Robobo Line Following Program with ROS

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Overview

Robobo

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- Developed by Mytechia

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- Two wheels and a plastic caster

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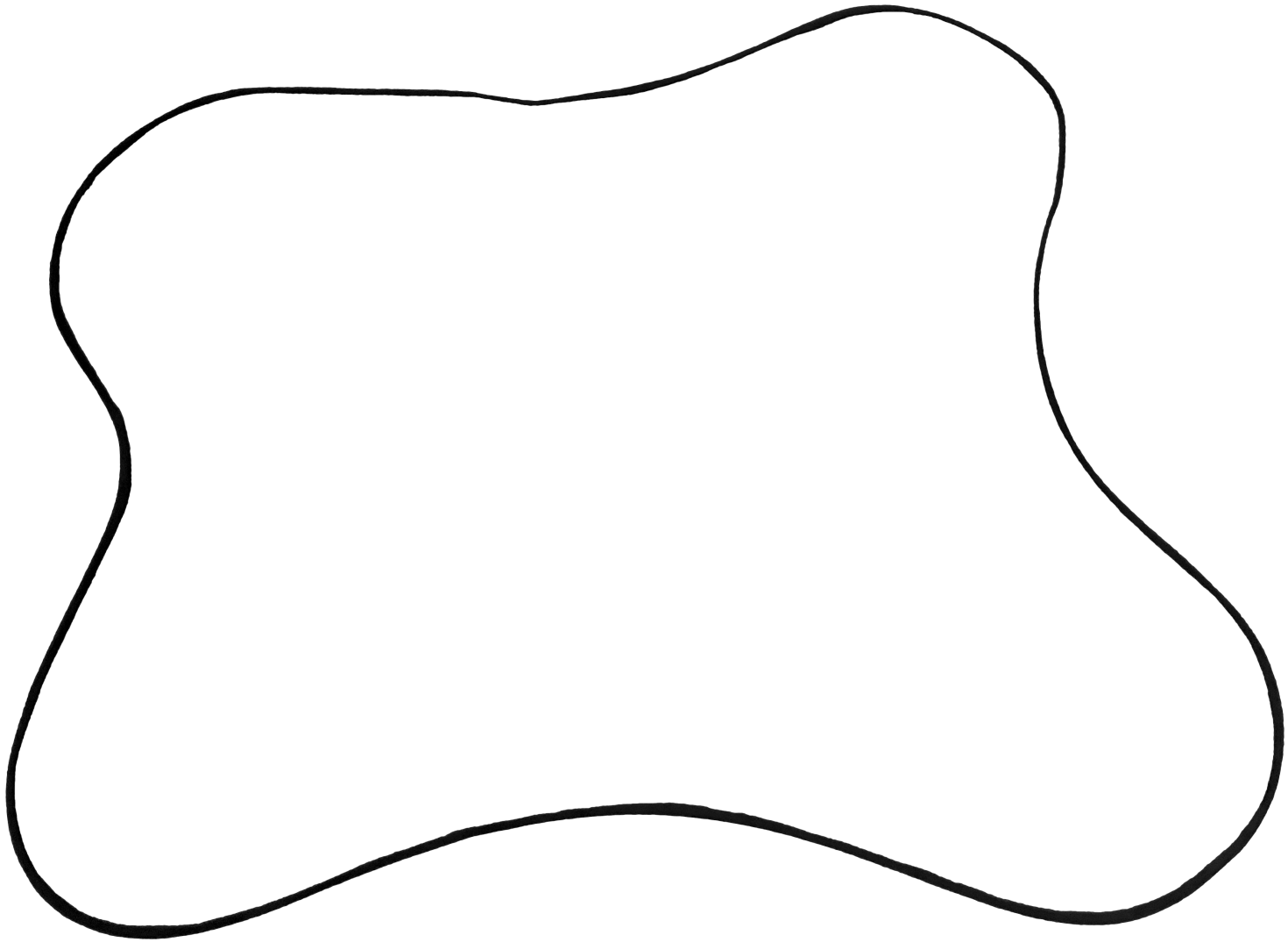
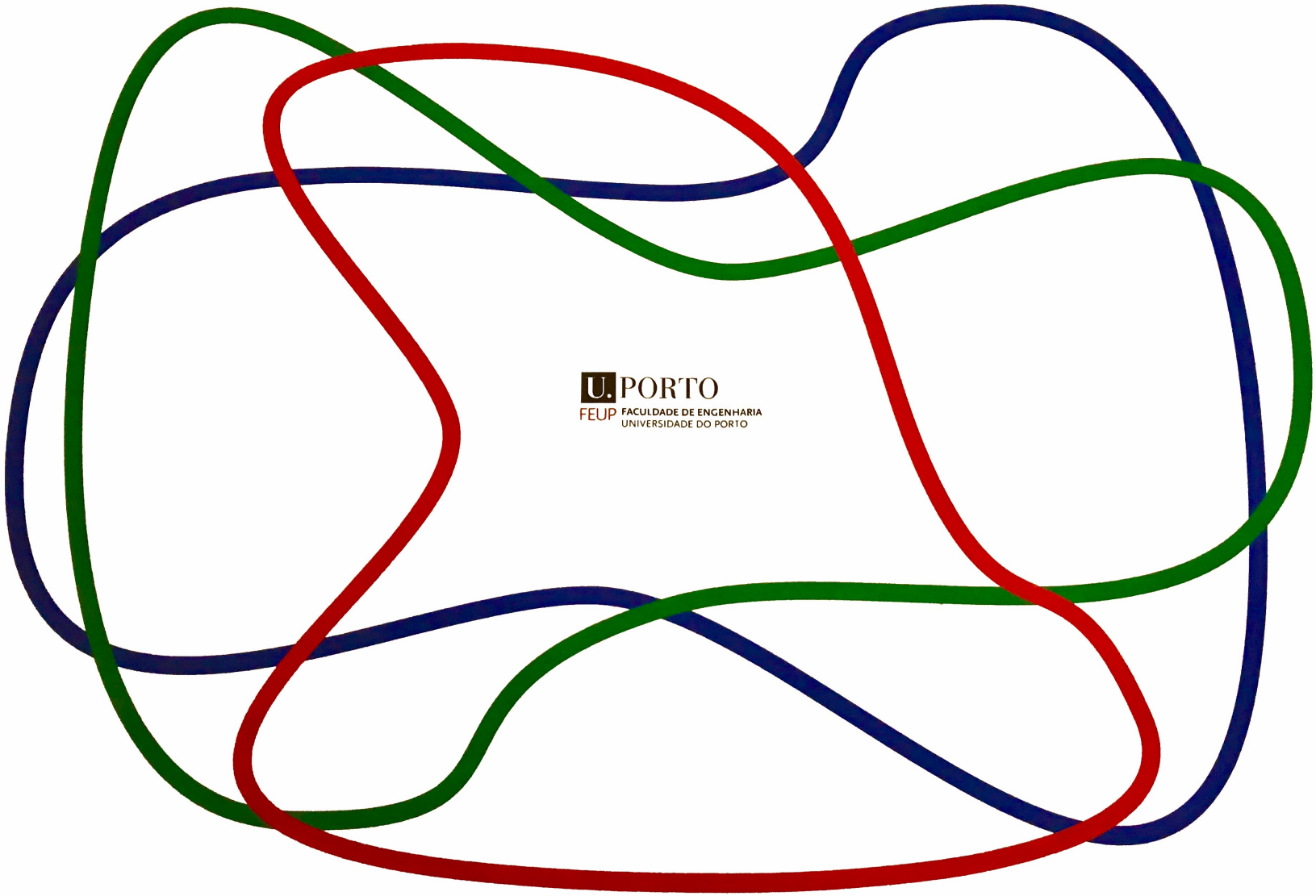
- Phone actuators: display, sound
- Programmable using ScratchX, Java and ROS

Maps



Maps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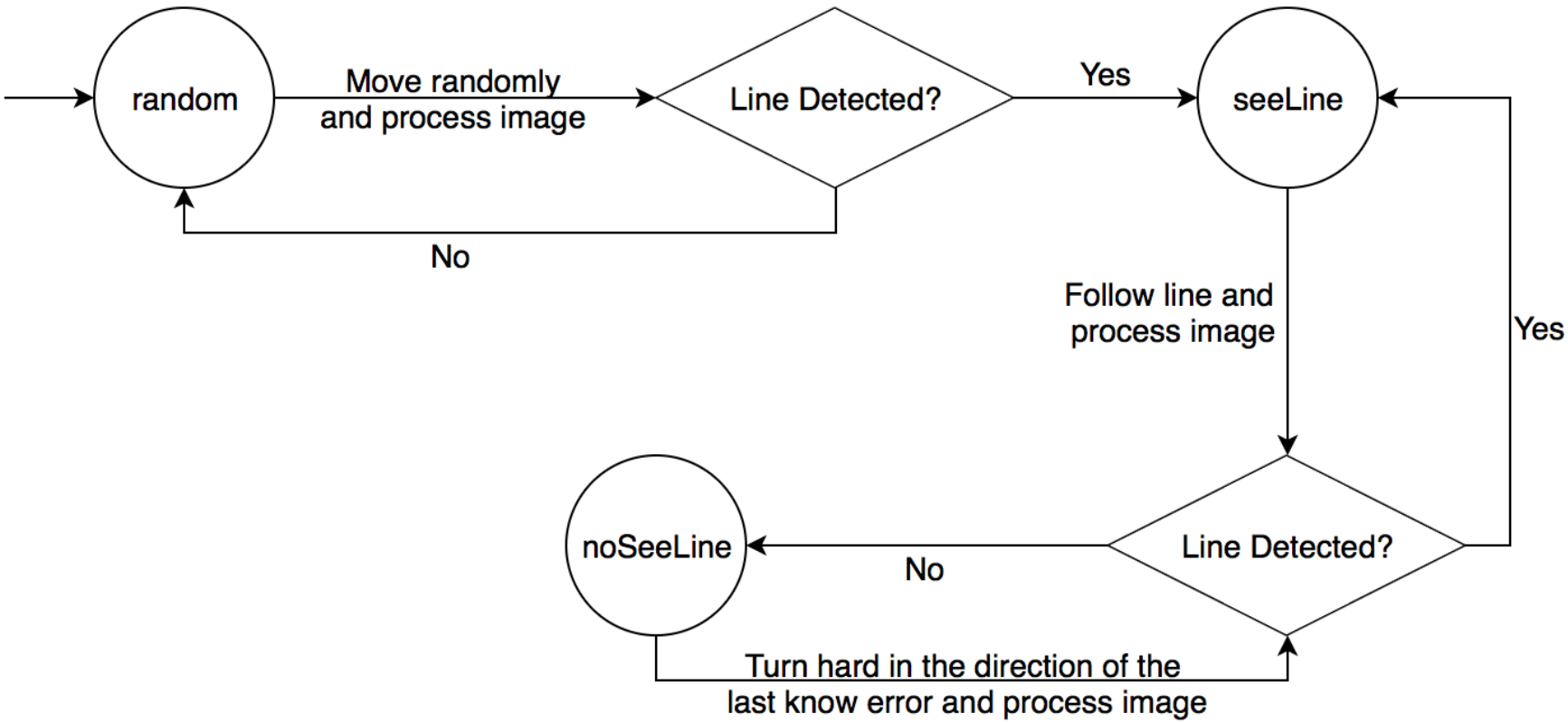
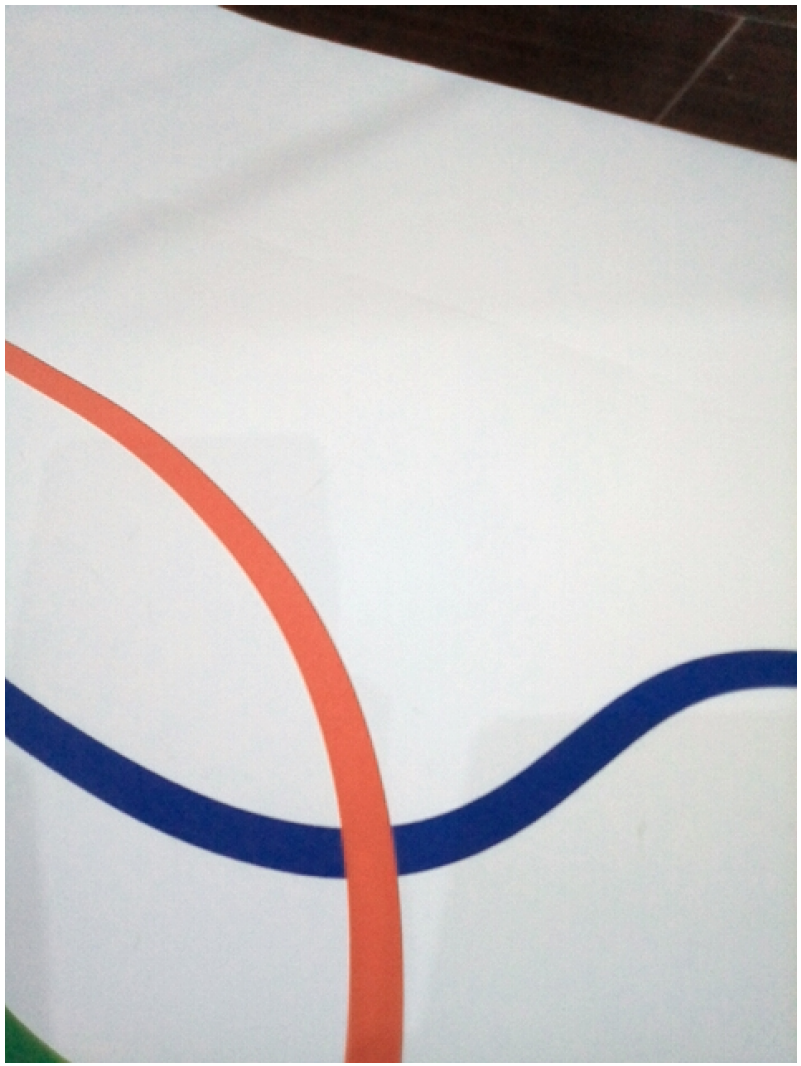
Behavior


random
Move randomly
and process image
Line Detected?
Yes
seeLine
No
Follow line and
process image
Yes
noSeeLine
No
Line Detected?
Turn hard in the direction of the
last know error and process image

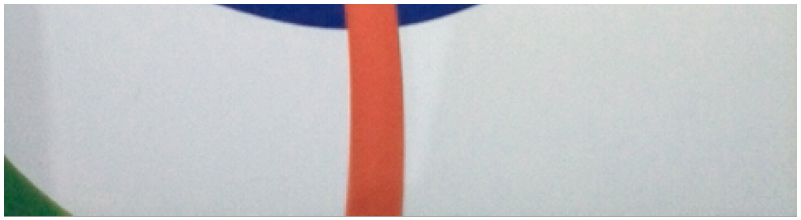
Camera Image Processing

1. Receive camera image



Camera Image Processing

1. Receive camera image
2. Select Region Of Interest (ROI)



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1. Receive camera image
2. Select Region Of Interest (ROI)
3. Create mask where only the color the robot should follow is selected
4. Make all pixels that do not belong to the mask white

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5. Transform the ROI from color to gray scale

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6. Blur the gray scale ROI

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7. Compute threshold of blurred ROI

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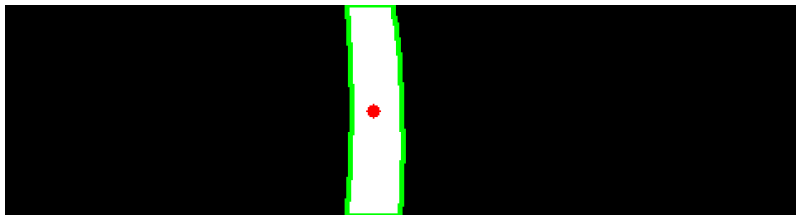
9. Compute the centroid of that contour using image moments



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9. Compute the centroid of that contour using image moments
10. Use the centroid to determine the signed normalized error

Line Following

1. Compute angular velocity using a PID controller:

$$\omega = K_p * P + K_i * I + K_d * D,$$

K_p, K_i, K_d: proportional, integral and derivative constants
P, I, D: proportional, integral and derivative terms
$P = e, I = I + e, D = e - d$: e current error, d previous error

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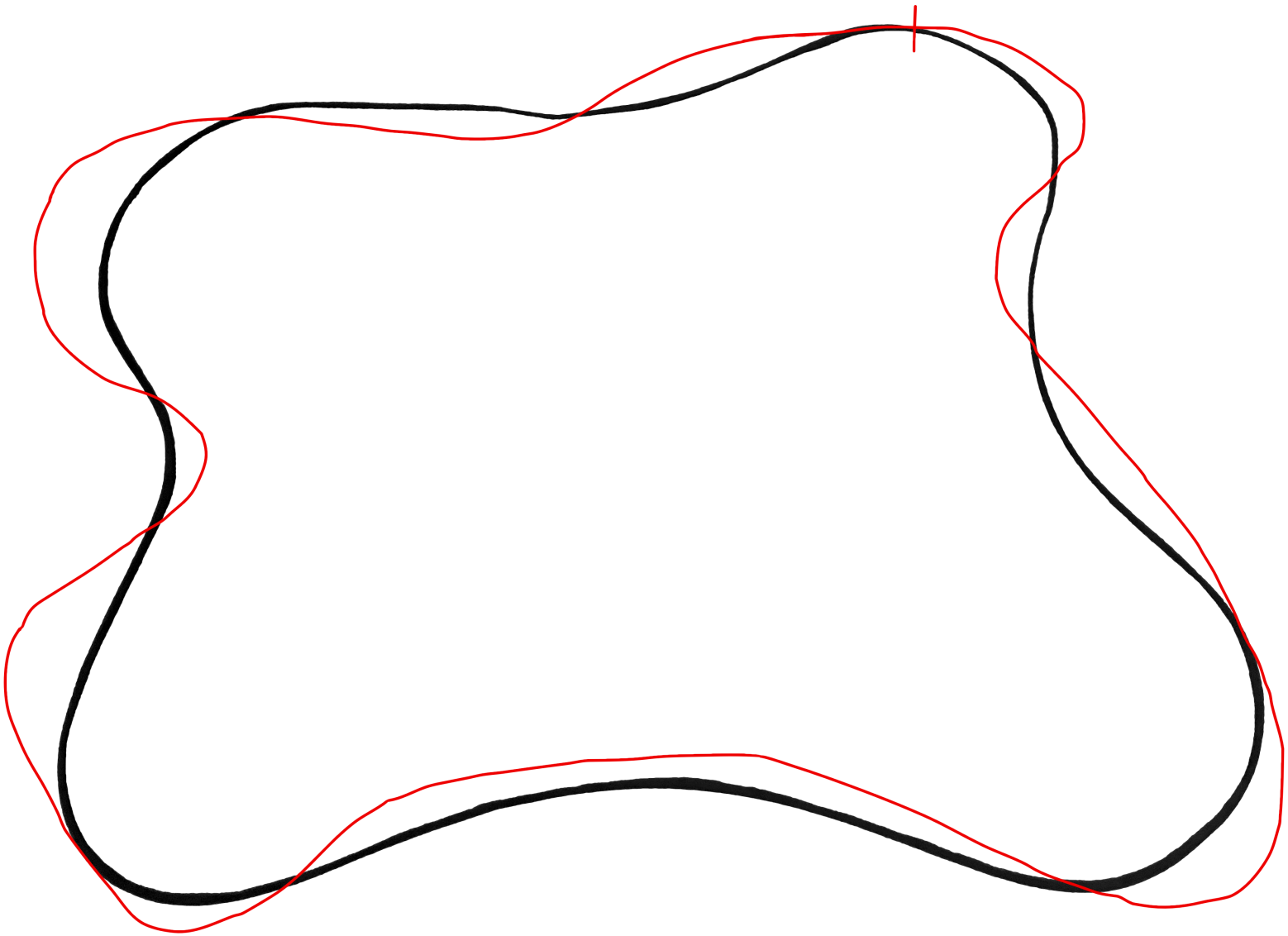
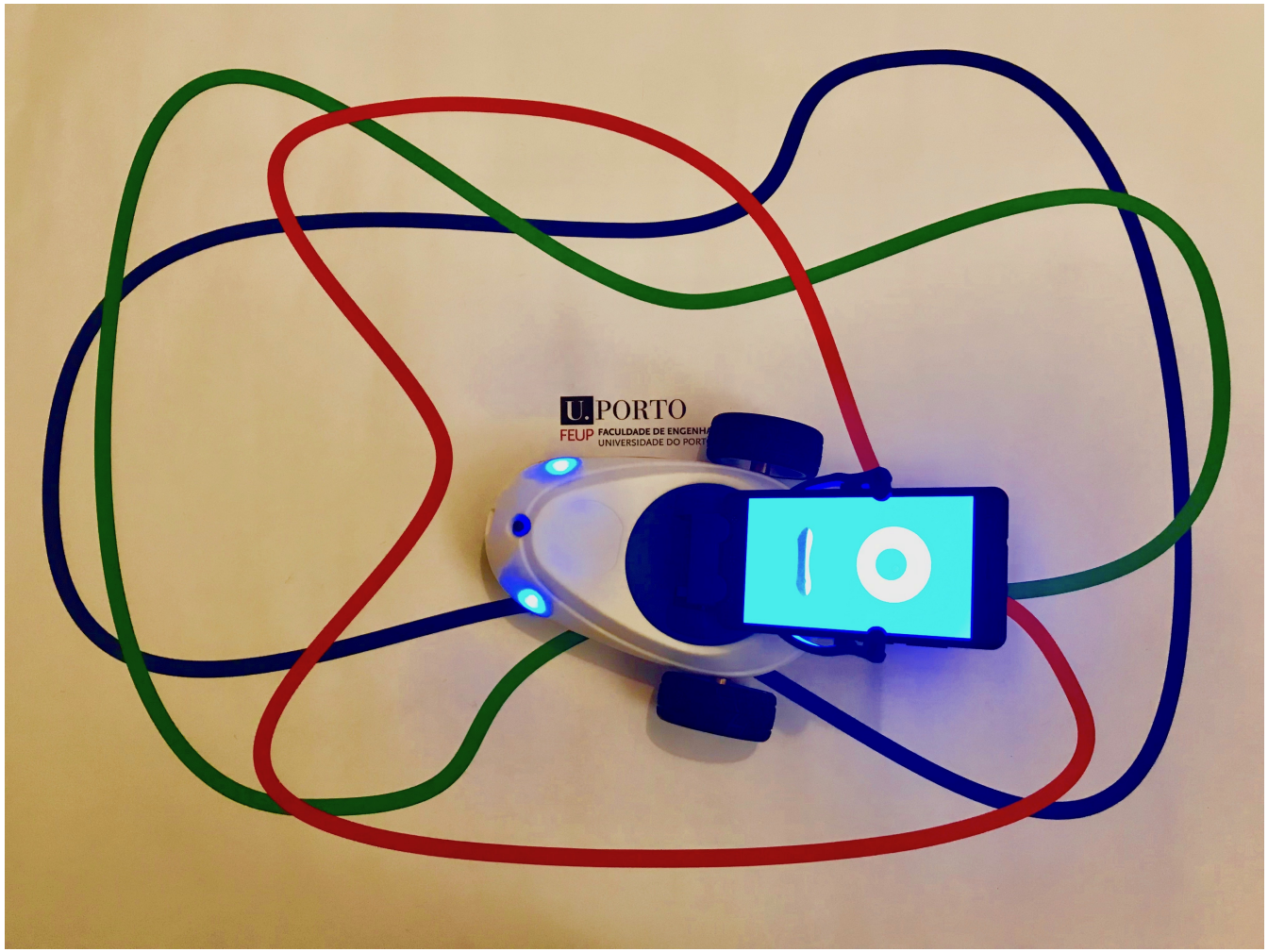
2. Send move command to each wheel, with left wheel speed $v - \omega$ and right wheel speed $v + \omega$, for a linear velocity v.
3. After tunning, the constants used where $K_p = 8, K_i = 0, K_d = 8$, with a linear velocity of 8.

Black Map with Pencil



Colored Map Video



Limitations

- Initial robot position

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- Initial robot position
- Camera image width

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- Camera image width
- Linear velocity

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- The camera image processing is the most challenging, but also the most rewarding part
- For real world projects, sometimes one must use tricks to overcome some of the limitations
- Using ROS to program Robobo is pretty much the same as programming any other robot

Bibliography


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