum School in Manhattan is not unique in using robots and other computerized CD and DVD programs and when they go to school and attend science classes, she says, they frequently are taught by robots. "It's not that we have taught 200 years ago," Goff says. "Clearly, a new type of education is needed to make kids learn science fast."

But when they go to school and attend science classes, she says, they frequently are taught by robots. "It's not that we have taught 200 years ago," Goff says. "Clearly, a new type of education is needed to make kids learn science fast."

The that's why Polytechnic University in Brooklyn is getting funding from the National Science Foundation's National Math and Science Initiative and the National Science Teachers (SMART) Program, to help teachers learn how to teach science, math and other subjects using robots, microchips and other computerized programs.

Prof. Vilas Kapila, associated professor, of mechanical engineering at Polytechnic, says the students in his class will be able to impact what they have learned to the students.

Some of the robots used in examples and assignments in his class were built last week when this reporter visited. One, a robot with a hand, was built by a group of three, and taught students in an "elbow" to extend, or something, against the students, or something, the other way.

The robots, says Prof. Kapila, can be used in war, when military vehicles are used to "explore" a city at night. A similar robot using auditory sensors, he says, can be used to "explore" a city, speaks kindly or angry to his targets next to it. "There's (actually paper cups, the robot will move by moving the sound,

One interesting example of high tech, computerized robots is the one at Middle College High School who took the name "Robot" and was built by students in Motion. A miniature golf cart, with a launcher for a toy ball, is programmed to move to a certain point and launch. This is a refresher that precise distance from the ball to the hole is important, and that it should hit the putt squarely... and sound.

Yet another device makes use of a slot track, which is a track with a slot, or a groove, in and speed sensors on the track. If the cars exceed the speed limit, they are stopped. The students who built them show them to their parents. The students who are taking part in the SMART seminar come not only from the Brooklyn area, but from the Bronx, and from areas in Rockland and Westchester Counties.

One teacher, Lauren Hines, who teaches math science, and was here to train the students in the SMART program, says, "I think the students are excited about the school is starting a new elective course."

Not only do the teachers use these techniques, but the students are also more engaged in learning using the SMART program. One student, a 10-year-old, although similar amounts are more typical, says he would not be interested in learning if they would attend, except when one of his parents would come to the school and lack of sufficient funding for any other reason.

With the SMART program, says Prof. Kapila, "Science labs can become fun."

**Teacher Rose Avai of Middle College High School demonstrates a "car" robot that has sensors in its "wheels."**

Photo by Matthew Szwarc

# SMART Participants



2003

People: PI, graduate students, and undergraduates partnered with 21 New York city metropolitan area pre-college STEM educators for 4 weeks in 2003 (10 teachers), 2004 (11 teachers), and 2005 (17 teachers) summer to develop projects demonstrating concepts of projectile motion, speed, time, static balance, mobile robotics, etc.



2004



FEATURE

## Science and Mechatronics-Aided Research for Teachers

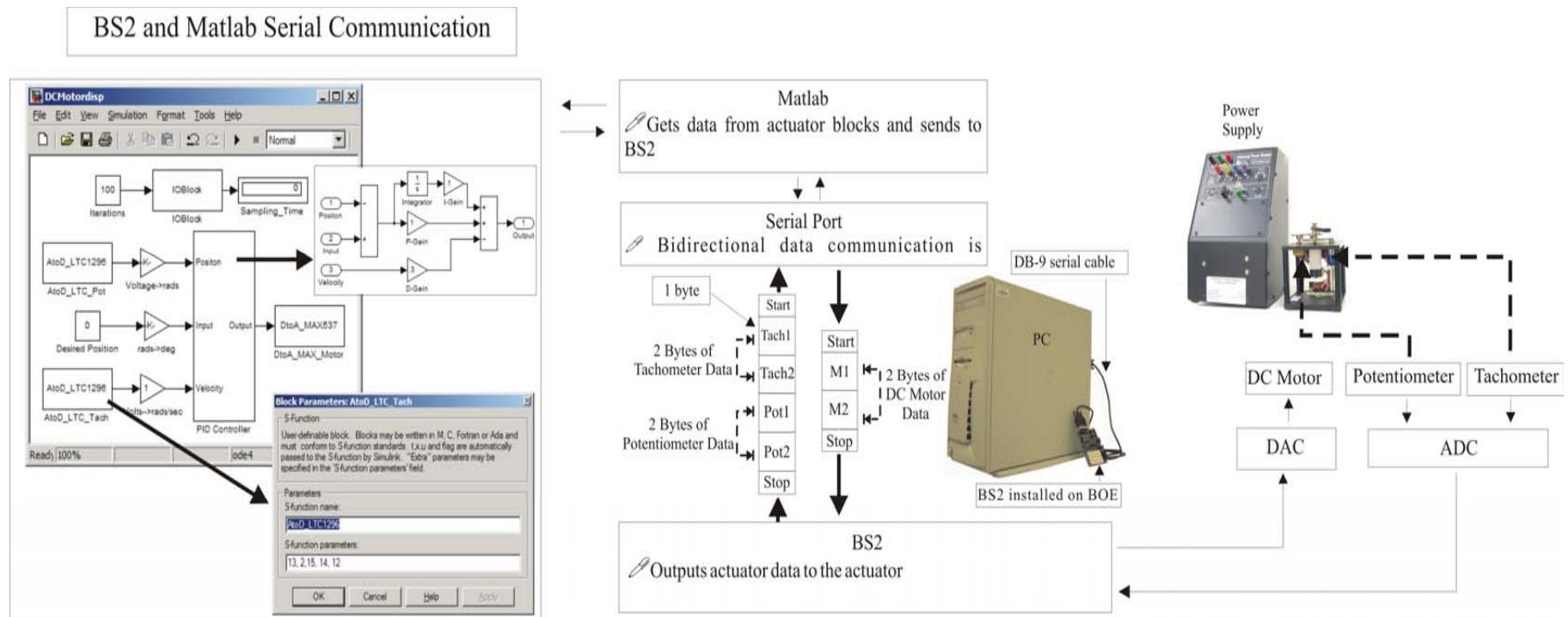
The "SMART" program provides teachers with training and workshops

### "Smart" Teachers

Mr. Richard Balsam of Science High School, Newark, NJ, raised over US\$4,000 from his school district for mechatronics kits and supplies and began a mechatronics research club. In addition, he is introducing mechatronics in his physics classes by integrating four sample activities for students. Mr. David Deutsch of Manhattan Center for Science and Math High School, New York, NY, has raised over US\$3,000 from his school and the Children's Aid Society for mechatronics and robotics kits. He is training students in an after-school mechatronics club. Mr. Paul Friedman of Seward Park High School, New York, NY, has raised over US\$1,500 from his school's alumni association for robotics kits. He has partnered with a colleague to train students in an after-school program. Mr. Robert Gandolfo of Plainedge High School, North Massapequa, NY, reported on his SMART experience in his school district newspaper [12]. Mr. William Leacock of W. C. Mepham High School, Bellmore, NY, received a US\$1,500 minigrant from his school district for mechatronics kits. Every other day, during a single class period of AP physics, he teaches a short lesson introducing his students to a hands-on activity planned for a double class period

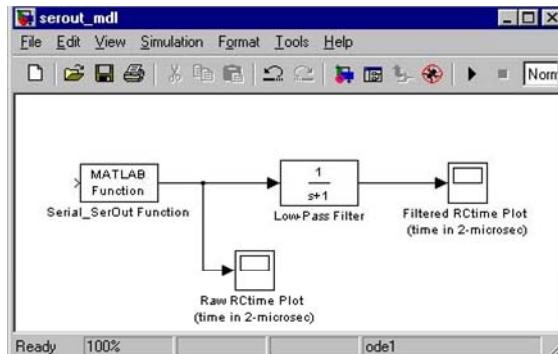
the following day. Mr. Leacock wrote the following to us: "The students are enjoying it so much that, even though I allow them a break in between the double periods, almost all of them stay and work right through the break. It is wonderful to see them learn and enjoy themselves so much." Mr. Michael McDonnell of Midwood High School, Brooklyn, NY, used over US\$5,000 funding from his school to obtain robotics kits and taught robotics to over 200 students in the Fall of 2003 and Spring of 2004 through robotics and advanced robotics courses. Furthermore, with colleagues, he applied for and received a three-year US\$300,000 grant from his school district under the Vocational and Technical Education Act (VATEA). The VATEA grant will enable him to develop and implement a four-year robotics curriculum in his school. Finally, Ms. Marlene McGarrity of the Christa McAuliffe School, Brooklyn, NY, raised over US\$1,500 for a project titled "Young Engineers are Made in Brooklyn Through Robotics and Mechatronics," through an online grant agency. From this grant, she obtained wheeled robots and Mars rover kits, and is using these in her seventh-grade classroom. She also wrote an article [13] on her SMART experience.

# Matlab Data Acquisition and Control Toolbox for Basic Stamp Microcontrollers

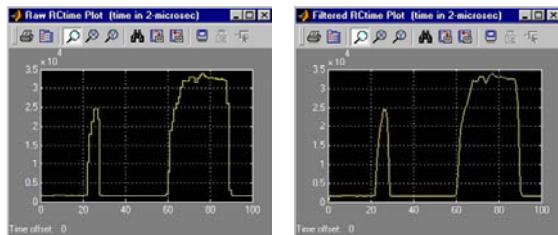


Anshuman Panda, Hong Wong, Vikram Kapila, and Sang-Hoon Lee

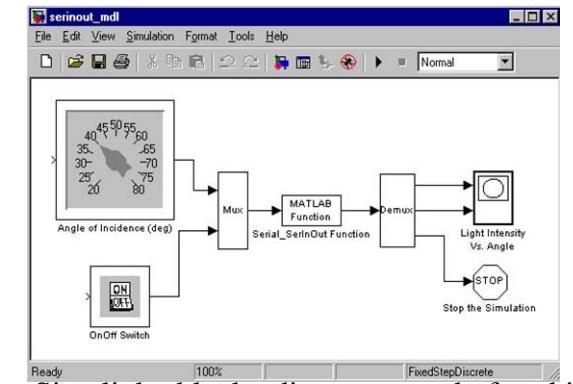
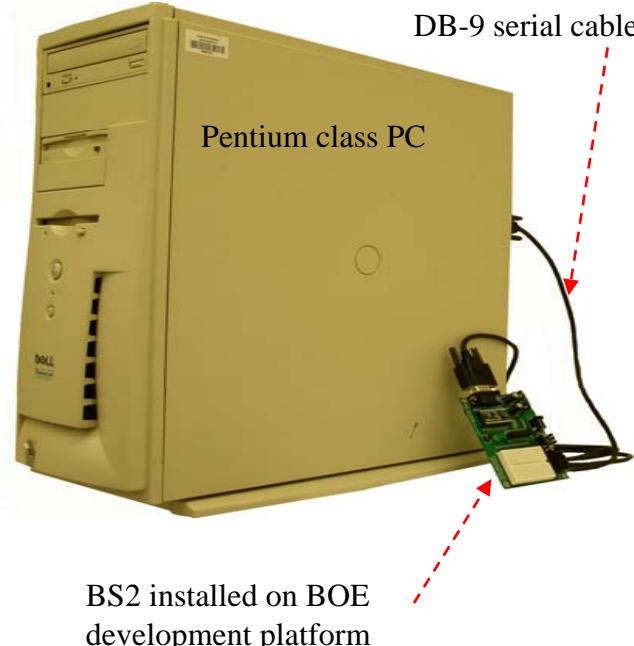
# Matlab-Based Graphical User Interface Development for Basic Stamp 2 Microcontroller Projects



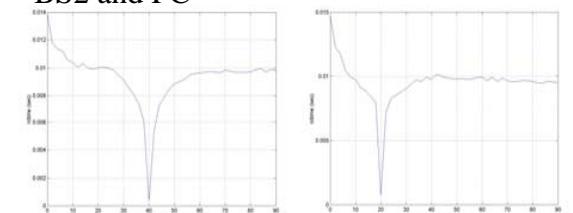
Simulink block diagram used for PC to BS2 serial communication



Unfiltered and Filtered plot of rctime



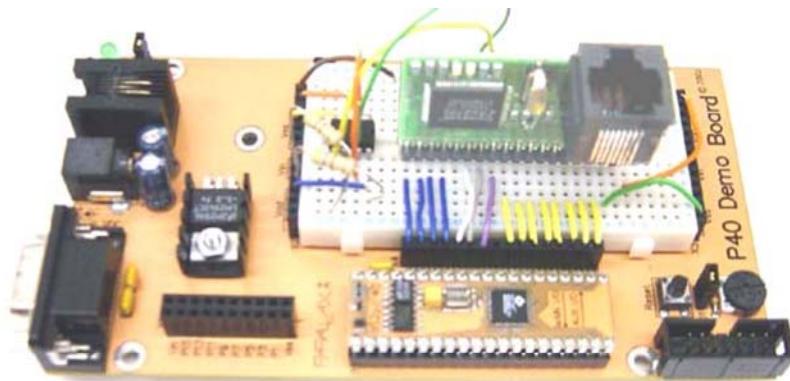
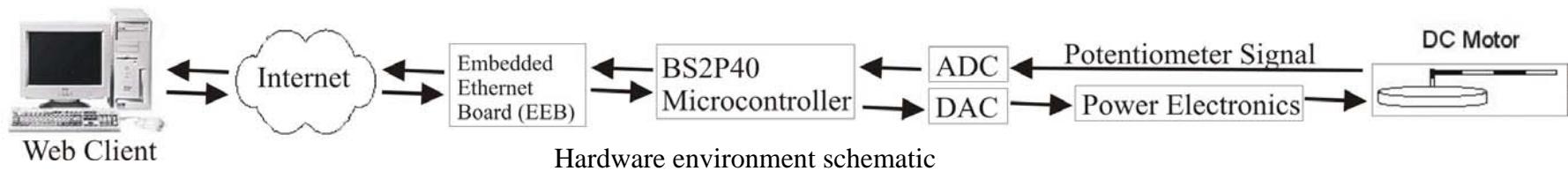
Simulink block diagram used for bi-directional serial communication between BS2 and PC



Plot of rctime vs. angle of light sensor

Yang-Fang Li, Saul Harari, Hong Wong, and Vikram Kapila

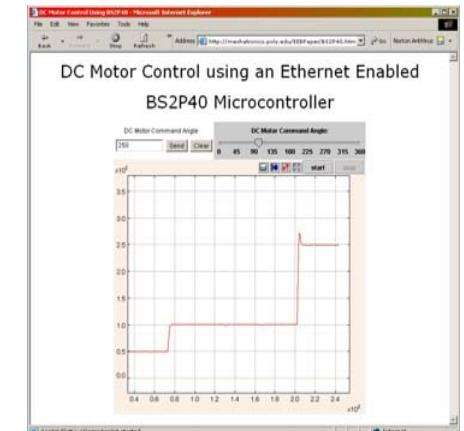
# Internet-Based Remote Control using a Microcontroller and an Embedded Ethernet Board



Ethernet Enabled BS2P40



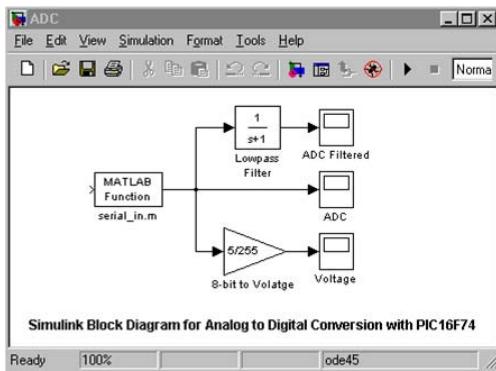
DC motor test-bed



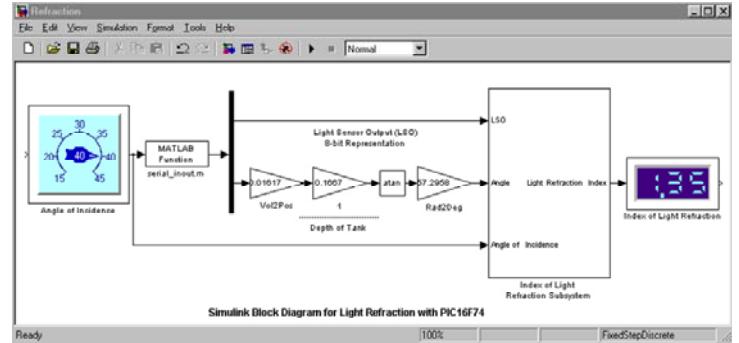
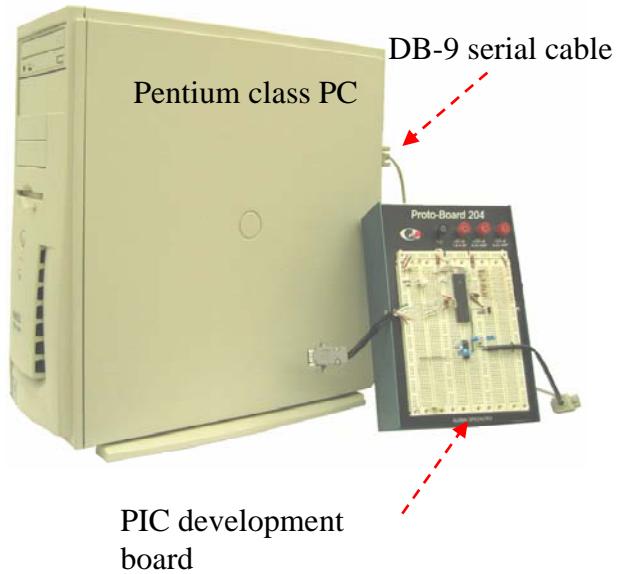
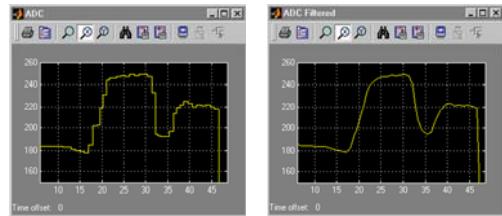
Java applet GUI screen capture

Imran Ahmed, Hong Wong, and Vikram Kapila

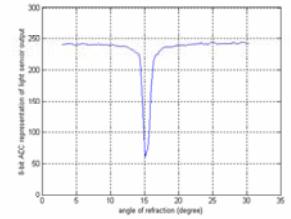
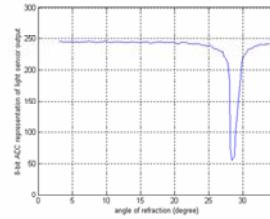
# Matlab-Based Graphical User Interface Development for PIC Microcontroller Projects



Simulink block diagram used for PIC to PC serial communication

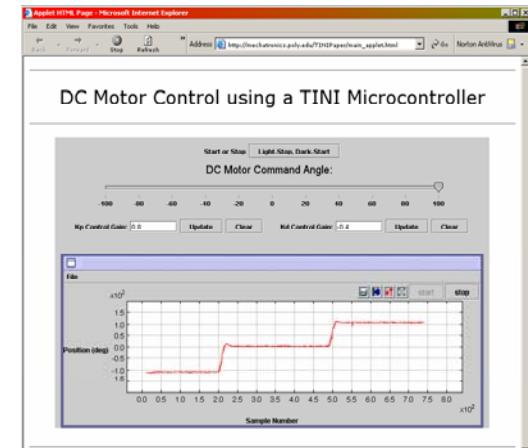
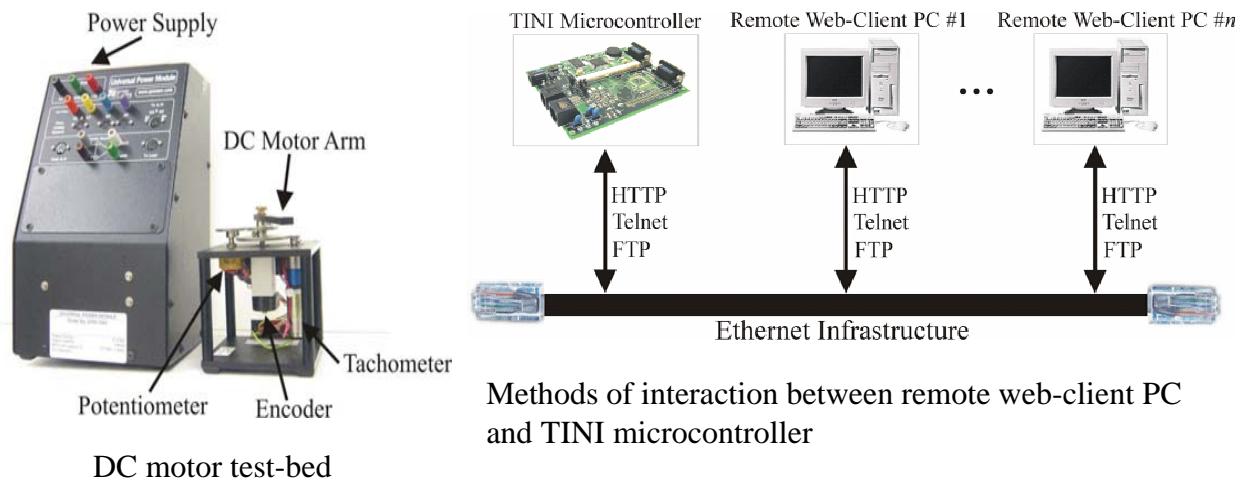


Simulink block diagram used for bi-directional serial communication between PIC and PC



Sang-Hoon Lee, Yang-Fang Li, and Vikram Kapila

# Internet-Based Remote Control of a DC Motor using an Embedded Ethernet Microcontroller



Java applet GUI screen capture

Hong Wong and Vikram Kapila

# MPCRL Demonstration

- Web-enabled **M**echatronics/**P**rocess **C**ontrol  
**R**emote **L**aboratory (MPCRL)
- URL: <http://mechatronics.poly.edu>
- Person in-charge: Mr. Nathan (Sang-Hoon) Lee