

QArm Lab Procedure

Object Detection

Setup

1. It is recommended that you run this lab individually.
2. Find any colored object (e.g., a blue phone, a green marker, a purple notebook ...). You will use it later in this lab.
3. Place the QArm in its resting position. You will not turn ON power for the QArm.
4. Connect your computer to the Intel Realsense camera on the QArm using the provided USB C – USB A cable via the camera port on the back of the QArm base.
5. Launch MATLAB and browse to the working directory for Lab 10 – Object Detection.

Object Detection

1. Open the Simulink model [ObjectDetection.slx](#) (Figure 1). You will use this model to process the camera video feed and detect objects you are interested in.

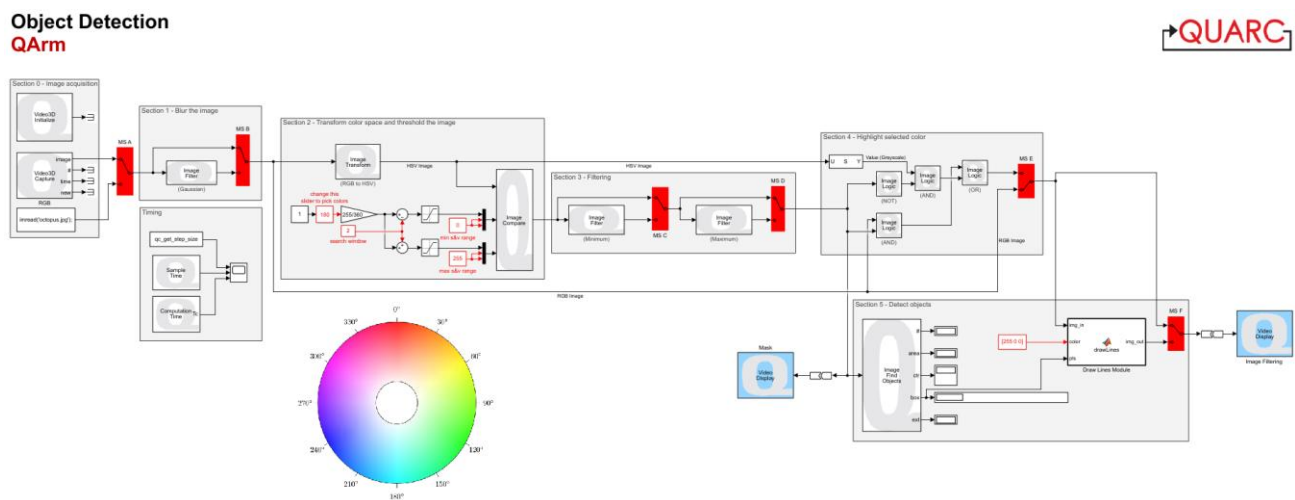


Figure 1. Object detection Simulink model.

2. Prior to running the model, open the model's [Configuration Parameters](#) and verify that they are configured as follows:
 - i. Solver type: Fixed-step
 - ii. Solver: ode4 (Runge-Kutta)
 - iii. Fixed-step size (fundamental sample time): 1/30 Hz
3. Make sure the Manual Switches, highlighted in red, are all up except MS E which should be down.
4. Run the model and open the **Video Display** on the rightmost side of the model ([Image Filtering](#)) highlighted in light blue in the model. You will use this to visualize what the filters are doing to the original image.

5. Focus on sections 0 and 1 related to image acquisition and blurring. While the model is running, flip the Manual Switch (MS B) to see the image before and after a gaussian filter is applied.
6. Stop the model, double click **Image Filter** block and change the kernel size to another greater odd number. Run the model again. What do you notice?
7. Open the **Mask Video Display** block highlighted in light blue, you will use this to visualize your image segmentation in the next steps.
8. Zoom and pan to Section 2, focusing on transforming the image to HSV and color thresholding. Using the color wheel under Section 2, find the approximate number (out of 360) for the hue color of your object and choose it using the red highlighted **slider**.
9. Observe your output while modifying your "search window" and the constant "min/max S & V range" that will change the saturation and value on your HSV range. Tune the **Mask Video Display** to highlight the area you're interested in. Some noise on the image is normal. The next step will work through filtering it. Figure 2 shows a sample result when thresholding for yellow.

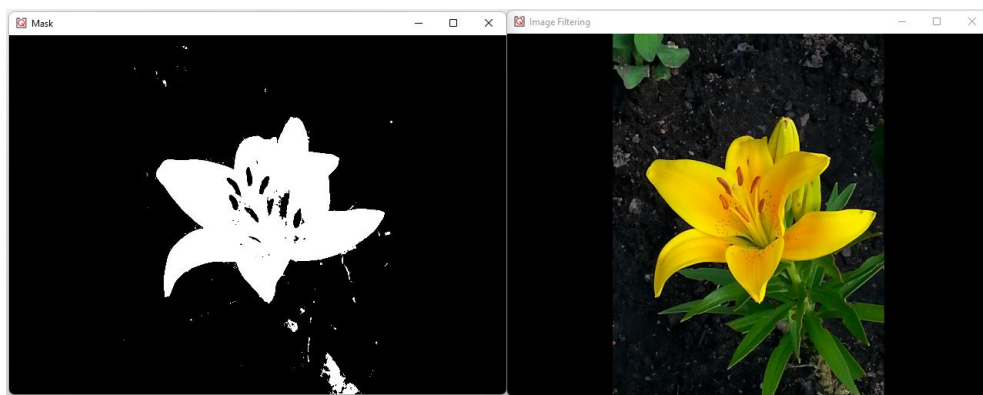


Figure 2. Image after selecting range of HSV values of interest.

10. Zoom and pan to Section 3, focusing on filtering. Continue observing the **Mask Video Display** while flipping the manual switches MS C and MS D. Try erosion, dilation and opening.
11. Stop the model, double click the filter blocks to change the Mask Size to 5, 7 or 9. Run the model again. Observe and make note of the changes. Figure 3 shows a sample result when using an opening filter. How is this different from no filter being used? How can you remove noise further?

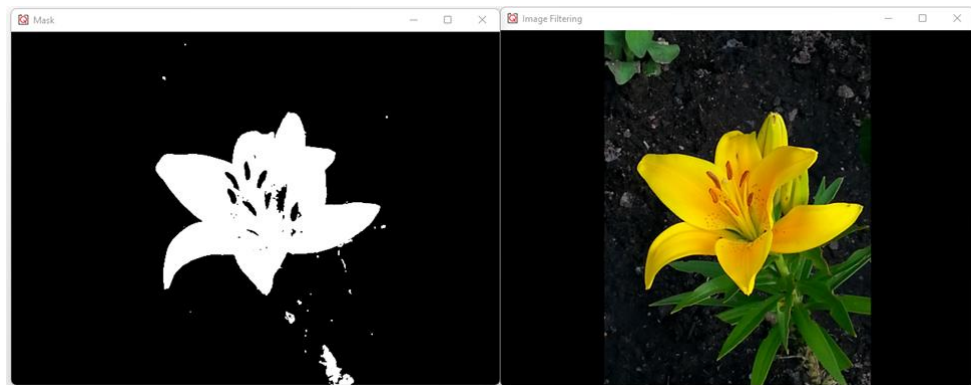


Figure 3. Image after performing a morphological opening.

12. Zoom and pan to Section 4, focusing on highlighting the selected color.
13. Flip manual switch MS E and observe your **Image Filtering Video Display**. What are the logical operations in this section doing? Figure 4 shows a sample result.

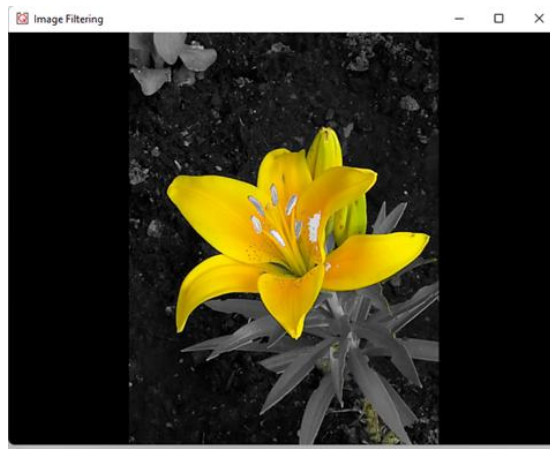


Figure 4. Highlighted color of choice.

14. Zoom and pan to Section 5, focusing on Object Detection. Flip manual switch MS F and observe how your **Image Filtering Video Display** now draws a black box around your object. What does the bounding box represent?
15. Modify the color input to the Draw Lines module using RGB values to see the box change color. Move your object around the camera view. Figure 5 shows a sample result.

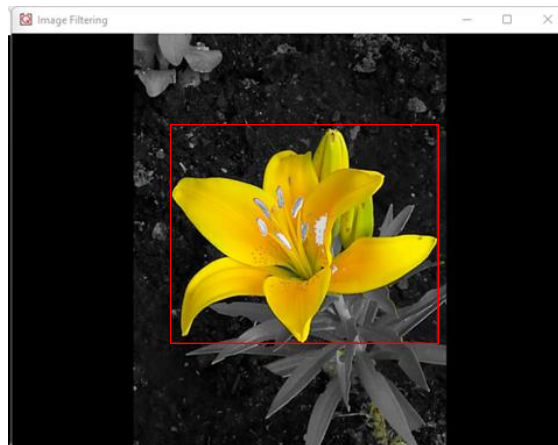


Figure 5. Object recognition of our object of interest.

16. Double click on the Image Find Objects and while observing your display, change the connectivity type between 4 and 8 directions and observe the changes.
17. Change the minimum number of pixels to a higher or lower value. and move your object further away from the camera to see when it will stop recognizing it. What does the 'Exclude objects at edge' option do?
18. Go back to the start of the model and switch Manual Switch A (MS A). Instead of using the video feed, you will be using the octopus picture from the previous lab. Choose a color you are interested in highlighting and switch the rest of the Manual Switches on and off to see how they affect the final image.
19. Stop the model and close MATLAB.