# Sponsored by Research Experience for Teachers (RET) Program of NSF

## Polytechnic University Mechanical Engineering

**Project URL: mechatronics.poly.edu/smart/** 



## ORIENTATION



# **Project Director**



- Professor Vikram Kapila
- Associate Professor
- Room: RH 508
- Phone: (718) 260-3161/3160
- E-mail: vkapila@poly.edu
- URL: mechatronics.poly.edu/vkapila/





## **Project Instructor**

- Name: Nathan (Sang-Hoon) Lee
- Room: RH 514
- Phone: (718)260-3791
- E-mail: sparknate@yahoo.com



# **Teaching Assistant**

- Name: Anshuman Panda
- Room: RH 514
- Phone: (718)260-3791
- E-mail: apanda01@utopia.poly.edu



# 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

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- Keep this room as clean as the work allows
  - after experiments, <u>put all components in their</u> <u>original place with the same original condition</u>
- 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 12, 2004 (Monday)
End Date	August 6, 2004 (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 12	13	14	15	16	
	Registration & Opening	Lecture, Lab, and discussion				
	Orientation	Lecture, Lab, and discussion				
2 <sup>nd</sup>	19	20	21	22	23	
	Lecture, Lab, and discussion					
	]	Brain storming for project				
3 <sup>rd</sup>	26	27	28	29	30	
	Building the project, report preparation, and presentation slides					
4 <sup>th</sup>	August 2	3	4	5	6	
	Building the project, report preparation, and presentation slides				Presentation	

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## **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 5 groups of 2 each
- All structured projects and final projects will be done in the same teams



## Ice Break

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



## **SMART 2003 Projects**



## **Static Equilibrium**



Teachers: Robert Gandolfo & Paul Friedman



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## **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 McGarrity



## The Ro-Boe-Clock



Teachers: Michelle Carpenter-Smith & David Deutsch



## **Reflection Experiment**

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## **Refraction Experiment**



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## **Static Friction Experiment**





## **Pendulum Experiment**





## Heat Conduction Experiment





## **Sample Mechatronics Projects**

#### ME3484: Mechatronics, Spring 2003 YES Summer Research Program, 2002



## **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**





<b>Richard Balsamel</b>	Science High School	Newark, NJ	\$4,000	School district
David Deutsch	Manhattan Center for Science and Math High School	New York, NY	\$3,000	School and through the Children's Aid Society
Paul Friedman	Seward Park High School	New York, NY	\$1,500	School's alumni association
William Leacock	W. C. Mepham High School	Bellmore, NY	\$1,500	School district
Marlene McGarrity	The Christa McAuliffe School	Brooklyn, NY	\$1,500	Online grant agency





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 hightech 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.

- Adam Balkin







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Phinolge teacher Robert Gandallademonstrated a medianism that combines courages of mechanical, electrical and computer the beam to the deviced value. All of the cience engineering to his students in the Introduction to Engineering class. The device was designed, built and programmed by Mr. Gandhills and Mr. Paul Friedman of Seward Park. HS as particl assumer second program at Polyachaic University

The device is a strength demonstration that involutes the method of a cancel of a human clines and has applications to the engineering problem solving activities that the Introduction to Engineering students will be doing over the where we -

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### **2003 SMART Participants**

#### •10 teachers

•PI

- •3 Poly graduate students
- •2 Poly undergraduates
- •1 undergraduate from CCNY





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



Unfiltered and Filtered plot of rctime

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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



#### 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



Unfiltered and Filtered plot of ADC





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



Plot of angle of refraction vs. light sensor output

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



**SMART** 

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



Hong Wong and Vikram Kapila



## **MPCRL Demonstration**

- Web-enabled Mechatronics/Process Control Remote Laboratory (MPCRL)
- URL: <u>http://mechatronics.poly.edu</u>
- Student in-charge: Mr. Hong Wong