Robotics report

1 - Line Following

1.1 - Approaching the problem

To create the line following algorithm we first looked at different potential approaches towards the problem. The first approach we considered was using a Convolutional neural network. This would involve using a neural network to identify the rope in order for the robot to follow it. This would be effective as it means that the colour of the rope wouldn't matter since the ai could identify any colour of rope. However this could cause issues with the robot losing the rope on the ground misidentifying other objects as rope.

A second solution is to use an edge detection algorithm and then apply various filters to isolate the rope. However this is a very complicated solution and would be very slow to run as well as being prone to the same misidentifying problems as the AI approach. This approach does have the benefit of being applicable to any colour rope since it would be detecting the shape of the rope and not the colour.

Another approach is using an image processing pipeline to identify the rope by colour. This approach would be beneficial as it is fast to run and doesn't require any training unlike the AI approach. However the drawback of this approach is it would not work on other colour ropes and has to be set to detect each colour individually as well as being affected by noise in the image. This is the method we decided to go with.

One final approach is to combine these approaches together. You carry out image processing on the image along with edge detection. This new image could then be used as input for the AI to identify the rope. This would be a very effective strategy since it would identify the rope reliably and be less effected by noise. However this would be very slow and would also be prone to all the problems associated with each solution.

1.2 - Image Processing Pipeline

The image is first blurred this is to remove any noise in the image and reduce the error this could cause. This blurred image is then converted to HSV. We then create a mask for the specified colour range in HSV. The colour range for blue is (90, 80, 25) to (105, 255,255) and the colour range for yellow is (15, 25, 25) to (50, 255,255). This mask is then applied to the image which removes all colours that aren't in this range. We then convert this image to grayscale and before performing thresholding on the image this leaves the image as a series of white pixels.

This image then has the top of it converted to black since the robot is only concerned with what is in front of it. And this removes any background objects that could influence the image.

1.3 - Moving the Robot

To have the robot follow the line we first need to identify what colour the line is. This is done by passing each frame into both of the image processors (yellow and blue) and then setting the current line colour to the one with the most white pixels. However noise in the image can cause the robot to switch between thinking the rope is blue and thinning the rope is yellow. To reduce this issue a running poll of the last nine frames is taken and the majority vote for these frames is then used to set the line colour.

We then take the thresholded image from the output of the believed line colour and if there is more than a set number of white pixels in the middle of the image the robot moves forward since the rope is in front of it. If there are more than a set number of white pixels on the left of the image the robot will begin to turn left and the same is true for the white.