CSCI 5980-DeepRob

Group #2
Tactile Perception for Robot Grasping and Manipulation

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Introduction:

The objective of this work is to perform in-hand pose estimation and classification, using visuotactile sensing techniques. A Sim2Real framework is presented to complete these objectives, making a large-scale real-world dataset obsolete. The specific application is tasking the UR5e robot to set up a chess board.

Input-output:

The input to our framework is a single depth image obtained from the Gelsight Tactile Sensor. The output is a class corresponding to the type of chess piece, and a rotation. This rotation is used to predict a transformation from grasp location to board location.

Network or Framework details:

Classification data is augmented using center cropping and random horizontal and vertical flips. Pose estimation is done through regressing the in-hand rotation. Both networks are Resnet50 models and are trained for 25 epochs, with batch size 32.

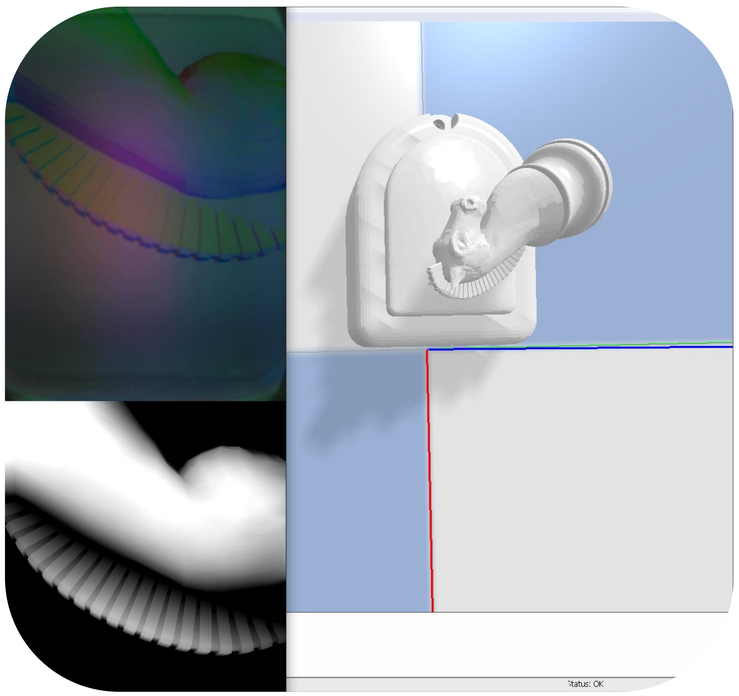
Dataset information:

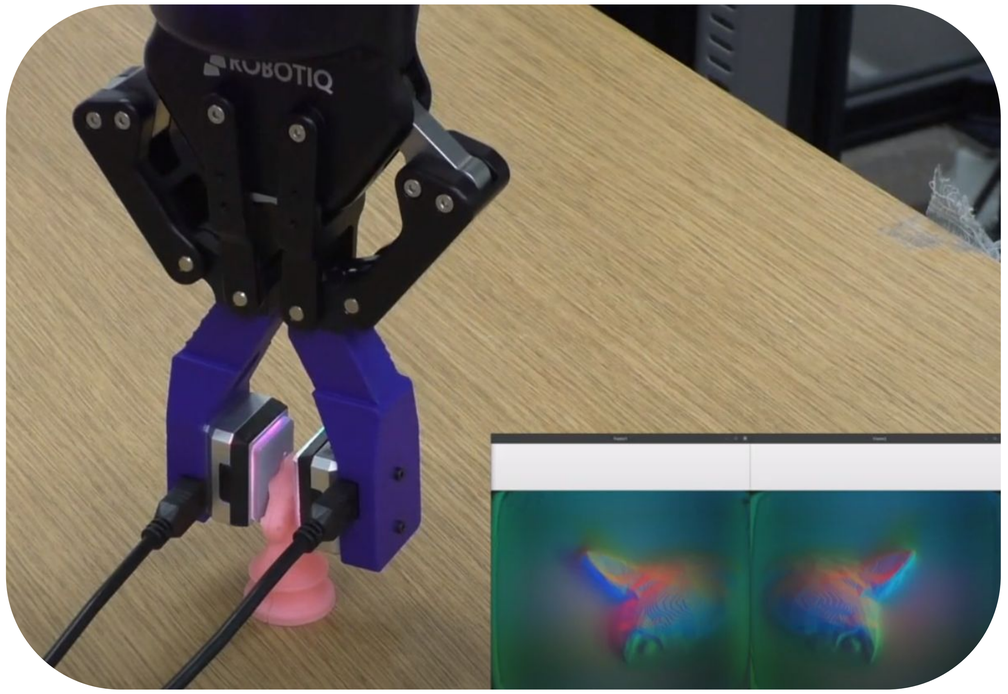
The dataset for this project is generated using a tactile sensor simulator called Tacto. Tacto enabled generation of over 90,000 RGB and Depth images. Throughout the project, various dataset optimizations have been made to close the Sim2Real gap. A requirement of this approach is access to the 3D models of each object.

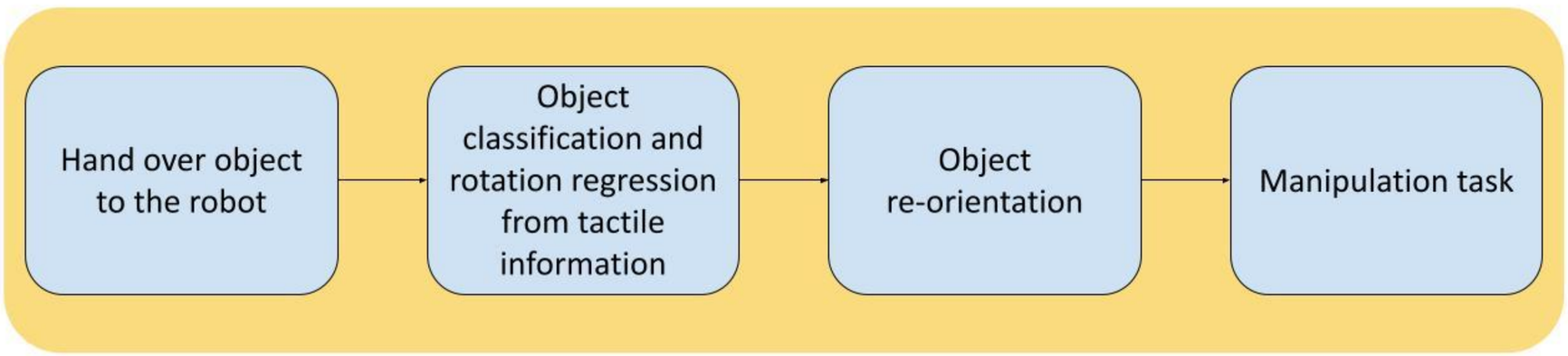
What did you experiment on:

Experimentation occurred during sensor interfacing, simulation automating, data generation, task planning, on-robot implementation, and model designing.

Sim2Real frameworks enable large-scale data generation required for model-based tactile perception and manipulation.







Tac2Pose: Tactile Object Pose Estimation from the First Touch, Bauza et al. , 2022
TACTO: A Fast, Flexible, and Open-Source Simulator for High-Resolution Vision-Based Tactile Sensors, Wang, Shaoxiong, et al. , 2020.

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