Mobile Robotic Arm

Sivankit Bhanot
Stevens Institute of Technology
sbhanot@stevens.edu

Introduction:

With the advent of physical robotic structures, it has become imperative that to make these physical structures smarter, they need to have a vision component. In this project we attempt to build a smart robotic arm that can identify objects in its environment and perform tasks on them. The longer term goal of this project is to have a mobile robotic arm that is mounted on top of a vehicle and also interprets voice instruction. Towards this longer term goal, we have intermediate stages:

1. First: Setup of individual components.
2. Second: Writing and building nodes for interaction over ROS.
3. Add mobility by mounting arm on car, and alo voice functionality.

In the course of this semester we have been able to complete the first of these tasks, and are currently working on writing code to aid the communication between the individual components.

The individual components consist of:

a. Interbotix RX 150 robotic arm by Trossen Robotics
b. Respberry Camera Module V2 (Object Detection Module)
c. Garmin Lidar Lite v3 (Sensing module)

The Arm:

The manufacturer has provided various ROS packages and source code that help with the understanding of various components of the robotic arm and running our own scripts on it.
One of the packages has the sdk which consists of the Python and C++ source code that initializes and creates a ROS node representing the physical arm. Various methods in the sdk allow control of the eight joint motors of the arm.

We were able to write scripts whereby the arm follows certain poses along a trajectory. However, these had to be predefined.

We are currently exploring the control of several of the joint motors through keyboard with the use of pynput library.

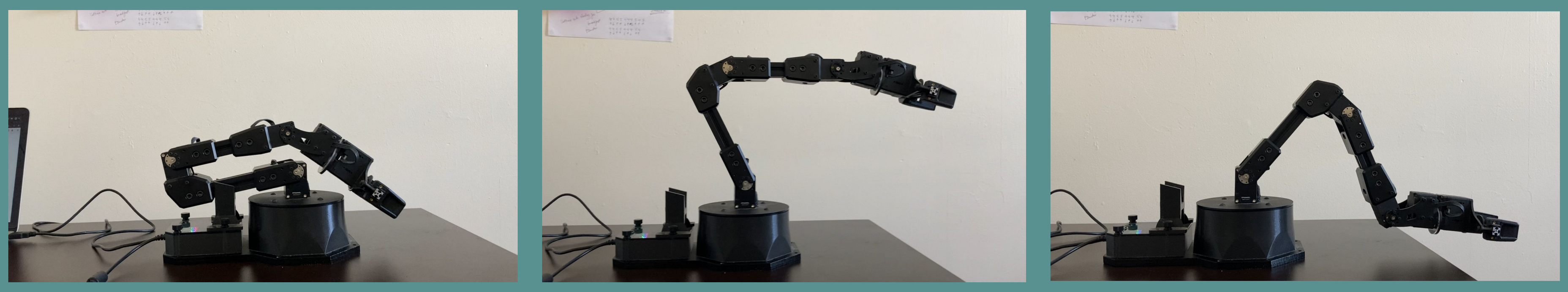

Fig. 1: Robot moving along trajectory defined by script written

Camera and Object Detection:

The Raspberry Pi Camera Module V2 was connected to the jetson Nano using the CSI Ribbon cable. After forking the Github Repo of Dustin Franklin, and installing the relevant libraries and tools, we were able to write scripts that could perform object detection using SSD-MobileNet V2 architecture (or another network after installing it and passing it into the argument). With the script we were able to perform object detection on any input images, videos or the camera feed and thereby have real time object detection.

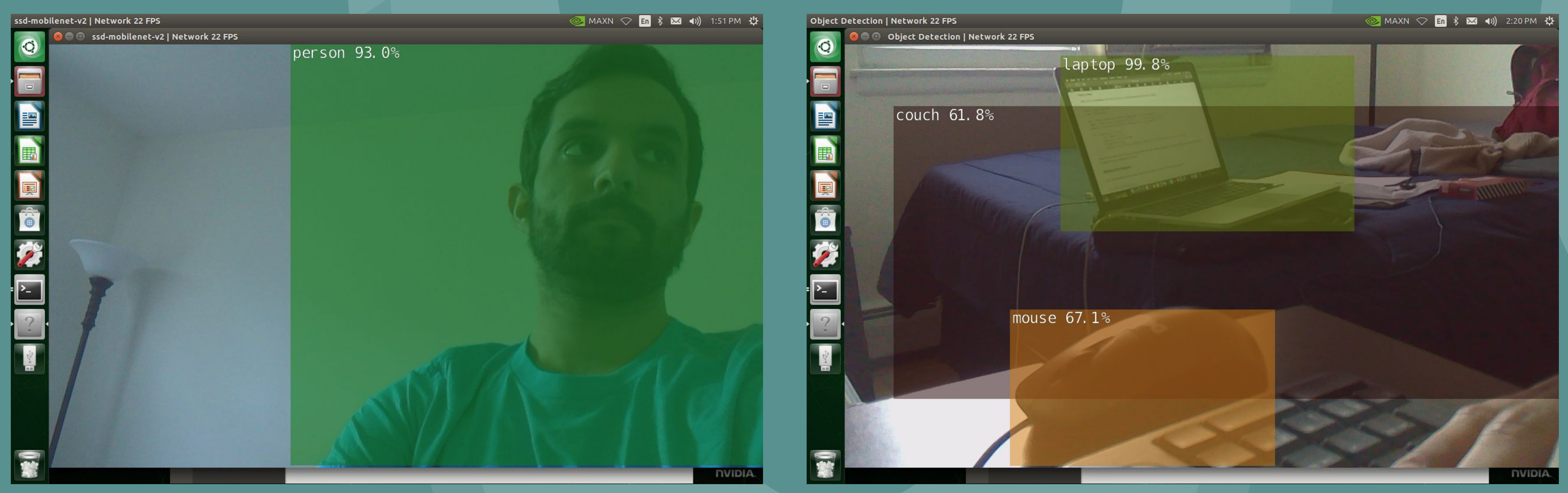

Fig. 2: Object Detection performed in real-time

To add communication between the object detection and physical arm node, a deeper investigation into the object detection node (known as detecnet node) and the topics it publishes to, is required.

detectnet Node

Topic Name	I/O	Message Type	Description
image_in	Input	sensor_msgs/Image	Raw input image
detections	Output	vision_msgs/Detection2DArray	Detection results (bounding boxes, class IDs, confidences)
vision_info	Output	vision_msgs/VisionInfo	Vision metadata (class labels parameter list name)
overlay	Output	sensor_msgs/Image	Input image overlayed with the detection results

Fig. 3: List of topics that detectnet node publishes and subscribes to

LIDAR Module:

The Lidar module was connected to the GPIO pins on the Jetson Nano and we were able to a C++ file that would output the measurements of the unidirectional sensor on the console. A ROS node encompassing these values that are output will also have to be created.

Vehicle:

After designing the chassis of metal plates, we have been able to produce the two metal plates as shown in the figure below. An order has been placed for the wheels too.

Fig. 4: Layer 1 of Metal Chassis, Bracket for the motor which will be fixed on Layer 1; and Layer 2 of chassis