Camera Arm Tracking

Collision Avoidance Through 3D Analysis

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Background

Alcon lab is designing an operating table with a robotic arm attached to it. This arm and attached tooling can help doctors perform surgical operations through accurate repetitive movements. While performing operations, the robotic arm must avoid collisions with the patient and surrounding environment to protect both the humans in the room as well as the equipment. This problem is crucial to achieving a safe operating environment where the robotic arm is controlled from unexpected behavior.

Overview

Out project uses 3D sensing cameras to recognize the robotic arm and detect potential objects within the movement path that may cause a collision. The cameras are attached to a motor system that moves such that the robotic arm is focused on and in the center of its view. Object detection is performed through a color coating of the robotic arm and determining the distance between the outline of the arm and the surrounding environment. If an object collision is imminent, the robotic arm halts movement, thus preventing an injury. Multiple systems are located around the room to remove any blind spots.
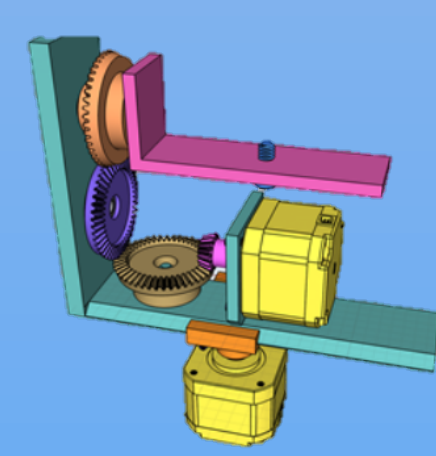
Hardware design/ Block Diagram

System Design

Software Design

Main Program
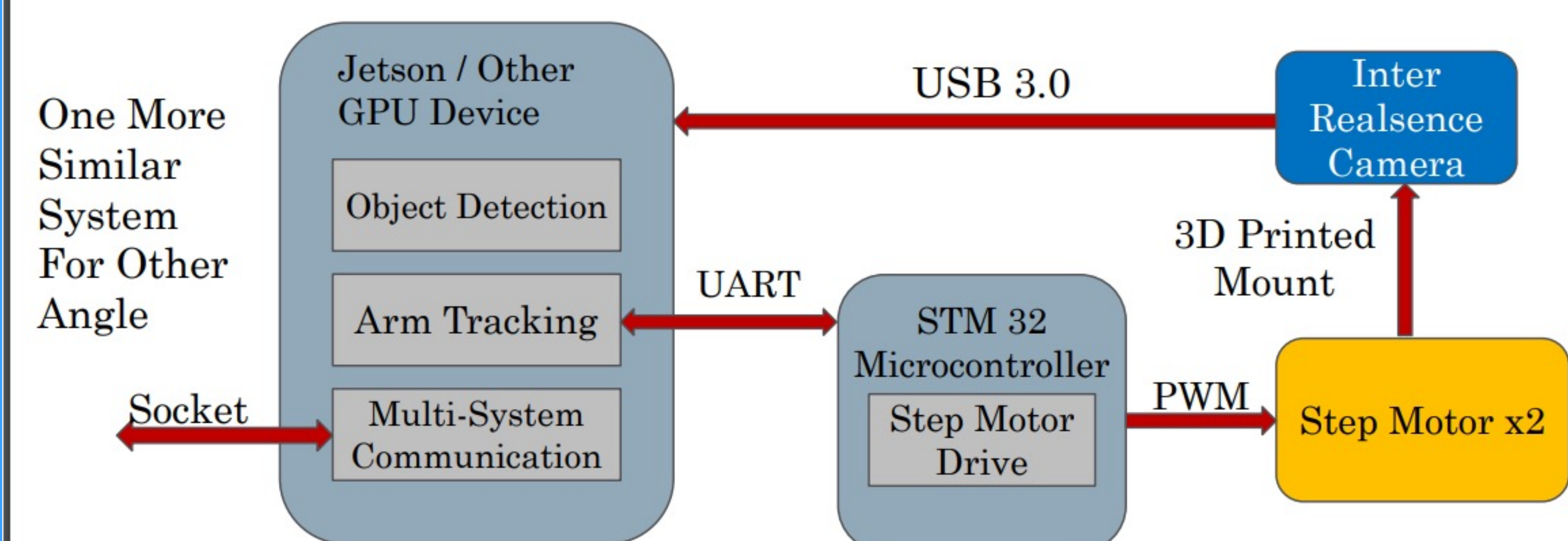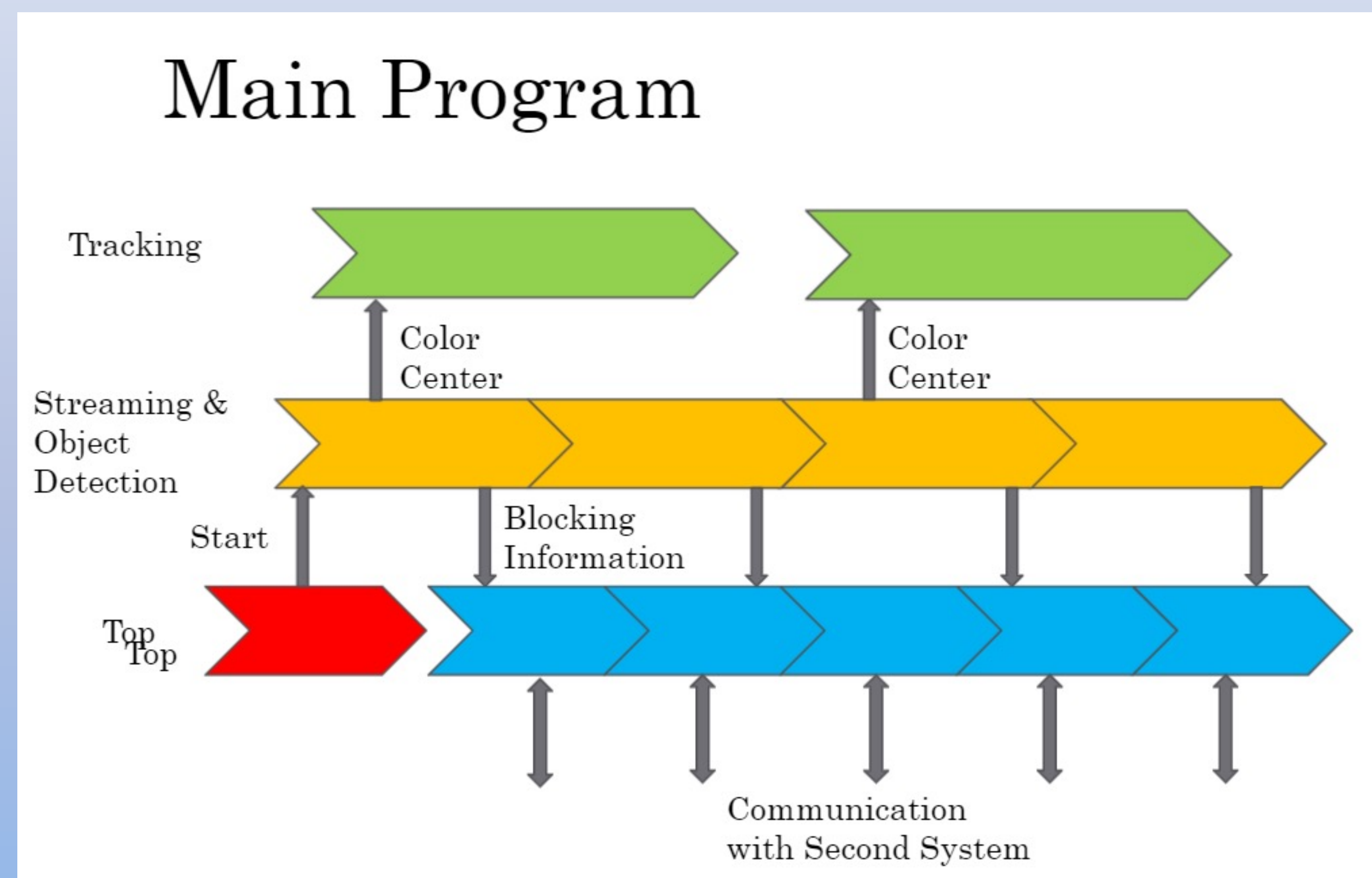
Hardware / Key Components

3D Printed Mount
Connects the step motor to the camera to let the camera rotate in two axes

STM32
Controls the step motor and communicates with Jetson to rotate camera to desired location
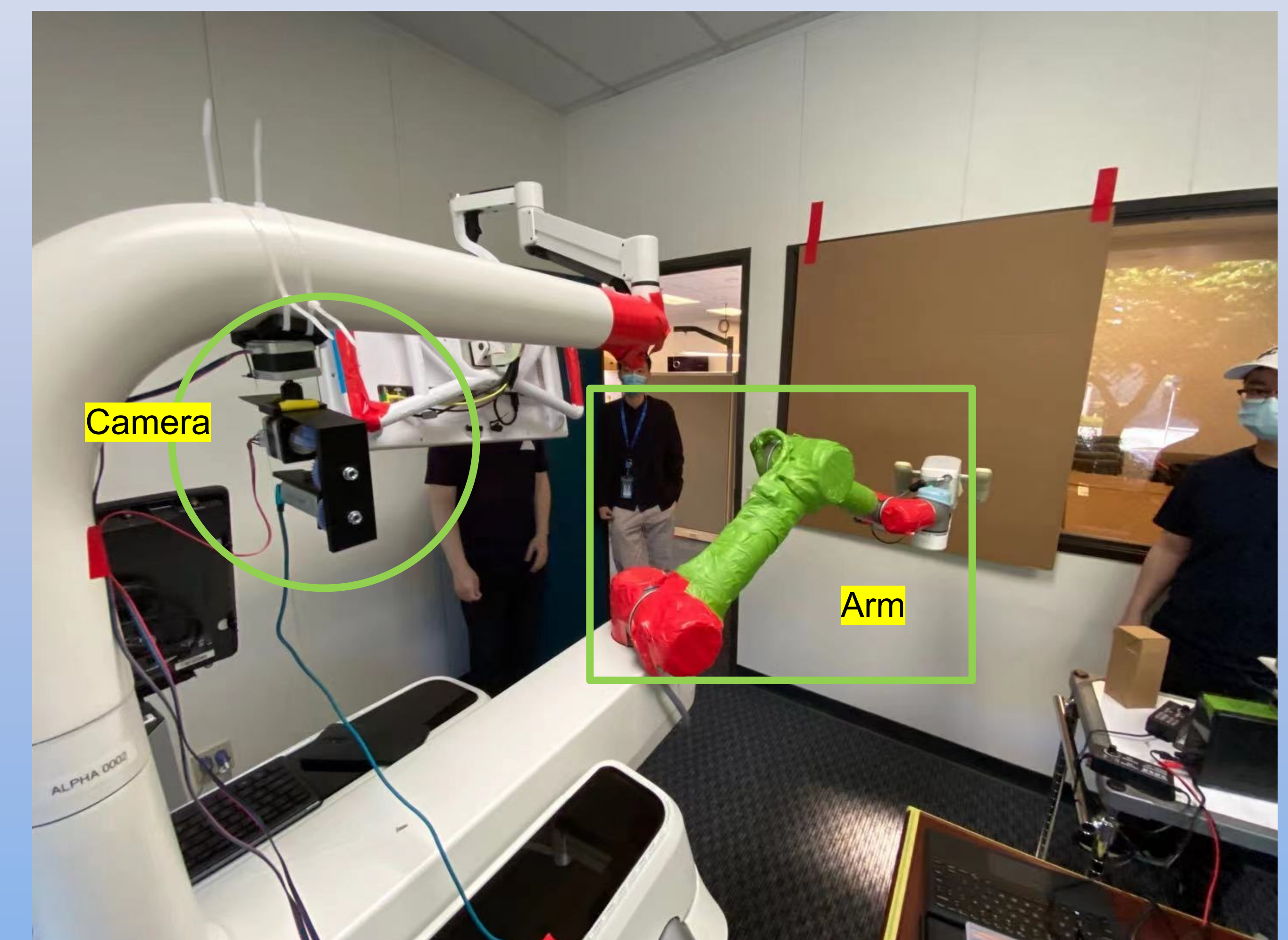
Jetson
Runs the main object detection and collision avoidant program.

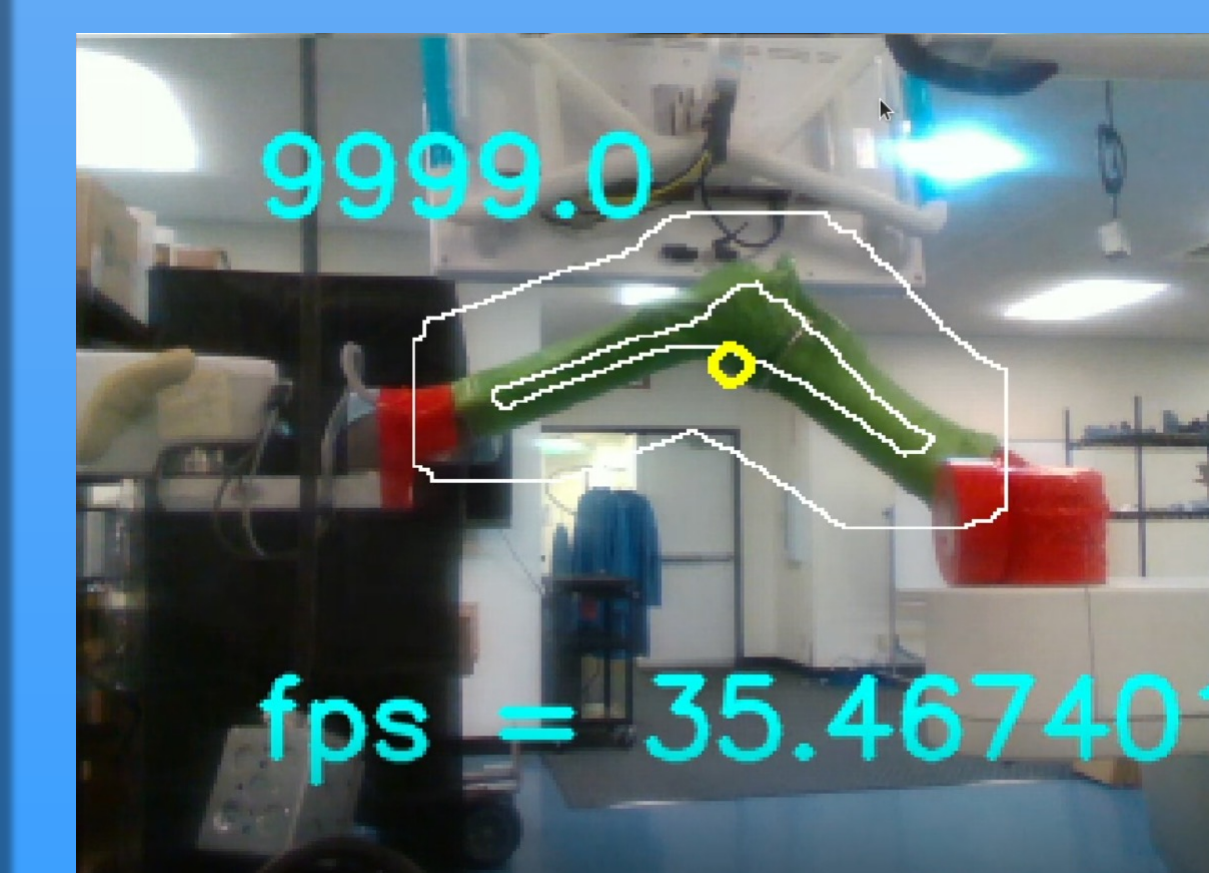### Intel Depth Camera D435
Providing color image and depth image to Jetson to analysis.

Final product

Detection result

Safe

Blocked

Our program can detect objects around the outer layer of the robotic arm. When the program identifies the objects that could cause collision, it sends a 'blocked' signal. To raise the performance of collision avoidance, our camera tracks the center of arm, indicated by the yellow circle in the center of robotic arm

Alcon

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