

I. Abstract

Our project is to create an autonomous robot able to score rings in the 2016 Roborodentia competition for Cal Poly Open House. We want to make sure Roborodentia is able to showcase the best of what Cal Poly engineers have to offer. This means making sure the robots in the competition are technologically advanced, and they can serve as an example of what it means to be an engineer to the prospective students who come to open house. With proper funding, we can make a robot that will exceed these expectations and impress any potential future engineers that come to Cal Poly Open House.

This project provides hands on learning experiences in mechanical, electrical, and computer engineering. Designing, constructing, wiring, programming, and testing will all be required in completing this project. Through code optimization, our robot will be programmed to achieve the the largest multiplier of ring points. Such an advanced robot will require state-of-the-art equipment and materials. For example, we will use omni-wheels to navigate the course and utilize 360 degrees of motion for speed and efficiency. Additionally, our robot would know its position from ultrasonic sonar, infrared, and Hall effect sensors. Our scoring mechanism will use motorized potentiometer technology to lift the rings off the pegs. Additionally, a custom 3D printed, servo driven gripping mechanism will be used to store the rings without threat of losing grip. These technologies are not cheap, but they are essential to build a state-of-the-art robot for the Roborodentia competition.

With any luck, we will make a truly impressive robot that can showcase the skills Cal Poly engineers possess. This Roborodentia robot will serve as an example of what Cal Poly's "Learn by Doing" motto really means and, hopefully, showcase the benefit of the engineering program to the young men and women at this year's open house.

For more information about the Roborodentia competition, please visit

III. Objective(s)

This funding will help us purchase our parts. In previous years we didn't want to break our budget, so we went with the cheapest parts and scraps we could find lying around. We were able to put the effort into our code, but the hardware and mechanical systems could not compete with teams who were able to build more expensive robots. Here are a few items that we could not afford in previous years that we would like to use in our robot this year:

1. Four ultrasonic sensors for navigational awareness
2. Precision line following via additional infrared sensors
3. Four high torque motors for increased speed
4. Four omni-wheels for complete cartesian movement
5. High capacity / high amperage battery for continuous robot longevity
6. Stepper servos used for higher precision ring manipulation
7. Two Arduino microcontrollers to divide robot labor

By using these components, we will be able to create a truly state-of-the-art robot for Roborodentia 2016. This robot will showcase the skills that Cal Poly engineers possess and will hopefully bring more interest to the department.

IV. Methodology

Movement:

Our robot will navigate with four omni-wheels that give it complete instantaneous movement. It will not have to turn around since it can move while spinning and orienting itself in the right direction. We will try to reach the rings that require our robot to cross over a $\frac{3}{4}$ " bar because the rings on that side earn three times the amount of points as the regular pegs. This will require us to turn our robot 45 degrees in order to have all our wheels contribute to scaling the bar rather than just two.

Scoring:

We will use two high torque servos to create a claw and grab all the rings from one peg. After our robot has grabbed the rings we will lift them up and store them. The rings will be stored by flipping them onto one of the pegs our robot has on a spinning board. Each of the three pegs will have a servo and will carry all twelve rings at once to the scoring pegs. Once we reach the scoring pegs, we will turn use the servos to dump the rings onto the scoring pegs.

V. Timeline

The robot must be ready for the competition on April 16, 2016. This objective will definitely be met because we are also taking CPE 400 with our advisor, Professor John Seng. To prepare for meeting our deadlines, we have created a full timeline Gantt Chart (for reference week 1 refers to week 1 of Winter Quarter). The major milestones for this project include:

- Finalization of our design by week 3
- All special order parts arrive by the end of week 5
- Chassis construction finished by the end of week 4
- Gripping mechanisms constructed by week 7
- Testing and coding will be done incrementally between weeks 4 and 10
- A fully functional version of the code ready by week 8
- This should then give us approximately four weeks to debug and test before the Roborodentia competition

Gantt Chart: _____

Warren J. Baker Endowment

for Excellence in Project-Based Learning

Robert D. Koob Endowment for Student Success

CAL POLY

PROPOSAL BUDGET

Student Applicant(s):	
Faculty Advisor:	
Project Title:	Requested Endowment Funding
Travel <u>subtotal</u>	\$0
Travel: In-state	\$0
Travel: Out-of-state	\$0
Travel: International	\$0
Operating Expenses <u>subtotal</u>	\$500.00
Non-computer Supplies & Materials	\$228.89
Computer Supplies & Materials	\$271.11
Software/Software Licenses	\$0
Printing/Duplication	\$0
Postage/Shipping	\$0
Registration	\$0
Membership Dues & Subscriptions	\$0
Multimedia Services	\$0
Advertising	\$0
Journal Publication Costs	\$0
Contractual Services <u>subtotal</u>	\$0
Contracted Services	\$0
Equipment Rental/Lease Agreements	\$0
Service/Maintenance Agreements	\$0
TOTAL	\$500.00

Supplier	Quantity	Part	Unit Pric	Appx Total Pric
Wheels and Motors				
RobotShop	4	60mm Omniwheel	\$15.45	\$61.80
RobotShop	2	37D Bracket	\$7.95	\$15.90
RobotShop	4	60mm to 6mm D Hub	\$10.30	\$41.20
Professor Seng	4	37D Motors	\$13.50	\$54.00
			SubTotal	\$172.90
Electronics				
Amazon	2	Arduino Mega	\$37.77	\$75.54
Hobby King	2	4000mAh LiPo Battery	\$23.00	\$46.00
SparkFun	6	IR Sensor	\$2.95	\$17.70
Amazon	4	High Torque Servo	\$12.99	\$51.96
Amazon	1	Motor Shield	\$20.01	\$20.01
Sparkfun	3	Slide Pot	\$19.95	\$59.85
			SubTotal	\$271.06
Fabrication				
Amazon	1	Plexiglass Glue	\$5.99	\$5.99
Misc	1	Plexiglass, Screws, standoffs, et	\$50.00	\$50.05
			SubTotal	\$56.04
				Total Price
				\$500.00

Advisor Recommendation:

I am writing this letter in support of this project application for the Excellence in Project Based Learning award. I am the faculty advisor for the annual Roborodentia competition and the advisor for the Cal Poly Robotics Club. The Roborodentia competition is an excellent annual venue for showcasing student innovation and engineering skills.

Each year, several students build robots and compete in a tournament while many prospective high school students watch on. I believe it is important to provide students with the resources necessary for them to build the best possible robots. Funding provides great value to both the student contestants and enhances Roborodentia as a recruiting tool for future Cal Poly students.

Darius, Matthew, and Mytch are responsible students who have experience in constructing robots. I taught an Introduction to Robotics course where Matthew and Darius were students, so they have the skills necessary to make this project a success. The 3 of them are also involved with the Robotics Club which has served an important role in furthering robotics development on the Cal Poly campus.

I believe the design and budget they have presented here is detailed, realistic, and accurate. The costs of building a robot for Roborodentia fall in line with what they have presented here. The 3 of them have experience in working with the motors they have outlined, developing the electronics, and executing the mechanical fabrication choices they have listed.

I think that the award selection committee would be hard-pressed to find a project that would provide more value than this project. If the goal is to award excellent project based learning, then I believe that this project covers all the bases. It aids these 3 students in achieving their goals of building this robot, provides great visibility for the university during Open House and the Roborodentia contest, and serves as a recruiting tool to attract students to Cal Poly. I do highly recommend this application for funding.

-John Seng
CSC Dept.
Cal Poly