Robotics as a Learning Medium for Engineering Practice and Team-based Design in Capstone Projects

Ninad Pradhan, Timothy Burg, Richard Groff, Darren Dawson
Dept. of Electrical and Computer Engineering

CLEMSON UNIVERSITY

"robotics projects are used as a medium to teach senior-year undergraduates the tools required for engineering practice and team-based design."

Results and Conclusions

ECE Capstone Organization

ECE 495 Fall Senior Year (2 hrs) → ECE 496 Spring Senior Year (2 hrs)

Robotics in the first semester electrical and computer engineering design course has been used to

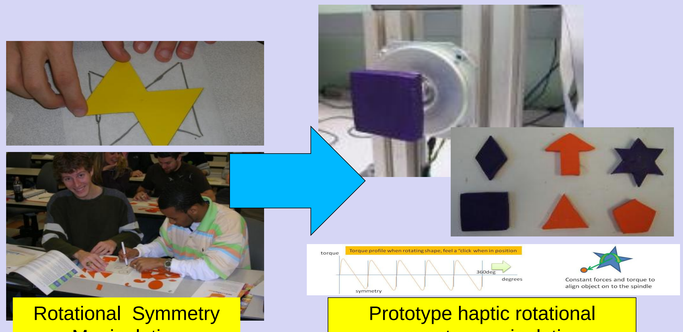
- Dictate technical and nontechnical learning outcomes
- Promote collaboration with industry partners to evaluate the results.
- Provide consistency between projects and team experiences
- Providing the design freedom expected in a capstone design course
- Excite students

Haptic Virtual Manipulatives

One of the most efficient methods used for math instruction is the use of **Manipulatives**, i.e., real world objects used to teach abstract math concepts.

Manipulatives | Virtual Manipulatives | **Haptic Virtual Manipulatives**

Virtual Manipulatives, created with computer software, promote more focused involvement but give up the crucial **sense of touch** of physical manipulatives.



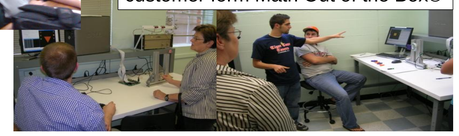
Rotational Symmetry Manipulative

Prototype haptic rotational symmetry manipulative

Customer Requirements

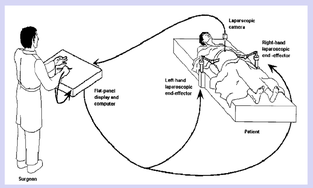
Industry Panel lead by a PE

Demonstration of prototypes to customer form Math Out of the Box®

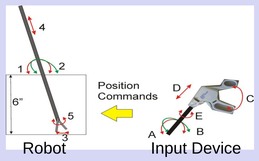


The Laparoscopy Surgery Robot

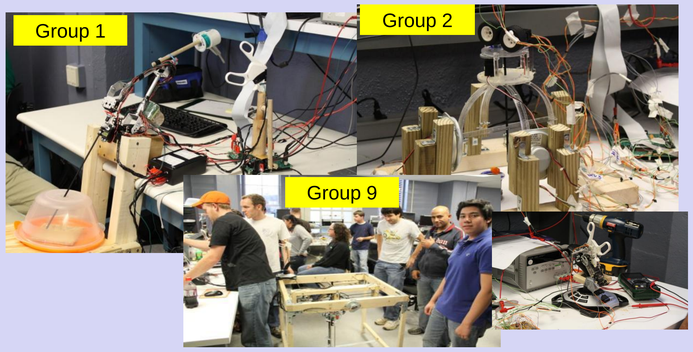
Each group is requested to design and build a working prototype of a new, low cost implementation of a teleoperated laparoscopic robot.



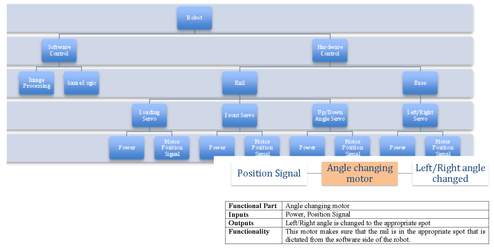
Tele-operated surgery robot



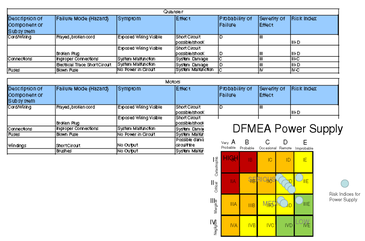
The user will move the input device to a position and the control system will force the robot to an equivalent position.



Systems Integration

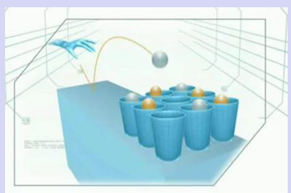


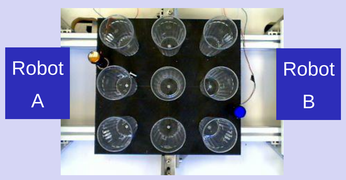
Functional Part	Angle changing motor
Inputs	Power, Position Signal
Outputs	Left/Right angle is changed to the appropriate spot
Functionality	This motor makes sure that the rail is in the appropriate spot that is dictated from the software side of the robot.



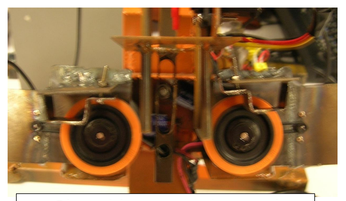
Ping Tac Toe

Build a robot that will bounce a ping pong ball off of a surface, through a window, and into a scoring bin, a cup. Two robots will play in a head-to-head competition to win a game of ping tac toe.

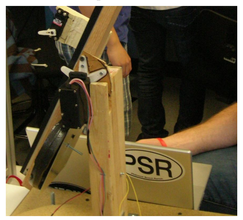




Closed-loop Control



Closed-loop speed control

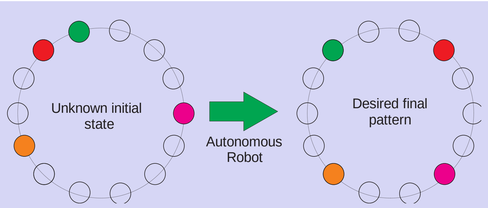


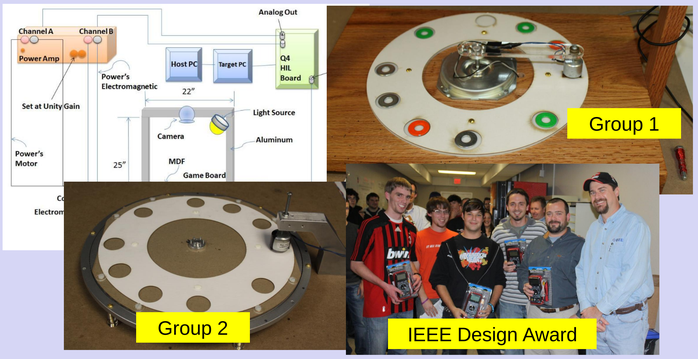
Closed-loop position control

Closed-loop pressure control

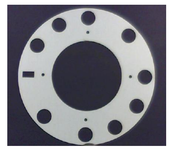
Puzzle Solving Robot

An autonomous robot will move colored disks from an unknown initial state to create a desired pattern in the shortest time possible. Final configuration will be read from a QR barcode.



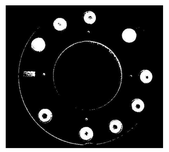


Computer Vision

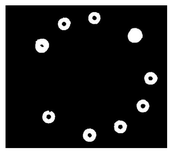


Background

Game



Threshold



Erosion Connected Components Dilation