

# Warren J. Baker Endowment

*for Excellence in Project-Based Learning*

# Robert D. Koob Endowment *for Student Success*

CAL POLY

## Proposal Cover Page

Title of Project:

Inclusive Lectern II

Proposal Author: Pedro Mogollon / Joanna Moraza

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Student ID: 009809068 / 009981058

Signature (Optional): \_\_\_\_\_

*Signature provides permission to check financial aid eligibility.*

Previous Baker/Koob Endowment funding? (circle one):      **Yes**      **No**

Team Member(s)	Signature	Cal Poly Email	Department
<u>Pedro Mogollon</u>	<u><i>Pedro Mogollon</i></u>	<u><a href="mailto:pmogollo@calpoly.edu">pmogollo@calpoly.edu</a></u>	<u>ME</u>
<u>Joanna Moraza</u>	<u><i>Joanna M.</i></u>	<u><a href="mailto:jmoraza@calpoly.edu">jmoraza@calpoly.edu</a></u>	<u>ME</u>

Faculty Advisor: Sarah Harding

Department: ME

Faculty Advisor email: sthardin@gmail.com

Telephone: 805-756-7994

Anticipated Start Date: September 22, 2016

Anticipated End Date: June 6, 2017

Total Funds Requested (\$): 2,000.00

Signature of Faculty Advisor: *Sarah Harding*

Date: 11/11/16

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## PROPOSAL NARRATIVE

### I. Project Title

Inclusive Lectern II

### II. Abstract

The *Inclusive Lectern* fills a need at Cal Poly San Luis Obispo for American with Disabilities Act (ADA) complaint lecterns, which accommodate presenters who use wheelchairs. While a prototype of the *Inclusive Lectern* was completed in 2015 there are inherent and vital flaws. This year's engineering team shall address these flaws by improving the actuation system (electrical-linear actuator) that enables adjustment of the lectern height. In addition, a retracting system will be incorporated, consisting of force transducers and micro-controllers for collision prevention between the work surface and the legs of the user when lowering the lectern. The new system will be more safe and achieve the same height-adjustable range; it will be manufactured from components that are replaceable and easily maintained.

### III. Introduction

During the 2015-2016 academic year at California Polytechnic State University San Luis Obispo (Cal Poly), a group of mechanical engineering students built a height-adjustable lectern that provided grandeur and inclusivity to various presenters on campus (Figure 1). John Lee, an Assistive Technology Specialist for the Cal Poly Disability Resource Center (DRC) and sponsor of this project, was able to showcase the functioning lectern during the Global Accessibility Awareness Day (GAAD) celebration at Kennedy Library on May 19, 2016. The *Inclusive Lectern* was well received by attendees during this event as on the social media coverage of the event.

However, the *Inclusive Lectern* became non-functional after the actuation system that enabled the height-adjustable feature failed. John Lee introduced the new problem to the Cal Poly Mechanical Engineering Department during senior project presentations. Our team, which consists of Pedro Mogollon and Joanna Moraza (two mechanical engineering majors) were selected to design and build a new actuation system for the *Inclusive Lectern* as a senior project. Although this project features several mechanical aspects, it is interdisciplinary in nature due to the association of ergonomics (an important subject in kinesiology) and the application of electrical systems.



Figure 1. The Inclusive Lectern

#### IV. Objective(s)

1. Manufacture a new actuation system that is sturdy with replaceable and maintainable components that allow a height adjustability of 22 inches (measured from the ground to the bottom of the work surface) to 48 inches. The actuation system must provide a linear stroke length of 26 inches and a force of 350 lbs. The actuation speed of the lectern will be at least 1.6 in/s.
2. Manufacture a retracting system for collision prevention that is capable of a reaction time of at least 0.5 seconds.
3. Have a functioning lectern with a robust actuation and retracting system before the Senior Project Expo (June 2, 2017).

#### V. Methodology

In the process of disassembling the prototype *Inclusive Lectern*, we analyzed the current actuation system and defined the boundaries of our workspace. The lift mechanism is activated by manual control switches and with floor pads that lift/lower the lectern when a load (such as the weight of a wheelchair) is applied. Unfortunately, the actuation system can no longer raise the lectern past 40 inches (measured from the work surface to the floor), unable to accommodate all presenters using the lectern. The lift mechanism designs from the previous team were considered and we completed more research to identify potential solutions. After receiving approval on our project proposal from our sponsor John Lee, we moved on to the ideation phase of the project. Three ideation sessions for the actuation and retracting subsystems were conducted. A few of the solutions were prototyped using materials such as foam core board, construction paper, and Knex (Figure 2). The prototyping allowed us to visualize the pros and cons of our designs. As a team we developed a Pugh matrix for each subsystem, this tool facilitated the comparison of a few of our designs based on important specifications. For example, an important specification to consider was the size of the work space. Our design is constrained to the space of the previous actuation system because we do not want to alter the aesthetics of the lectern. As a result, the designs that were selected were the systems that incorporated an electrical-linear actuator and force transducers.



**Figure 2.** Prototypes of Two Actuation Systems

## **VI. Timeline**

To achieve the tasks mentioned in our objective we will have benchmarks to aid us in the design process. The first benchmark was the Project Proposal; this document is an agreement with our sponsor on the scope of the project. The current benchmark is the Preliminary Design Review (PDR) where we will present our solutions for the actuating and retracting systems. During this process, we will obtain feedback, from our sponsor and advisor who will assist in the improvement of our design. During the Winter 2017 Quarter, we will work on the following milestone, which is the Critical Design Review (CDR). The CDR will include a functional description of our final design, layout drawings, analysis, safety considerations, material selection justification, fabrication/assembly and maintenance instructions. The team will proceed to ordering parts and material to manufacture the design. The Spring 2017 Quarter, will consist of building and project testing. The final milestones for that quarter will be the Project Hardware/Safety Demo, the Final Design Report, and the *Senior Project Expo*.

## **VII. Final Products and Dissemination**

The completed project will be presented during the *Senior Project Expo* in June 2, 2017. The Inclusive Lectern will remain at Cal Poly for the use of various events through the DRC.

## **VIII. Budget Justification**

Our team is requesting to be funded with \$2,000. Over half of the budget for this project will be devoted to the new actuation system. This actuation system is a crucial part of our design as it will provide the vertical motion to increase/decrease the height of the lectern. Without this system, our lift mechanism would not be automatic, instead it would have to be manual. A manual mechanism would involve work from the user, which could present difficulty to the presenter operating the lectern; making the lectern exclusive rather than inclusive. Electrical-linear actuators vary in price, depending on the stroke length and force. The actuators we are considering range between \$500-\$700 We asked for \$1400 under non-computer supplies and materials because we are considering using at least two linear actuators, plus the shipping and handling fees. Beside the actuation system, we need the resources to purchase the components for the collision detection system. The necessary components include microcontrollers, force transducers, and other electrical elements we need for connection and interfacing. Microcontrollers and force transducers alone range between \$50-\$100 and \$90-\$100 respectively. We plan on purchasing one microcontroller and at least 3 force transducers. Finally, the rest of the money that is awarded will be used to rent or buy any necessary power tools to assist with the build of the systems. Thank you for your consideration for the Warren J. Baker and Robert D. Koob Grant.



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CAL POLY

### PROPOSAL BUDGET

<b>Student Applicant(s):</b>  Pedro Mogollon Joanna Moraza	
<b>Faculty Advisor:</b> Sarah Harding	
<b>Project Title:</b>  Inclusive Lectern II	<b>Requested Endowment Funding</b>
<b>Travel</b> <u>subtotal</u>	<b>\$ 0.00</b>
Travel: In-state	\$ 0.00
Travel: Out-of-state	\$ 0.00
Travel: International	\$ 0.00
<b>Operating Expenses</b> <u>subtotal</u>	<b>\$ 1,800.00</b>
Non-computer Supplies & Materials	\$ 1,300.00
Computer Supplies & Materials	\$ 500.00
Software/Software Licenses	\$ 0.00
Printing/Duplication	\$ 0.00
Postage/Shipping	\$ 0.00
Registration	\$ 0.00
Membership Dues & Subscriptions	\$ 0.00
Multimedia Services	\$ 0.00
Advertising	\$ 0.00
Journal Publication Costs	\$ 0.00
<b>Contractual Services</b> <u>subtotal</u>	<b>\$ 200.00</b>
Contracted Services	\$ 0.00
Equipment Rental/Lease Agreements	\$ 200.00
Service/Maintenance Agreements	\$ 0.00
<b>TOTAL</b>	<b>\$ 2,000.00</b>



Mechanical Engineering Department  
1 Grand Avenue  
California Polytechnic State University  
San Luis Obispo, CA 93407

November 11, 2016

RE: RFP – Inclusive Lectern

Baker-Koob Endowment Committee:

I am the senior project advisor for the Inclusive Lectern team. This project is being sponsored by John Lee of Cal Poly's Disability Resource Center (DRC). During the 2015-2016 school year, a team of senior project students built an Inclusive Lectern. This lectern was built so that standing individuals as well as those who use a wheelchair could present from behind a lectern. The beautiful lectern was presented at multiple events in the spring of 2016 just prior to the failure of the mechanism that raises and lowers the lectern. The mechanical engineering department and DRC are committed to getting the lectern working again so we can support inclusivity for the Cal Poly community. This project involves building a new vertical motion mechanism that is more robust and uses parts that can easily be maintained or replaced.

The lectern was built to raise and lower using switches or pads on the floor where a wheelchair user could just roll onto the pad to raise or lower the top surface. Unfortunately the mechanism that was used to actuate this vertical motion failed early during testing. Due to time and cost constraints of the previous project the students used adjustable table legs from a donated table for the vertical motion mechanism. This mechanism was not robust enough for the lectern. The only way to fix the lectern is to purchase \$700 table legs, but they would most likely experience the same failure thus this new project will completely redesign the vertical motion mechanism within the existing wood lectern structure.

The two mechanical engineering students on this team are working on this project in fulfillment of their senior project. They both selected this project because they have a strong interest in controls and they wanted to complete a project that would give back to the Cal Poly community. They are currently enrolled in the first quarter of the three quarter mechanical engineering senior project sequence. Because of the very structured nature of the course, I have confidence in the students' ability to design, build and test a new system for the Inclusive Lectern by June 2017.

The course is structured so that students have six hours a week with their team and advisor. As their advisor, I will be meeting with them weekly to check on progress, recommend steps they can take to improve performance, and break down any roadblocks. These meetings are crucial to the success of the project. In addition to assistance from mechanical engineering professors, the students have received support from a former student that was part of the original Inclusive Lectern project. His expertise on how the lectern was constructed and understanding of the failure mode will be helpful for the students working on this project.

This project is owned by Cal Poly and will remain at Cal Poly for our campus community to use at events all over campus. Please help this team with funding so we can get the Inclusive Lectern working again.

Sincerely,

A handwritten signature in cursive script that reads "Sarah J. Harding".

Sarah Harding  
Mechanical Engineering Lecturer

A handwritten signature in cursive script that reads "John Lee".

John Lee  
Disability Resource Center

(805) 756-7994