

# Embedded Systems

## ELEC3020

### Lab Assignment 9 – Image Processing

Points: 10

- TEAMS:** This lab will be conducted in teams of 2 students
- EQUIPMENT:** Mobile Robot with Embedded Controller, sensors and motors  
<https://roblab.org/eyebot/eyebot32>
- PREPARATION:** Prepare this lab at home by using the *EyeSim* simulator:  
<https://roblab.org/eyesim/>

#### EXPERIMENT 1 (2 points)

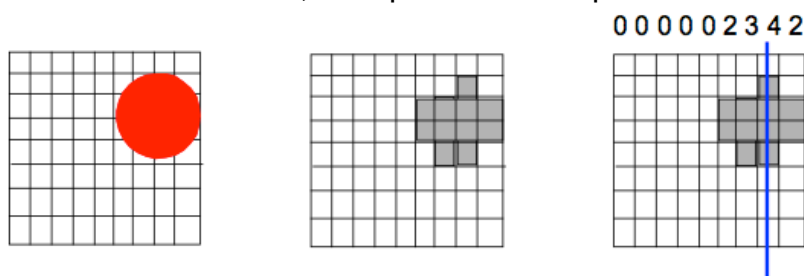
Write a program to “teach” an object color:

- Display current camera images on LCD, marking the center of the image with cross hairs
- When a button is pushed, record average HUE value from 3x3 center area and print this value to the LCD screen.

#### EXPERIMENT 2 (6 points)

Search for largest object matching hue from previous experiment in live image sequence.

1. Convert the RGB image to a HSI image as per lecture notes
2. Convert the HSI image to a binary image (1 for match / 0 for no match).  
A match is achieved if a pixel’s Hue value is within a range of the desired red hue  $[\text{hue}-x, \text{hue}+x]$  and the Intensity value is above a reasonable threshold.  
On the LCD, overlay matching pixels in red over the grayscale input image.
3. Create a histogram by adding all values of the match image
  - a. Column histogram by adding values column by column
  - b. Row histogram by adding values row by row
4. Find positions of the maximum values in row and column histograms.  
These identify the center of the color “blob”. If the max. histogram data value is above a threshold, then plot the found position as cross hairs on the LCD.



#### EXPERIMENT 3 (2 points)

Rotate the robot so the camera points towards the detected object. Use a P-controller or On-Off-controller to rotate the robot for each time step in small increments, so it continuously centers the detected object.