# Automating Eye Surgery with Deep Learning Using Simulated & Real Data
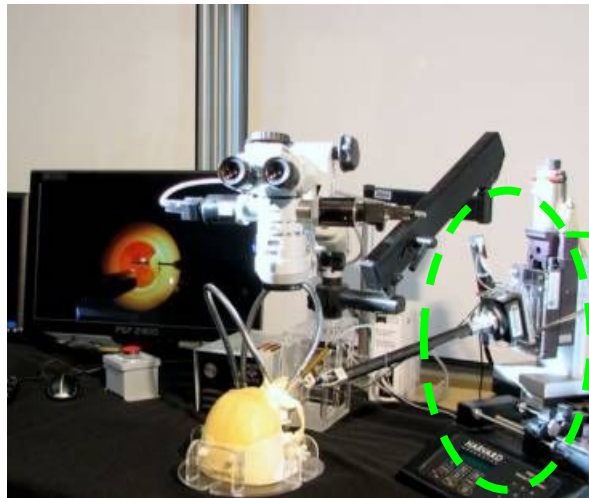
Brian Kim (jkim447@jhu.edu)
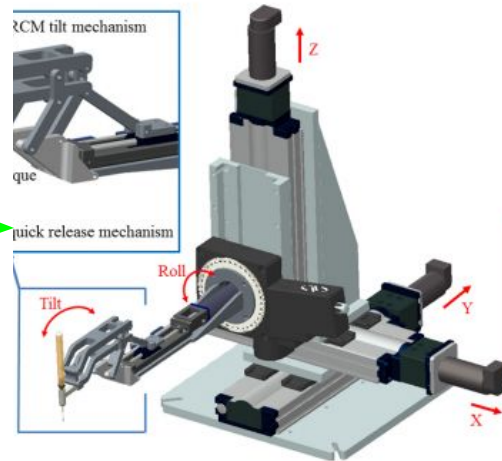Advisors: Marin Kobilarov, Iulian Iordachita

# Objectives

- Implement autonomous capabilities to Eye-Robot using **vision-based control/deep learning**
- Train deep learning models using data collected in simulation and real robot
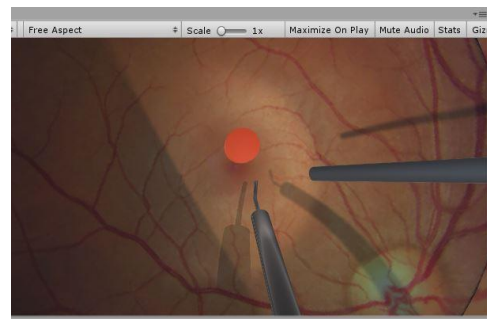- One application of Eye-Robot: [vein cannulation](#)
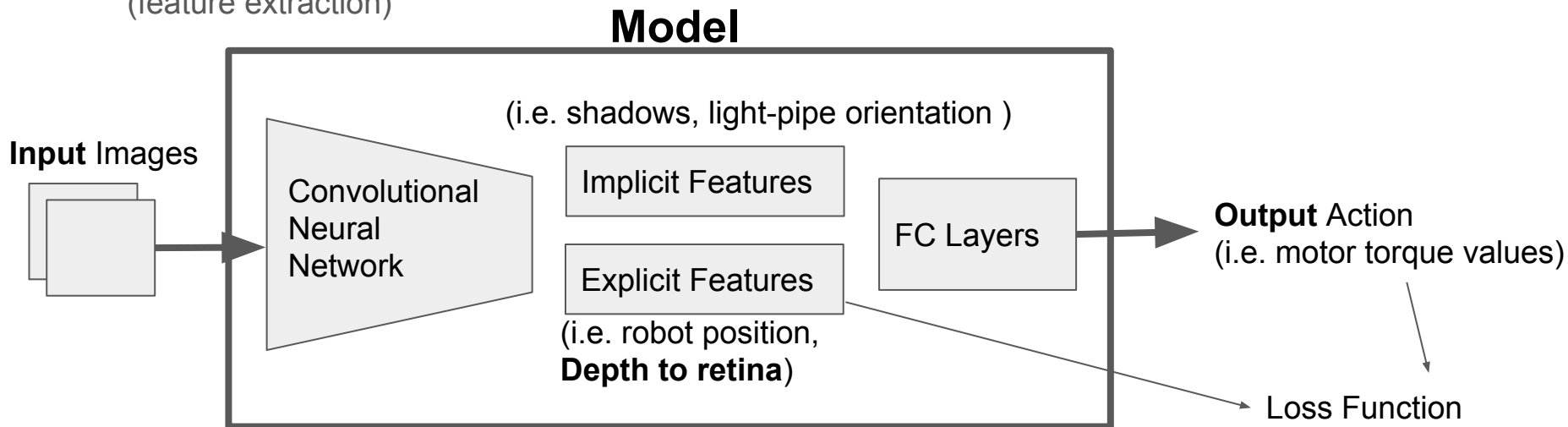
Data collected w/ robot:

Eye Robot Setup:

Eye Robot



Sim in Unity3D:

# Framework for Vision-Based Control

- Use convolutional neural network (CNN) to extract task-specific information from cues such as shadows, lightpipe configuration, features on the retina, necessary for planning and control of the tool
- Use Fully Connected (FC) layers Further train the network to map features to actions using supervised learning or RL
- Current work in progress: estimating the distance between the tool and the surface of the retina (feature extraction)

**Model**

(i.e. shadows, light-pipe orientation )

**Input** Images

Convolutional Neural Network

Implicit Features

Explicit Features

(i.e. robot position, **Depth to retina**)

FC Layers

**Output** Action
(i.e. motor torque values)

Loss Function

# Tasks

- Optimize the hardware set-up for smooth data-collection (hardware)
- Collect more extensive data on the real robot, and write scripts to automate data collection process
- Train/implement deep learning models for estimating distance and relative transform between tool and target on retina

**Skills:** Mechanical design/ prototyping/ Python / Deep Learning (not required)

**Students: 1-2 preferred**

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