

NSF Grant Number: EEC-0227479

PI: Vikram Kapila

Institution: Polytechnic University, Brooklyn, NY

Title: Science and Mechatronics Aided Research for Teachers (SMART): A Research Experience for Teachers Program

•Objectives:

- Introduce multidisciplinary field of mechatronics to teachers using a structured and integrated learning environment consisting of training, mentoring, and research.
- Provide teachers with experience, skills, and resources in mechatronics-oriented prototype product development via hands-on learning so that they can develop science projects by integrating mechanism, sensor, actuator, and microcontroller technologies.
- Enable the teachers to integrate project-based learning and learner-centered teaching in their science and mathematics curriculum and enhance their science laboratories.

•Approach:

- Mailed project brochure to over 300 high schools and received 35 applications from which 10 teachers were selected. Project began with an orientation session on July 14.
- For the first two weeks, the project focused on mechatronics tutorials (lecture/demo) in the morning/afternoon sessions each followed by structured hands-on experiments with clearly stated objectives, sequence of steps to follow, expected results, etc.
 - Teachers learnt about foundational elements of mechatronics, e.g., sensors, actuators, electronic/electro-mechanical components, and microcontroller technologies.
- In the last two weeks, teachers developed mechatronics-aided science projects to demonstrate concepts of projectile motion, speed, time, static balance, robotics, etc.
 - Teachers experienced the typical design, model, analyze, refine, prototype, and validate cycle arising in real-world mechatronics system development.
 - Teachers performed integration of various elements of mechatronics.
- Teachers completed project portfolios consisting of: working prototype, video demonstration, presentation slides, report, and website.

•Broader Impact: The project is:

- Advancing discovery and learning by exposing the teachers to the multidisciplinary field of mechatronics via training, research, and product development.
- Empowering the teachers to reinforce STEM training and educational experience of a diverse student body from New York metropolitan area and prepare the students for higher education and productive career opportunities in STEM disciplines.
- Enabling the teachers to enhance the laboratory infrastructure at their schools using mechatronics-aided science experiments.
- Allowing the teachers to develop synergistic interactions with FIRST Robotics.
- Using Internet effectively for wide dissemination of project activities.
- Broadening Polytechnic's ties with local school districts and businesses to sustain and grow its outreach activities.

•Significant Results:

- Design, development, and prototyping of mechatronics-aided physics experiments, e.g., light reflection, light refraction, heat conduction, static friction, periodic motion of a pendulum, projectile motion, static balance, speed, time, etc.
- All teachers greatly enhanced their knowledge of mechatronics as revealed by pre- and post-project assessment (technical quiz and survey).
- One teacher raised \$4,000 to develop a mechatronics research club and an elective course. Another teacher is leading a new robotics program at his school.
- Polytechnic University showcased SMART teachers' mechatronics-aided science experiments at the SMART Day @ Poly, which was attended by the SMART teachers, their colleagues, and school/district administrators. All attendees commented positively about teachers' accomplishments.
- NY1 and WABC television news reports showcased SMART activities.
- Several mechatronics related papers have been submitted for publication.

•Graphic:

