CS413 Coursework 2023-2024

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1 Part 1: Resistance is Futile

In this problem, we are simply interested in detecting specific colors (8 different colors) and then identify their order to decode the resistor value.

Looking at the bands in all the resistors, they are simple rectangular shapes (very thin for the case of the second image), and they consist of the same color.

It would make solving the problem much easier if we work on each resistor individually. Meaning that we first extract the resistors, then handle the resistor separately from its original image.

Extracting the resistors is almost identical to the example of extracting chromosomes we took in the labs. We perform the following steps:

1. Image Thresholding and Binarization: the thre images have white background, which makes it very good to extract the objects from the image. We apply constant threshold on each image to get a binary image.
2. Component analysis: from the binary image, we extract the connected component. Each component (ideally) should resemble an object of interest. A resistor in our case.
3. Post-processing: after extracting the resistors, we align them vertically. This will makes it easier to identify the order of the bands.

The above process runs smoothly on the first two images. The third image have many overlapping objects which makes the component extraction algorithm fail to separate them.

The following step is to extract colors from each resistor object. We use the HSV color space because it separates colors more easily than RGB.

The code detects all colors except for white, black, and golden.

2 Part 2: Spot-the-difference

In this question, we want to align board-2 with board-3 in order to identify the difference between the two boards.

If we look closely, we can see that there are actually three chips that exist in board-3 but don't exist in board-2.

First, to align the two images, we need calculate the transformation matrix. To get this matrix, we extract SIFT feature from the two images and find their matches. After having the transformation matrix, we transform board-2 to the destination perspective. And to *blend* the two images, we calculated their weighted sum.

To detect difference between the two boards, we calculated the absolute difference between board-2 after alignment and board-3. This difference will have higher values where the two boards are actually different and lower vales where the boars are the same. The difference however, is susceptible to lighting and other conditions, and therefore, it will have high values even if the two boards aren't different.

37th Conference on Neural Information Processing Systems (NeurIPS 2023).

After calculating the difference image, we binarize it and extract the blobs from it and highlight the resulting blobs.

3 Part 3: Pick-and-Place