EE183DA - Final Presentation

Launcher Section

Clarify motivation, scope, and key contributions (3 minutes)  **Will**

* How will this help society/advance robotics, etc?
* What is the overall goal of this project? (IE: make people happier by making candy easy to get)
* What we are doing and why we are doing it?
* “Key contributions” -> what’s new/special about the project
  + The “focus” of the project

**Solution:** Our team's solution to this problem is to design, construct, and demonstrate a robot which, when activated, can use facial recognition to scan its environment, searching for its owner among whatever humans may also be present. Once the owner is found, the robot will use a combination of image processing and range sensors to determine the distance between itself and the owner. Using this information, the robot will calculate the required *phi* and *theta* trajectory angles, and the required launch velocity for a snack or candy, to be launched such that it lands in the owner's open and waiting mouth.

The robot will then orient itself appropriately, using a worm drive to rotate the base of the entire assembly to the correct *phi* angle, and a second worm drive to align the launch rail with the correct *theta* angle. The reason worm drives are used is that they provide a large reduction, allowing the motors driving them to be smaller and use less power, while at the same time, allowing the control system to accurately move the assembly to the correct position.  
The robot will then move into the launch phase. The candy will be loaded into the launch cart, which will be sitting, held by gravity, at the start of the track. The launch cart will have a permanent magnet affixed to the back of it, and will rest against an electromagnet, which will be in a normally off position. The motor controllers will then be given the command from the Arduino to spin the launch wheels up to the appropriate velocity. When they are spun up to the correct velocity, the Arduino will turn on the electromagnet, and the repulsion between it and the perminant magnet on the launch cart will push the launch cart into the launch wheels, which will accelerate it down the launch rail at the predetermined velocity. When the launch cart hits the stop at the end of the launch rail, it will stop, but the candy on the launch cart will continue to move along its trajectory, towards the human.

**Motivation**: Solve a unique problem. The team was looking for a project that everyone was passionate about. That started with solving a problem that we had all faced, and all felt strongly about. Though some may look at this problem and immediately conclude that it is trivial to solve and will only contribute to the laziness of humans, the same could be said for the first TV remote developed. This robot is designed to improve the overall quality of life of the user, as well as increase the enjoyment they receive from their entertainment.

Project scope is the part of project planning that involves determining and documenting a list of specific project goals, deliverables, features, functions, tasks, deadlines, and ultimately costs.

**Scope:**

Scope of the project: humans interacting with robots.

**Unique Parts**

This project is advancement on other similar projects in this space. Previous solutions have lacked two essential components: Robot-Human interaction, especially in terms of safety of the human, and the cost and accessibility of the solution. For example, two distinct previous robots in this space that separate companies have attempted to take to market were both designed to launch canned beverages to a human when given the command to. Both of these robots lacked the ability to find the target on their own, with one requiring the user to clumsily attempt to manually aim the robot, while the other had no aiming abilities at all. Another big problem with the previous robots in this space is that none had the ability to adjust launch power. Lacking these features meant that the robots posed a risk to the humans around them. A human misaiming the robot, or standing too close to the robot poses a very real and serious risk of injury. With this team's design, all aiming is taken care of by the robot, which is able to see its whole environment, rather than blindly relying on aiming inputs from a human operator. Another advantage of this robot is that it will be able to control the power of its launch, so that it is not using the same launch power to deliver candy to a human that is standing 1 foot away and a human standing 10 feet away. The other important component of this robot is that all components apart from electronics are designed to be 3D printed, making easily and inexpensively manufactured, with 3D printers becoming more and more widely available. This will also make it easy for others to recreate or improve upon this robot's design in the future.

Identify task breakdown with particular challenges (8 minutes) **(split between all 4)**

* List out steps to complete this
* Give 1 or 2 biggest obstacles that must be overcome in order to complete these tasks

Challenges: Cost, 3D printing parts.

By far the largest challenge is cost. The limited budget means that each part purchased must be carefully thought out and justified. However, the group looks at this as an opportunity; completely this robot with this limited budget would show that a robot designed to perform this task can indeed be manufactured for a significantly lower budget than previous attempts.

Another challenge is the printing of 3D parts. Due to the limits of 3D printing, parts such as spur gears and the worm drive may not come out as they are CADed. This means that extra time must be designated in case workarounds are needed in the event that the first attempt at printing fails.

Task:

Complete Mechanical Launcher Design

Complete Specc-ing of motors, motor drivers, power electronics, and associated launcher sensors.

Print and assemble launcher mechanism

Get and test motors: specifically for different speeds as inputted from Arduino

Integrate motors and launcher, prove movement and launching system is effective and operates as intended.

Experimentally determine the input-output model between the Arduino and the launcher state.

Detail context / related work (1 minutes) **Danny**

* Talk about other work people have done
* Go into detail about how previous projects have been done in this area and how ours will be different/an improvement

**Related Work**

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**Trajectory and Robot state determination**

Once the location of the human target has been determined, the correct trajectory can be found using the vertical limit of 8 feet, which is the standard height of ceilings in American households. This trajectory will involve determining the rotation angle, launch angle, and launch velocity. Once these values are found, the robot can be moved to the appropriate state.

**Solution Overview**

The solution our team came up with is to design a build a robot that uses facial detection to find a human which it will launch a snack to, find the distance between the robot and the human and determine the appropriate trajectory, orient the snack launcher to correct position, and then load and fire the snack along the determined trajectory toward the human.

The mechanism of this solution will be 3D printed, and the electronics will be purchased such that the project stays within budget.

**Motivation**

The main motivation behind this project is to improve the quality of life of the human user. Though getting up to get snacks may not seem like a large inconvenience, compare this having a TV remote versus not having it. Though standing up to change channels on the TV does not seem like a big inconvenience, nearly all people much prefer having a remote to do it. In the same way, this robot will eliminate the need to stand up and get snacks.

Another source of motivation for this project was to build a robot that was accessible to others. By making the entire mechanism 3D printed, and using widely available electronics, it is a lot more accessible to others. This means that this project can be built by people looking to learn about robotics, and the design can be improved on by others in the future.

**Launcher Design**

The design of the launcher is shown here, in the 3D CAD prototype. The main features of it are that the base can rotate in the phi direction, and the launcher rail can rotate in the theta direction. The launcher is designed to launch one piece of snack food at a time, which will be loaded onto the launch cart.

The launch cart will be propelled forward by the launch

**Rotation**

One of the challenges of the rotating the base and launch rail is that the robot must be able to make small, precise movements, using low power motors. In order to solve this challenge, the design utilizes a worm drive on the base of the launcher as well as on the launch rail. The worm drive will give a very large reduction, allowing a low power motor to be used and make small changes. The motors driving these worm gears will be stepper motors, as stepper motors are good for small rotations and holding a set position.

**Snack Loading**

Due to budget limitations, the team decided to only design the robot to launch one type of snack. Lemonhead candies were chosen, as they are a consistent spherical size, which makes determining the trajectory simpler. They will be stored in a 3D printed container above the launcher, and will be dispensed one a time by a servo controlled corkscrew mechanism

**Launch**

In order to launch the snack, the launch cart will rest out of reach of the launch wheels while the wheels are spun up to speed. The launch cart will have a permanent magnet attached to the back of it, and will rest against an electromagnet that is normally off. When the launch wheels are up to speed, the electromagnet will turn on, and the repulsion will bump the launch cart into the wheels, accelerating it down the launch rail until it hits the stop, at which point the snack will leave the launch cart, continuing on its trajectory toward the human.

Recording Info

-Cite all sources and pictures in write-ups and presentations

-For motivations, use sources.

-not just whats missing in the world

-back it up with sources

-give numbers

-back up what youre saying with a collection of what other people are saying

-find related work or background material or sources not just for technology we are using, but also for the motivation and for the scope of the problem. This will serve toward making the contributions more well placed in context.

-Scope

when you describe the background and motivation, everything before you talk about your technical solution, you will be building an expectation in the reader's head of what they will be seeing before you tell them, it's important to narrow it down so that they don't have an expectation that it isn't what you're going to provide.

-"take only background, motivation, and intro sections of the paper, everything without the solution, and give it to someone else to read."

-see if it matches, if not, then limit the scope. say what you will do, and what you will not do

-give reasons why we will not be doing it. draw a path from what we did to a solution that may be valuable later. explain why we don't do those things (money or time reasons, or others)

key contributions

-clarify in the scoping of the project

-these are what we are going to do, these are the things we are not going to

-"not within scope of project to do state estimation so we will use external state estimator, because at some point someone can throw on a state estimator, we are not going to deal with that"

-"or we only care about state estimation, not about control, someone else can solve that problem"

-the scoping of the problem leads into/talks about the contribution, what is it that we will have accomplished over the 10 weeks.

-Contributions are not conclusions; part of what will do is expected conclusions, when we are done with the project we will have actual conclusions

-conclusions are not a summary, will not say "this is what we have done, this is the robot that we built, and this is the capabilities: those are contributions"

-contributions say: this is the technical development and engineering we have done over these 10 weeks

-conclsions are: take a step back from the engineering: with regard to society or humanity, or some bigger picture, what is the meaning of what we have done? we have spent 10 weeks putting the effort on engineering, but why should anyone else care? are there engineering reasons they should care? are there application driven reasons why they should care?

also, present it to non-engineers. conclusions could be: "how does algorithm could apply? applies to one class of applications, but could also say, where else it could be used? how else could mechanism be used? it was designed to solve this problem? but where else could we see the processes that are used to design that mechanism show up?

the key is: we will be doing something in these 10 weeks, and if all goes great, then we will have a product, a device, an engineered solution, or a device you can sell. we dont want what you've done to end/ we want it to live on. we want people in the future to be able to improve on it. there should still be a reason to read the final report, even if it didnt turn into anything useful. those are the conclusions. that is what we have to explain.

milestones

3 aspects: goal, task, deliverable

they are different

goal: to be able to estimate the state of the robot

task: involves writing code, plus more

delierable: some noun, that we can show, proves the goal has been generated. code doesnt prove this, proves lines of text are written. deliverable: graph that superimposes a line drawn on a pic or video taken of the robot.

task: write code to estimate, generate code to show the deliverable, have camera, draw lines. go into this much detail.

example: state estimation is not specific enough. will also go into potential challenges. (bugs, math syntax, data transfer). Challenges in deliverable. graded on how well we hit these deliverables.

where should we define the scope?

when talking about what we arent doing, (partly in the intro/statement of problem) (we are only looking at this subset of problems).

in problem statement: if talk about whales die cause trash, make it clear afterward that we will not be talking about whales, this is a problem involving trash, we are only considering an object of this size.

whatever is technical solution (in intro basically) should be in the readers mind by the time they finish the intro.

we must fill into the reader's head exactly what we want them to be thinking of.

- Loading individual objects from a hopper is a challenging task, you will encounter jamming and multiple item drops.  --answered in solution