Project Title: Dumy

Team: Ekansh Parag Agrawal, Anirudh Singh Chaudhary, Jayden Hilton

EECS 149/249A Project Charter, Fall, 2023

Repo Link: h3x4g0ns/dumy

Project Goal:

The goal of the project is to automate playing a game of laser-fetch with a cat. We will utilize a 3-DOF robot arm with an attached laser. The computations will be done either by a headless Linux server computer or by an NVIDIA Jetson board.

Project Approach:

We will have the server code running on a [Jetson or Headless Linux server] that will process camera frames using a YOLOv5 model and monocular depth detection.With the monocular depth estimation we can use transformations to create a limited 3d world view. From the bounding box of the cat along with the calculated world position of the laser tip, we will then try and correct the position of the arm to the trajectory of the cat. We will solve an analytical inverse kinematic problem to understand where the robot arm must move in order to keep the laser pointer out of the cat's reach. We will then want to pass in the new joint angles to the RP2040 through a serial connection from the Jetson. The RP2040 will then move the arm to the necessary world position from the joint angles. This will move the robot arm accordingly so it's always stimulating the cat.

Materials:

- RP2040
- NVIDIA Jetson
- 3d printed robot arm
- Headless Linux Server
- Laser pointer
- Servo motors
- Breadboard
- Jumper Cables
- Power Supply

Schedule:

- [ ] Oct 23, 2023: Complete Project Proposal
- [ ] Nov 7, 2023: Milestone 1 Due
    - [ ] Hardware: Design, manufacture, and assembly robot arm
    - [ ] Robot Stack: Basic robot controls, being able to move and control the robot arm to go in the desired direction & orientation [Jaden]
    - [ ] Vision Stack: Be able to identify the cat and begin calculations for world position of the laser tip [Ekansh & Anirudh]
- [ ] Nov 8-10, 2023: Milestone 1 Presentations
- [ ] Nov TBD, 2023: Milestone 2 Due

    - [ ] This is more of the integration milestone where we should be able to move the robot arm to follow the cat. From there if we can do that then we will be able to move the laser pointer away from the cat as well. [Everyone together]
- [ ] Nov - Dec, 2023: Milestone 2 Meetings
- [ ] December 13, 2023: Project Demo/Poster
- [ ] December 14, 2023: Peer Evals and Project Report Due

Risk and Feasibility:

Risks:

- Optimizing computer vision/latencies
- Possible hardware failures with servos and 3d printed parts.
- Stretch goals may not be feasible in allotted time
- When dealing with image <-> camera <-> world transformation there's a lot of trial and error that goes into calibrations, projections, and transformations

Feasibility:

We believe that the project is entirely feasible, most of the resources required are already in hand, and the boilerplate code is in progress. The most obvious risks are with the vision stack, as that comprises most of the risk. There is no physical risk except for an uncontrolled robot swing but we will take necessary precautions to make sure that we are a safe distance away when dealing with the robot arm.