

The APSC Times

DEC 25, 2016 – LATE BREAKING REPORT! An Unidentified Flying Object (UFO) has crash landed in the Pacific Ocean! The crash is reported to have occurred approximately 200 km West of the NW tip of Vancouver Island, where the ocean is approximately 3000 metres deep. A local Vancouver company, Coastal Recovery, is leading the effort to retrieve items from the wreckage. Due to the unpredictable sea conditions this time of year, and the unknown state of the wreckage, a fully

autonomous retrieval system is required. Since this is out of Coastal Recovery's realm of expertise, they are contracting out the design of the system. They will be hosting an open design competition for teams to showcase their designs to prove which concept has the greatest potential. This team will be granted the contract and go into full scale production. Due to the timely nature of this event, the competition is scheduled to occur the week of January 30 – February 3, 2017.

Overview

Why this Design Project

To this point, you have completed two design projects: an introduction to design with the Cardboard Chair, and an introduction to CAD and rapid prototyping with the adaptive device project. This project will add elements of fabrication and robotics. It will require the methodical application of the design process to guide the development and testing of a computer-controlled claw.

Connections to the rest of the course

Like all major projects in the engineering profession, this project is team-based. The project will conclude with a demonstration of your final claw design and a poster presentation. The presentation in particular is intended to give you experience presenting your ideas and justifying the decisions you have made.

Problem Statement

Teams will be responsible for designing, constructing, and programming a fully autonomous Claw Retrieval System (similar to an automated version of prize-based vending machine cranes) that can pick up various designated objects at specified locations. The claw will attach to a common crane system used by all teams in the class, so your focus will be on the design of the claw mechanism. The project combines computer programming with an Arduino microcontroller device that interfaces with a sonar sensor and servo motor. You will develop hands-on skills while working with sheet metal to construct your claw, and you will get experience programming microcontrollers in order to control your device.

The project is intended to help you develop a deeper understanding of each phase in the design cycle, with an emphasis on Stage 5: Develop and Test Solution. To encourage prototyping and testing, teams are allowed to bring two claw systems to the design competition; you may choose to do this to tailor the capabilities of different claws to different rounds of the competition, or for redundancy in case of a fault with one claw. There is no penalty if you choose to only focus on one claw retrieval system.

This module will also introduce formal engineering design drawings, and it will give you an opportunity to further develop your sketching as well as your technical communication through a poster presentation. This module will culminate with a student design competition to allow groups to test their crane designs against the rest of the class for a given set of objectives: in one round, retrieve as many different objects as possible in a limited time, and, in a second round, retrieve the highest quantity of a standard item. Teams will also participate in an additional bonus round cooperating with other teams within the Studio section.

Resources

Each team will receive one Arduino kit per 2 students. During studio sessions, teams will be given the necessary sheet metal and other consumables, like screws, rivets, wire, rod stock, etc. Each student will receive one 8" × 8" piece of sheet metal – this should be plenty for your team throughout the module; however, if you need more, extra sheets will be available for purchase at \$3 each. Hand tools will only be available during these studio sessions, and limited extra sign up sessions – **be sure to prioritize tasks when you have access to the tools!**

Timeline

- Week 1 (Jan 3-6): Project context and introduction to hand tools
- Week 2 (Jan 9-13): Introduction to microcontrollers and further exploring prototypes
- Week 3 (Jan 16-20): Isometric and orthographic drawings
- Week 4 (Jan 23-27): Effective technical communication
- Week 5 (Jan 30 – Feb 3): Design Showcase

Evaluation

Design Showcase

The assembled designs will be tested at a public design showcase in EDC 303 in your studio session. Three teams will compete in parallel completing each of the first two competition rounds: a variety round and a bulk round. The variety round entails collecting as many different objects as possible, and the bulk round entails collecting as much as possible of a small bulk item. The final 12 minutes of each studio will be a team competition, where studio section teams work together with multiple claws to retrieve large items for bonus points for the entire section.

The full Rules and Scoring document is available on Connect. This includes a full list of requirements for your design and details for how you may operate your crane at the competition.

Poster Presentation

A poster session will take place in EDC 301 at the same time as the design showcase. The poster is a technical presentation – although aesthetics should not be ignored, posters will be evaluated primarily based on how well they communicate the details of the team’s design process. Full details are in the Poster Presentation Guidelines, available on Connect.

The work you will do in your studio sessions will directly contribute to your poster. Keep digital or paper copies of your progress for easy future reference.

Progress Checklist

At the beginning of each week each team member will fill out a brief progress checklist as part of the normal “getting ready for the week” activities on Connect. This checklist is intended to provide you feedback on whether you are on track with the progress of your project. Deliverables along the way have intentionally been minimized to allow you the freedom to allocate your time and efforts accordingly; however, keep in mind that you will be evaluated on how you use the design process, so make sure you can justify the process you used and the decisions you make! You will have studio deliverables in the first 2 weeks to make sure your development with the hand tools and Arduino are on pace.

Impact on Your Course Grade

This project contributes 10% to your total course grade: 4% from your competition performance, and 6% from your team’s poster outlining your design work and decisions.