Robotic Vision

Exercise 1 – Determining Position and Orientation :

Capture some images of a cube/brick with a distinct color on a background with another color (use e.g. webcam, phone, ..). It may of course be related to your final project..

Import the file into MATLAB – you may use “Machine_Vision_Intro.m” as inspiration..

Experiment with color-based positioning and edge-based methods for orientation.

Try to test the ability of your algorithm to *generalize.* This is one of the most important aspects of designing algorithms – that the algorithm is able to robustly cope with different realistic situations. For instance, you could try to change the illumination (eg. what happens if there is suddenly sunshine from the window?), different positions of the object or experiment with *occlusion* (when the object is only partly visible due to an overlap – eg. if there are more than one object or the robot itself makes a shadow).

Exercise 2 – Camera coordinates and Perspective transform :

Capture images of an object from different heights that you measure directly – e.g. 10, 20, 30, 40, 50, 60 cm height. The object should be quite flat, such that the “z-axis” (height) is the same for all points on the object – also the camera should be positioned directly above the object (with no “tilt”).

Manually measure the distances of the object lenghts (height and width) and also measure the same distances in number of pixels in the images.

First, try to estimate the constant k from the perspective transform (ie. $\Delta \boldsymbol{r} = \frac{\boldsymbol{f}}{\boldsymbol{s_x}} \frac{\Delta \boldsymbol{x}}{\boldsymbol{z}} = \boldsymbol{k} \frac{\Delta \boldsymbol{x}}{\boldsymbol{z}}$ where f is the focal length and s is physical photosite size on the sensor) – you know Δr (pixel coordinate distance) and Δx and z (from manual measurements). For instance, average over the different values that you get.

Plot the relation between measured object lengths in pixels and camera height – relate this plot to the perspective transform, ie. a “1/z” shape..