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Vision-based autonomous docking

Autonomous docking is the ability of a robot to detect and navigate toward its charging station from any position and/or orientation. This type of navigation is essential for autonomous robots. Our goal is to design a way for our tbot to accomplish this accurately and efficiently.

We used a green cylinder as the visual cue for the dock. We implemented colour-based tracking in order to detect the green cylinder using the appropriate range for hue, saturation and value in HSV; Combining the three filters to create the best binary image with minimal noise. The bot was to look the for the specified green cylinder. If the cylinder was not in its view, the tbot would scan around him, rotation until the cylinder was detected. Then the tbot would start moving towards the "dock".

The cylinder was raised off the ground by 6 inches. We set our predefined docking position to be right below the center of the cylinder. We used the area of the cylinder in the binary image to measure distances. The closer the object the bigger the area in the bots view, and vice versa. The tbot obtained its heading by keeping the cylinder centered in its view at all times. Once the tbot was near the cylinder, within 6 inches, the tbot would slow down significantly to be more precise for the final "docking." Once the cylinder area was 277,000 pixels in the bots view, the tbot would stop its velocities and tracking of the cylinder.

Our approach made it so that the tbot could start from any position, as long as it still had an unobstructed view of the dock, and it would always be able to dock on its own.