LAB 03-SENSING AND ACTUATION FOR THE ARM

Group Member: Syed Muhammad Hussain, Hammas Abid

24th January 2023

EE366L/CE366L: Introduction to Robotics Lab

1. TASK 3.1 Understanding of the functioning of the system

(a) Sensors (Intel SR-305 RGB-D Camera) and Actuators (Servo motors, links, and gripper)

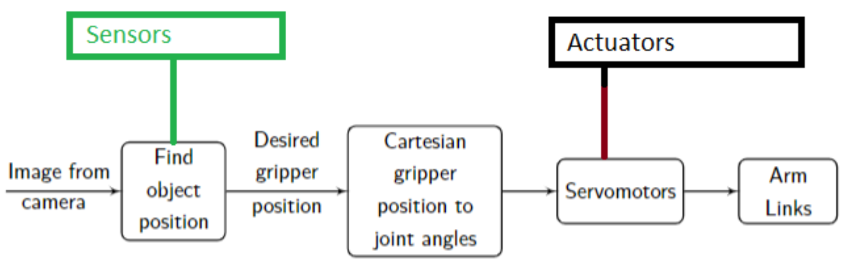


Figure 3.1: Block diagram of our vision-based pick and place robot

(b) The Potentiometer as a Position Sensor The potentiometer is the most widely utilized of all "Position Sensors" due to its low cost and ease of use. It moves along a track by means of a wiper contact connected to a mechanical shaft that can be angular (rotational) or linear (slider type). The fact that something is referenced either to or from a fixed point or position is what the Position Sensor detects. The "positional" feedback is provided by these kinds of sensors. Using "distance," which could be the distance between two points, such as the distance traveled or moved away from a fixed point, or "rotation," which is angular movement, is one way to determine a position. For instance, measuring a robot's ground travel distance by rotating its wheel Linear sensors can be used to detect an object's straight line movement, while rotational sensors can detect an object's angular movement

Research Link:

$$https://www.electronics-tutorials.ws/io/io_2.html:\ :text=The$$

Research Link:

$$https://www.fierceelectronics.com/embedded/potentiometers-a-proven-position-sensing$$

2. TASK 3.2 More Specifications

(a) Required parameters:

1. Angle Rotation Limits: 0 to 300

2. Resolution: 0.29

3. Speed Limit (in joint mode): 0 – 114 RPM

Joint Mode

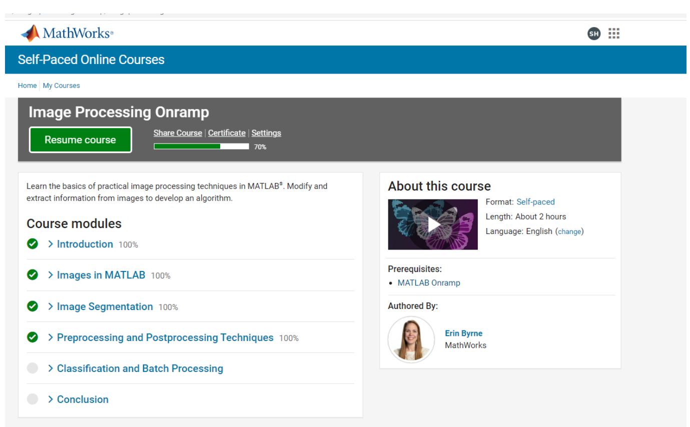
0-1,023(0x3FF) can be used, and the unit is about 0.111rpm. If it is set to 0, it means the maximum rpm of the motor is used without controlling the speed. If it is 1023, it is about 114rpm. For example, if it is set to 300, it is about 33.3 rpm.

4. Torque Limit: 0 – 1.5 Nm (Stall torque)

(b) The angular resolution of the motor is just the resolution of one motor. However, when moving in the Cartesian plane multiple motors are used. This means that their resolutions are added. This leads to a combined total of 0.9-1.2 depending on how many motors are employed. As such, the Cartesian resolution is higher than the resolution of the individual motors

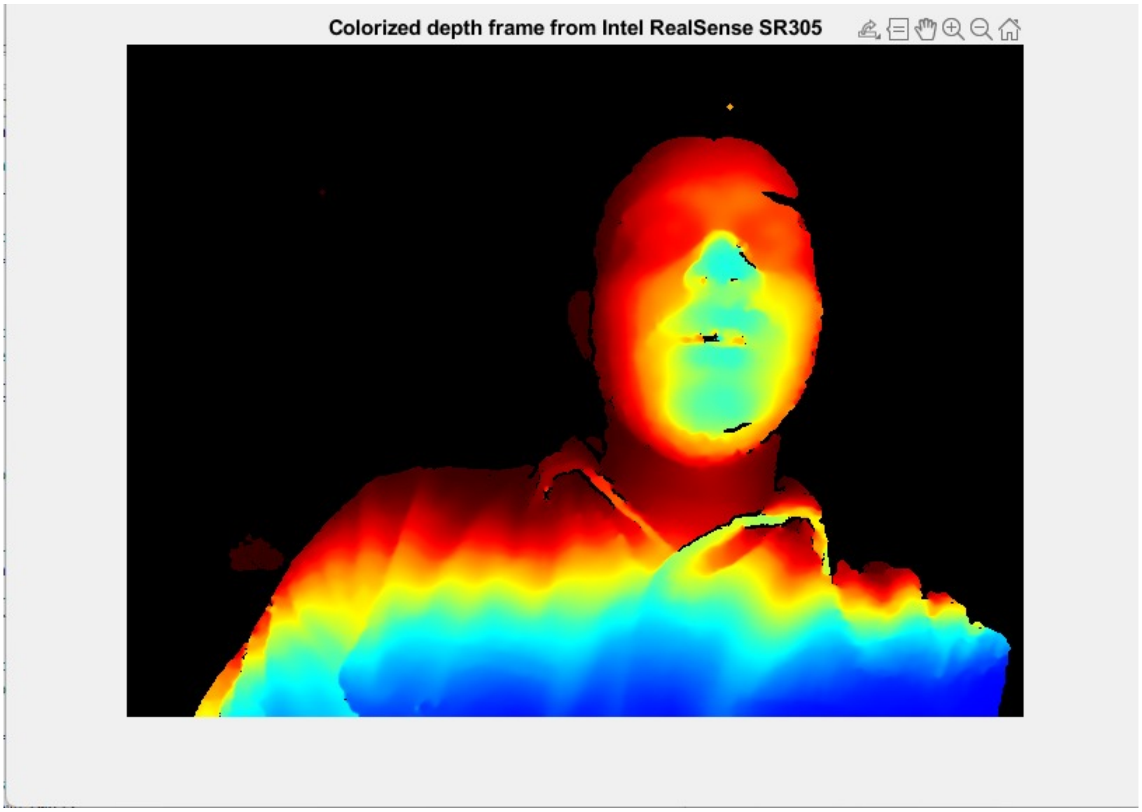
3. TASK 3.4 Image Manipulation in MATLAB

(a) Course Progress Certificate.



4. TASK 3.5 Extract color and depth images

(a) Verified that the code works and make sense of the provided code.



(b) Modified the code so that it also extracts a color frame

CODE //

```
function depth_example()
    % Make Pipeline object to manage streaming
    pipe = realsense.pipeline();
```

```
    % Make Colorizer object to prettify depth output
    colorizer = realsense.colorizer();

    % Start streaming on an arbitrary camera with default settings
    profile = pipe.start();

    % Get streaming device's name
    dev = profile.get_device();
    name = dev.get_info(realsense.camera_info.name);

    % Get frames. We discard the first couple to allow
    % the camera time to settle
    for i = 1:5
        fs = pipe.wait_for_frames();
    end

    % Stop streaming
    pipe.stop();

    % Select Color frame we changed get_depth_frame to get_color_frame
    color = fs.get_color_frame();
    %We will not be needing colorizer as its color frame already
    % Colorize depth frame
    %color = colorizer.colorize(depth);
    % Get actual data and convert into a format imshow can use
    % (Color data arrives as [R, G, B, R, G, B, ...] vector)
    data = color.get_data();
    img = permute(reshape(data',[3,color.get_width(),color.get_height()]),[3 2 1]);

    % Display image
    imshow(img);
    title(sprintf("Colorized depth frame from %s", name));
end
```

5. TASK 3.6 Reflection

(a) The software, hardware, and working mechanism of the servomechanism were the primary takeaways. It was also important to understand resolution and the differences between physical and virtual coordinates. To some extent, accuracy was also related to this. Then, we learned about repeatability—how various tasks like picking and placing are repeated and the torque requirements for carrying them out. We also learned about the robot's limitations and how its operation may differ in different locations. In this lab, we implemented the vision part of the pick and place operation like how useful depth vision is in sensing environment.

Questions that arose were on how we could improve the resolution calculations and make them more accurate, and how these calibrations are carried out in the real world.

We have read out the research paper in order to get an in-depth understanding of the vision-based pick-and-place operation instead of elaborating more I have attached the link to Research Paper Please look into that for further details.

Research Link:

$$https://airccse.org/journal/avc/papers/2315avc02.pdf.$$

6. TASK 3.7 Bonus

(a) Working

Date

TASK (3.7)

Solution

=> Stall Torque = 1.5 Nm

Now the $1/5^{th}$ of stall torque

=> $1.5/5 = 0.3 Nm$

=> $M_L = 250 g$ (Weist lift strength)

=> $L_3 = 95.6 mm$

$= 0.0956$

=> $m_3 = 54.6 g$

∴ Now the Torque can be calculated as

$$T_3 = M_L g L_3 + m_3 g L_3/2$$

$$= (0.25 \times 0.095 \times 9.8) + ((0.055) \times (9.81) \times (\frac{0.09}{2}))$$

$$= 0.259 \ Nm$$

Verified the Result by calculating and Performing the actual.

Answer