Robotic Projectile Throwing

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Overview

- Application-oriented project utilizing imitation learning
- Robot will throw a small ball into a basket
- We wanted to add novelty to the common pick-and-place task

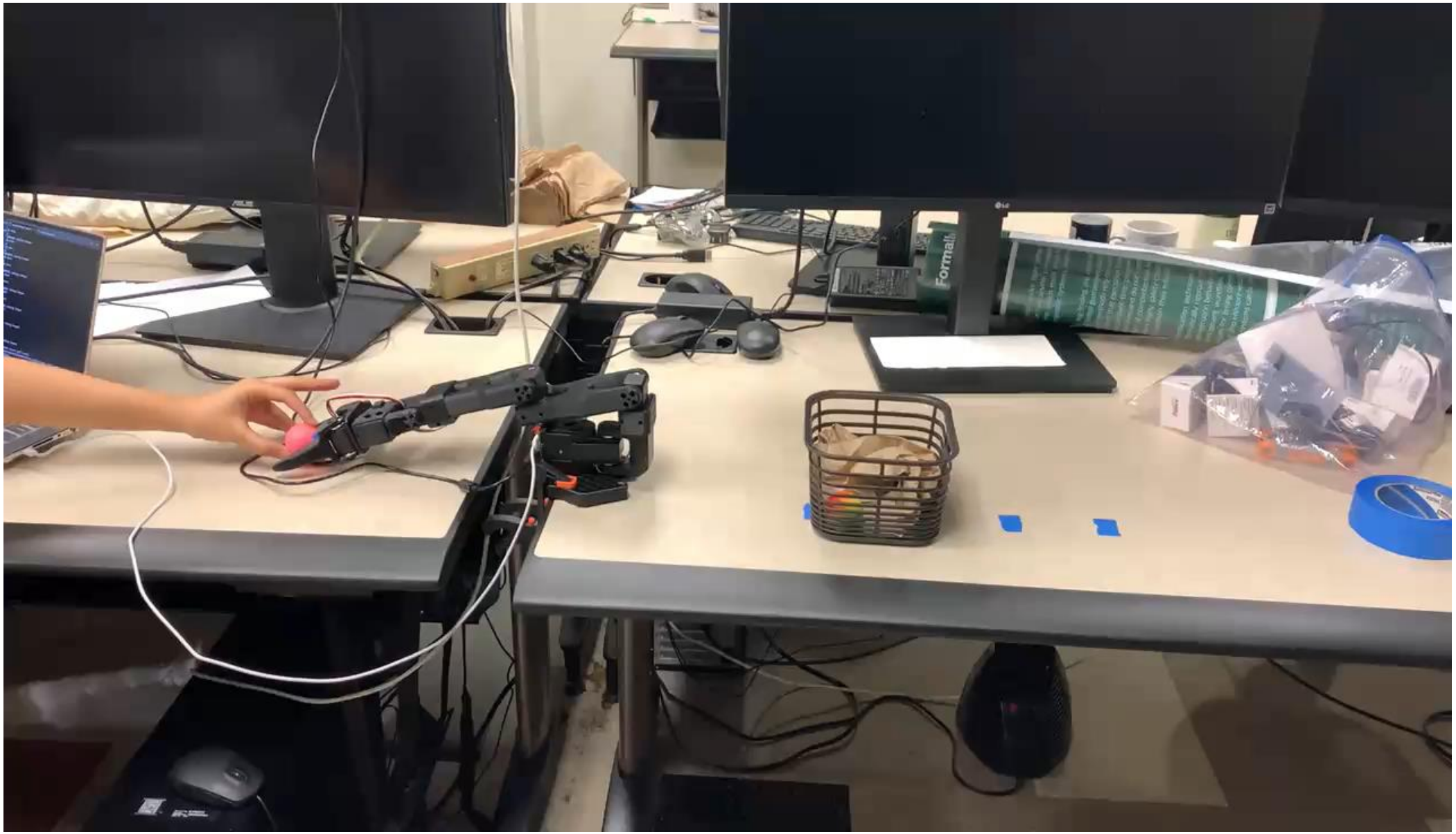
Data Collection

- Used leader arm
- Collected demonstrations for throws of different basket distances:
  - 20cm
  - 30cm
  - 40cm
  - 50cm
- 10-30 throws demonstrated per distance
- Tracked failed and successful throws
- Experimented with keeping some joints stationary for the best throwing motion

Training

- Used ACT (Action Chunking with Transformers) policy
  - Relatively short training time (especially with GPU)
  - Requires relatively few training samples
  - Predicts sequences of future actions – allows for smoother trajectory
- Relied on joint data rather than camera input to train (videos during throws are blurry)
- Included failed throws in training data
- Trained successfully on 20cm and 40cm throws

Demo – 20 cm Throw



Demo – 40 cm Throw

Evaluation

Throw distance	Lowest Accuracy	Highest Accuracy
20 cm	96%	100%
40 cm	47%	60%

- Accuracy varies based on the type of ball used to throw (some balls may bounce out of basket)
- 30 total trials
- If the ball hit the rim of the basket, it was treated as a fail

Future Work

- Pick up ball and then throw
- Throw different objects
- Automatically adjust to different basket distances