Multi-disciplinary Design Projects in a Capstone Design Course

Richard Bannerot
Ross Kastor
Gangbing Song
Department of Mechanical Engineering
Cullen College of Engineering

Paul Ruchhoeft
Department of Electrical and Computer Engineering
Cullen College of Engineering

Marvin Beasley
Engineering and Business Consultant

Abstract

In the one semester, three engineering department (Electrical and Computer Engineering, Industrial Engineering and Mechanical Engineering), capstone design course taught in the Cullen College of Engineering at the University of Houston, multidisciplinary teams (at least two of the three departments must be represented on the team) work on design projects provided by local industry and the faculty. In the last two years 64 teams have worked on 57 projects in the course. These projects could be classified as follows:

- Fourteen "emerging technology" projects provided by faculty
- Twenty-five projects provided by local industry
- Eleven projects associated with national student design competitions
- Seven projects provided by faculty and the class instructors (some open ended product development projects)

A rich source of good design problems associated with emerging technology has been some of the University's research laboratories (These projects were discussed in the reference given at the end of this paper.):

- Micro-Nano Engineering Laboratory in the Department of Electrical and Computer Engineering that focuses on commercial applications of micro-nano scale structures
- Opto-electronic Materials and Devices Laboratory in the Texas Center for Superconductivity and Advanced Materials that specializes in developing novel IR sensors and detectors
- Smart Materials and Structures Laboratory in the Department of Mechanical Engineering that specializes in active and passive vibration control and structural health monitoring.

The major source of projects remains local industry. These projects are listed below (Some of the projects were repeated.):

- a multiple sealant extrusion device,
- a robot for active defense for practicing free kicks in soccer,
- the development of a transportation synchronization decision-making tool,
- re-engineering a commercial borescope for space applications,
- a mechanize fire hose lay-up device,
- the design of tank and pipe rack foundations,
- a failure analysis and testing of concentric cylinder configurations,
- a high temperature, high pressure packer for down-hole applications,
- an evaluation and optimization of an industrial electrical power system,
- a reduced gravity NC-mill chip collection system,
- an electronic tape measure for medical applications,
- predicting drill string lock-up in mechanical packers,
- a space telescope propulsion system,
- an ion system for the SAFER battery,
- the design of a velocity fuse valve,
- the design of a control system for a bridge-crane for ship model testing in a tow tank,
- an emergency pyrotechnic cutter, and
- a lithium ion battery charger for the mini AEROcam.

The product development projects require that the students develop a new product which includes: performing the associated market surveys, developing a business plan, designing the device, and then building and testing a prototype. A semi-retired engineer and business entrepreneur has served as client and consultant for these projects. These projects have included:

- a low power light source
- a foot activated computer interface
- a dressing station for bi-lateral amputees
- a smart crutch using an MR fluid
- a human fatigue sensor and alarm

This paper will describe some of these projects and how the structure of the course allows the entire class to be introduced to all class projects. In fact, the course final exam includes questions on all the projects for that semester.

Reference

Raul Ruchhoeft, Gangbing Song, Richard Bannerot, and Ross Kastor, "Introducing Emerging Technology, into the Engineering Curriculum Through Capstone Projects," Proceedings of the 2004 Annual Conference of the ASEE Gulf Southwest Section, March 10-12, 2004, Texas Tech University, Lubbock, TX, on CD.