

Lab Procedure for Simulink

Vision: Image Processing

Setup

1. It is recommended that you review **Application Guide – Vision** before starting this lab.
2. Hardware Preparation
 - a. Ensure that the QArm Mini is securely attached to the base.
 - b. Verify that the manipulator is in the rest position.
 - c. Confirm that the QArm Mini is connected to the PC and turn it ON (the light in the switch should be red).
 - d. Check and update the latency setting as shown in Figure 1:
 - i. Navigate to Device Manager > Ports
 - ii. Select the appropriate device - USB Serial Port (COMx) Make a note of the COM port Number.
 - iii. Go to Port Settings > Advanced > Latency
 - iv. Set the latency to 2 ms

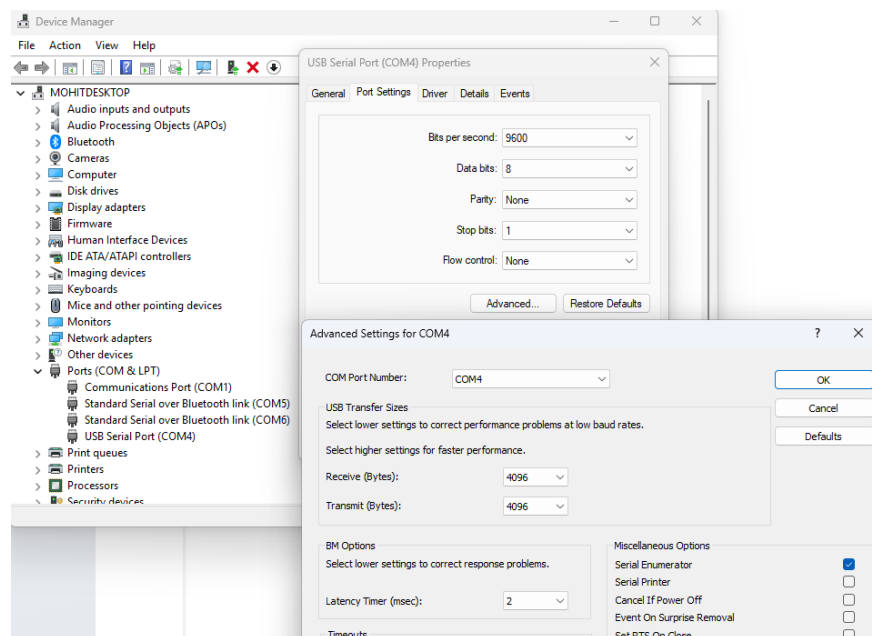

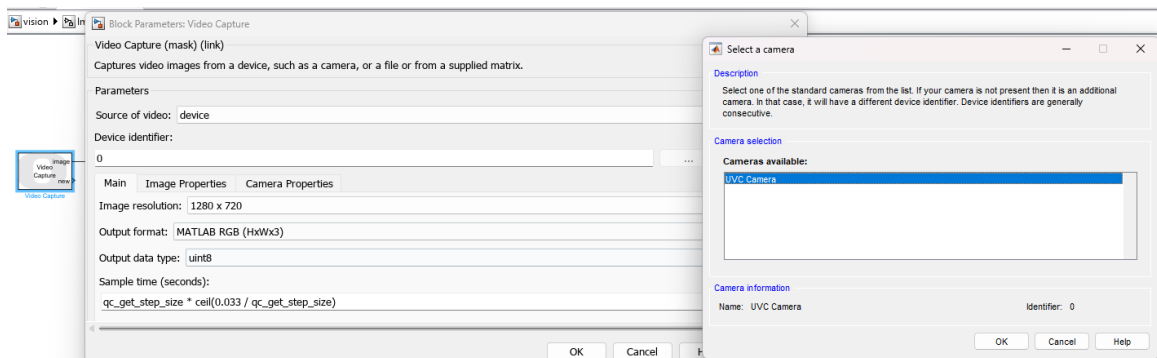


Figure 1. Latency Settings

Image Processing

1. Open **vision.slx**
 - a. In the Hardware tab, open **Hardware Settings** -> **Solver** and verify:
 - i. Solver Type: Fixed
 - ii. Solver: ODE2
 - iii. Fixed Step Size: 1/30
 - b. From the root level's **Application Layer**, double-click QArm Mini subsystem to navigate to the **Interface Layer**, and then the **Hardware Layer**, and double-click on the **HIL Initialize** block.
 - c. Update the **Board Identifier** value to match the COM port you noted during setup.
2. Find any solid-colored object (e.g., a blue phone, a green marker, a purple notebook etc). You will use it later in this lab.
3. Go back to the root level of your model (**Application Layer**). Build and deploy the model using the **Monitor and Tune**  button.
4. Open the Image Processing subsystem which processes the camera video feed to detect objects. Ensure all Manual Switches (MS) are up, except MS D, which should be down. Run the model—the QArm Mini will move to its home position. Open the Video Display (Image processing) on the right side to visualize how the filters affect the original image.

Note: Click the video capture block on the left, click on the ... tab under Device Identifier and verify that the UVC Camera is selected.



5. Focus on Section 1 related to image acquisition and blurring. While the model is running, flip Manual Switch (**MS A**) to view the image before and after applying a Gaussian filter. What do you observe?

6. Stop the model, double-click the Image Filter block, and increase the kernel size to a larger odd number (e.g., 5, 7, or 9). Rerun the model and observe how the image changes.
7. Open the **Mask** Video Display block to monitor image segmentation. Identify your object's hue (0–360) using the color wheel and adjust the slider in section 2 to match the object's color. Modify the search window and the min/max S & V range to isolate your object as shown in Figure 2. Some noise is expected—this will be addressed in the next step.

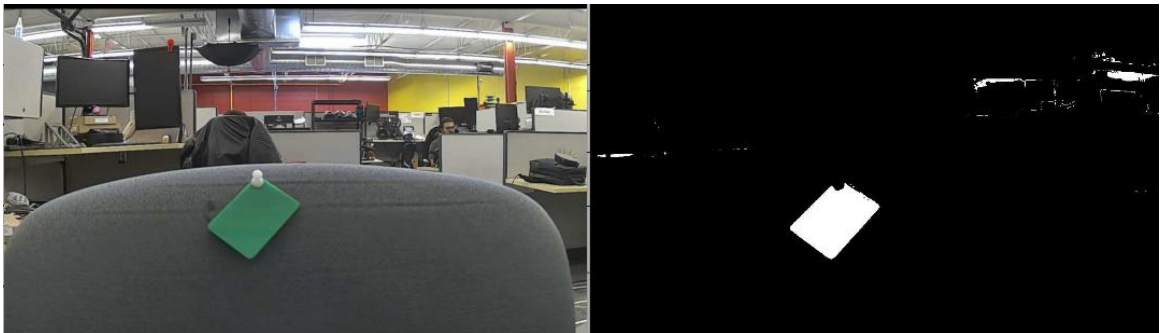


Figure 2. Identify Object of Interest

8. Zoom and pan to Section 3 of the model, focusing on filtering. Continue observing the Mask Video Display while flipping the manual switches **MS B** and **MS C**. Try erosion (minimum filter only), dilation (maximum filter only) and opening (both) filters. What do you observe?
9. Stop the model, double click the Image Filter blocks in Section 3 to change the Mask Size to 5, 7 or 9. Note that both values in the mask size need to be the same. Run the model again. Observe and make note of the changes. How is this different from no filter being used? How can you remove noise further?

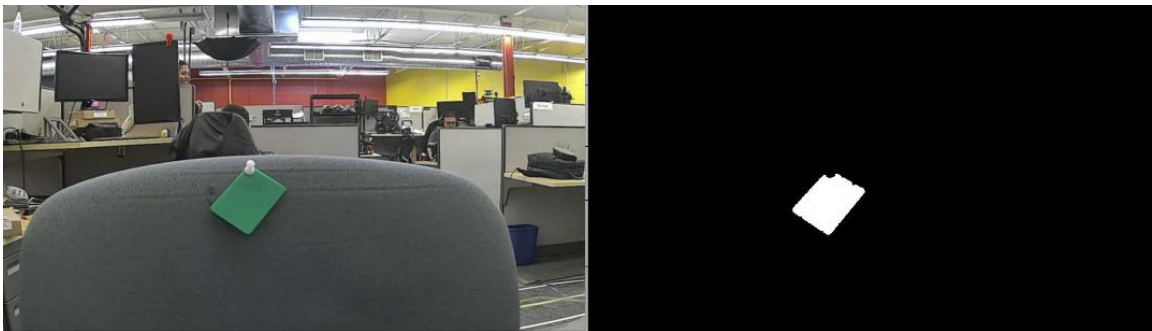


Figure 3. Image Filtering

10. Zoom and pan to Section 4 of the model, Flip Manual Switch (**MS D**) and observe how the Image Processing Video Display highlights the detected object as shown in Figure 4. What logical operations are being performed in this section?



Figure 4. Highlight Selected Color

11. Zoom and pan to Section 5 of the model, focusing on Object Detection. Flip manual switch **MS E** and observe how your Image Filtering Video Display now draws a black box around your object. What does the bounding box represent?
12. Modify the color input to RED to the Draw Lines module changing RGB values to [255, 0, 0]. See the box change color as shown in Figure 5 below. Move your object around the camera view.

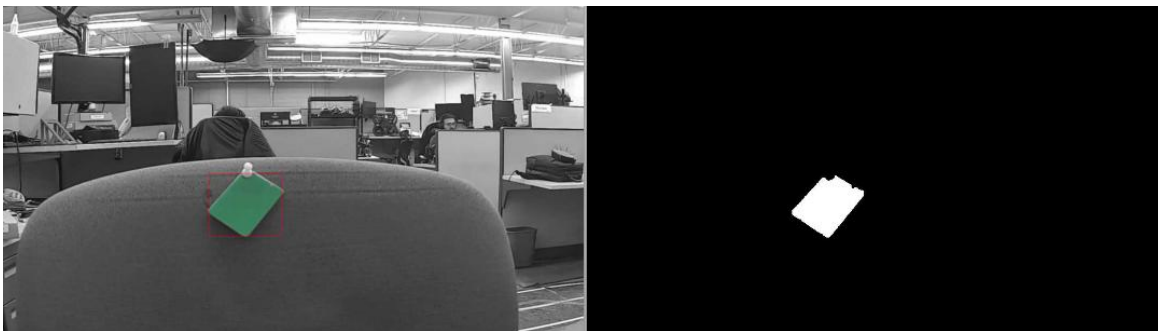


Figure 5. Bounding Box Around Highlighted Object

13. Double click on the Image Find Objects block and while observing your display, change the connectivity type between 4 and 8 directions and observe the changes.
14. 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?
15. Stop the model.
16. Gently return the QArm Mini to its resting position.