

Development and Implementation of a Line Following Algorithm for the Navigation of Beer Carrier Robot

Under Supervision of:

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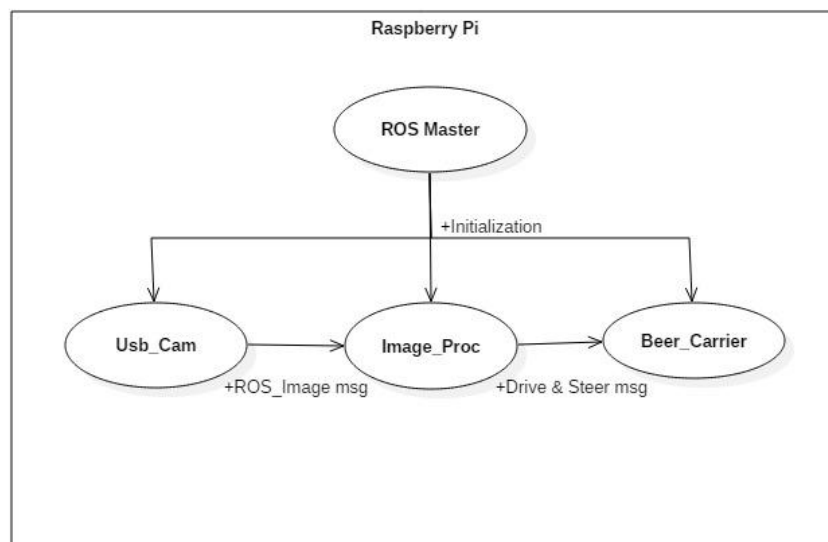
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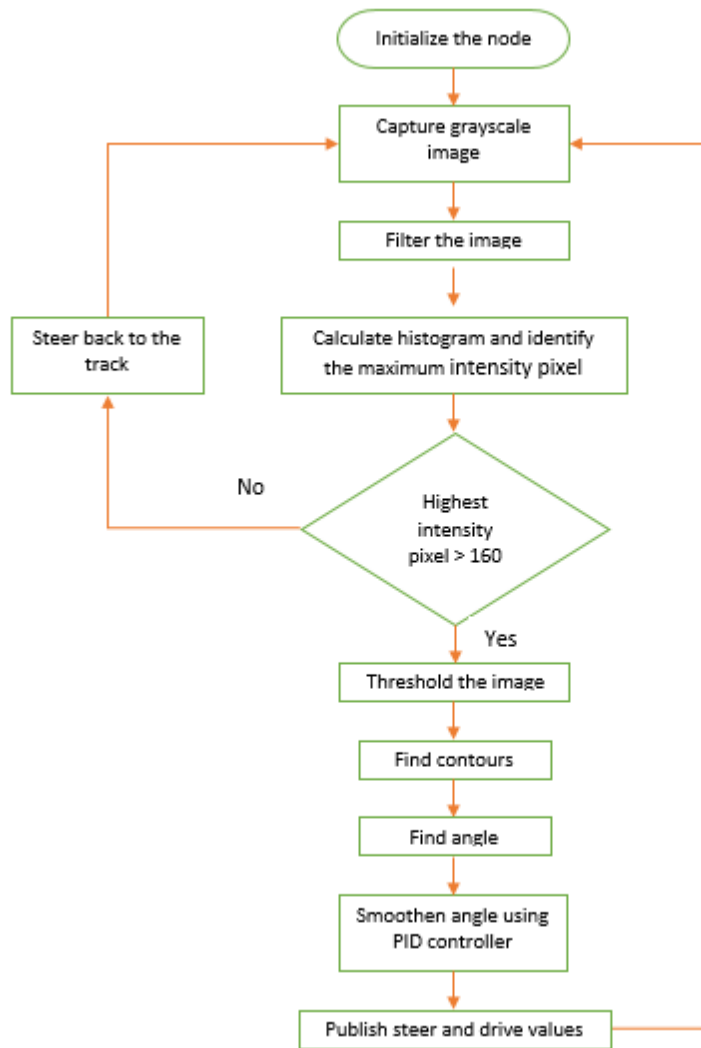
Description:

The main aim of this project is to build an intelligent robot that can follow a white line. The line following feature should be added to an existing robot (Beer carrier). It should follow both straight and curved profiles in order to reach the destination. It has a USB-camera to get images from its surroundings. By processing these images, the white line has to be identified and instructions has to be sent to the motors of the robot, to drive and steer. ROS (Robot Operating System) has been used to make the robot modular. Every time a new feature adds to the robot, there is no need to replace the entire software except that particular feature. All the images are processed in OpenCV, which is a C++ library. The program runs on a single Raspberry Pi. Motors controlled by a bridge circuit using PWM (Pulse Width Modulation) signals.

Three different ROS Nodes are used in this project as follows:



Process flow for the Image_Proc node is as follows:



Testing & Results:

Tracks which are used to test the robot in this project are as follows:

Curve Type: Broad
Curve Distance: 2.43m
Curve Radius: 0.775m



Curve Type: Medium
Curve Distance: 1.36m
Curve Radius: 0.65m



Curve Type: Short
Curve Distance: 2.10m
Curve Radius: 0.30m



The following statistics gives the insight to select the optimized parameters for this robot.

Motor Driving Power : 0.2 Driving Speed : 0.40 m/s		Trial1	Trial2	Trial3	Trial4	Trial5
Curve Type	Broad(deviates)	1	0	1	0	2
	Broad(time)	7.54s	7.31s	7.56s	7.34s	7.9s
	Medium(deviates)	2	2	2	1	2
	Medium(time)	3.83s	3.79s	3.85s	3.6s	3.8s
	Sharp(deviates)	Out of line	Out of line	Out of line	Out of line	Out of line
	Sharp(time)	NA	NA	NA	NA	NA
Motor Driving Power : 0.15 Driving Speed : 0.28 m/s		Trial1	Trial2	Trial3	Trial4	Trial5
Curve Type	Broad(deviates)	0	1	0	0	0
	Broad(time)	9.96s	10.45s	9.26s	9.93s	9.2s
	Medium(deviates)	0	0	0	0	0
	Medium(time)	5.78s	5.21s	5.36s	5.26s	5.46s
	Sharp(deviates)	3	3	2	3	2
	Sharp(time)	12.48s	11.2s	11.76s	11.98s	11.1s
Motor Driving Power : 0.1 Driving Speed : 0.12 m/s		Trial1	Trial2	Trial3	Trial4	Trial5
Curve Type	Broad(deviates)	0	0	0	0	0
	Broad(time)	21s	19.41s	20.6s	20.9s	19.8s
	Medium(deviates)	0	0	0	0	0
	Medium(time)	9.2s	8.5s	9.85s	8.5s	8.7s
	Sharp(deviates)	2	0	2	2	1
	Sharp(time)	22.6s	20s	21.6s	22s	19s

Table 1: Statistics of the robot for different speeds

Features:

- Line Detection.
- Back track to the line if it misses.
- PID Controller.
- Differential Drive.

A short video for demonstration:

https://youtu.be/KQK36Qh9o_0