MTRN4230 Lab 02

1. Aim

Lab 2 aims to familiarise you to some simple tools in computer vision. This is a common robotic sensor, particularly used in modern environments. You will be working with computer vision further in your projects later in the course.

You will also be completing the demonstration component of the ROBOT-1 assessment task if you have not already completed it in lab 1.

2. Pre-lab

You must have completed the necessary pre-demonstration components for the ROBOT-1 assessment, as outlined in the ROBOT-1 Assessment on Moodle.

Pre-lab checklist:

- Watch lecture 2 on robotic sensors and actuators, particularly the section on computer vision (this will enable you to do the lab)
- Complete all “Prior to Lab Demonstration” tasks for the ROBOT-1 assessment.

3. Lab Activities

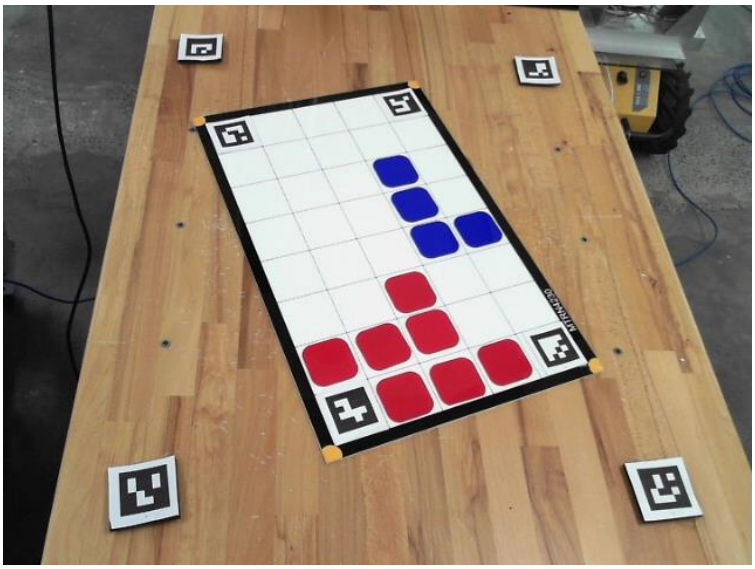
3.1. Assessed Tasks (ROBOT-1 Assessment – Demonstration)

Complete the ROBOT-1 In-Lab Demonstration in person during your scheduled lab time.

3.2. Computer Vision Lab Work

Your demonstrator will demonstrate how we can use computer vision to have your robot interact with a dynamic environment. We may face a wide variety of situations in industry where we do not always know arrangements or alignment of objects, and thus computer vision plays a critical role here.

In the lab today, we will be looking at a simple, yet fun, situation. We are trying to have our robot play a mini game of Tetris. Here, the robot arranges pucks on the board to display the game state as blocks fall or are moved. Computer vision detects when a new block is added to the top of the board by detecting a change in the number of pucks on the game board.



During the lab you are tasked to complete the computer vision aspect of the code. You have been given an example of a situation that may be faced by the robot and must identify the location of all the pucks of each colour (red and blue). Follow through the steps below to complete this task.

To complete this task, you will need to use the skills from the computer vision component of lecture 2.

1. Identifying Markers

Commonly, the input image that is viewed and must be analysed does not take up the entire screen. The camera may be offset in some way that would result in a warped image. As such, the first step is to transform the input image so that the important component takes up the complete frame.

You can find the sample file on Moodle alongside this lab document.

In our situation, the game board has been marked for you with distinct ArUco markers. ArUco markers are useful for finding positions within an image, as they are easy to identify across a range of lighting conditions and have known binary patterns, allowing for pose and orientation calculation.

The first step is to identify these.

1. Read in the image from a file
2. Identify ArUco markers using the *readArucoMarkers* function (https://au.mathworks.com/help/vision/ref/readarucomarker.html)
3. Identify the location of the centre of each marker on the game board

2. Perspective Transform

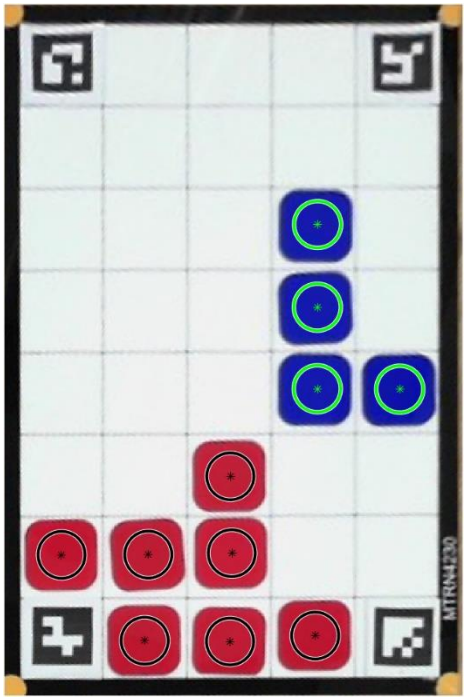
Now that you know where the markers on the board are, you need to ensure that these are transformed to the four corners of your frame. You can assume that there is one board corner in each quadrant of the input image. The output frame (once transformed and just containing the board) should be $390\ px \times\ 590\ px$ in size.

Importantly, the ArUco markers are within the board, not exactly on the corners. In the transformed frame, the centre of these markers will have the coordinates:

$$(50, 50), \quad (340, 50), \quad (50, 540), \quad (340, 540)$$

3. Identify Pucks

Now that your frame is correctly aligned, you can use this to perform a useful task. In this circumstance, you need to find and mark the location of the red and blue pucks within the game board. You can do this in a similar way to the Color Masking section of Lecture 2. Your resulting image should look something like below.



HINT: Use the *regionProps* function to determine the centroids of white parts in a mask. See examples: https://au.mathworks.com/help/images/ref/regionprops.html

4. Post-lab

- Start to review and start on the ROBOT-2 assessment due in Week 4.
- Next week we will cover further the RTDE and RVC Toolboxes which can also be used for the ROBOT-2 assessment. It is recommended that you look through the reference material and example code provided beforehand to make a start on ROBOT-2.