ACM 11: Coin Counting Project

This is one possible topic for the ACM11 MATLAB project. Difficulty rating: medium. 100 points. 10/22/08.

Suppose we wish to determine the value of coins in a picture. For this project, for simplicity, we will only worry about disjoint coins, and all coins will be away from the edge. The instructions here guide us through the process step-by-step. If you find a simpler or better method, that is fine also. These instructions assume that the Image Processing Toolbox is installed.

(a) Original coin image
(b) Edge detection, via "canny" filter
(c) Filled regions
(d) Distinguish disjoint regions

Figure 1: A sequential look at the coin counting problem

The first step is to load a sample image of coins. MATLAB has an image called coins.png, and it should be in the path, so you can load it with just imread(‘coins.png’). We get a grayscale image; the function imshow will plot it for us. This gives plot (a) in Figure 1.

Second, we detect the edges of the coins. The toolbox has the edge command, which will do this. You can choose from several methods; the 'canny' method gave good results for me. You may also choose your own threshold values if you are getting poor results. Algorithmically, this step is not easy, but MATLAB has done the hard-work for us. By plotting, we get plot (b) in Figure 1. To see some examples of the edge command and the various commands, run edgedemo.

Now, we wish to “fill-in” the regions. Use the regionprops command with the 'FilledImage' flag. The results are saved in a field called FilledImage, which is a matrix of 0s and 1s, with a 1 corresponding to being inside a region. This gives plot (c) in Figure 1. There are actually some very tiny regions outside the coins, barely visible on the plot, which we need to worry about later.

To go further, we need to be able to distinguish one region from another. This would not be a pleasant task to do ourselves, but fortunately MATLAB has a built-in function called bblabel that will give each contiguous region its own label. For plot (d), the data was further processed using
the `label2rgb` command which makes each region display in a new color, but this is only for visual effect and is not necessary.

To infer information about the coins, we would like to know the area of each region. Using the result of the `bwlabel` command as input to `regionprops`, use the `'area'` flag for `regionprops` to return the area for each region. The output of this command is an array of structures, and a bit unwieldy. We can convert it to more usable form using a special form of the square brackets:

```matlab
stats = regionprops(...);
areas = [stats.Area];
```

With this information, we are done with the image processing. We might wish to exclude any areas that are too small (e.g. due to an artifact in the edge detection process). For the large areas that correspond to coins, we wish to determine which type of coin it is from. The dimensions of American coins are available on the internet, so it would be easy to classify the coins if we had a scale. Since there is no scale for this image, we can normalize by the largest area, and “cheat” by using the fact that the largest coin in the picture is a nickel. Then it is a simple matter to find which area corresponds to which coin and count the amount of money in the picture. Plot (d) was labelled using `text`, with centers of the coins determined via the ‘Centroid’ flag for `regionprops` command.

Visually check the picture, and verify that your program was correct. To make sure it wasn’t a fluke, let’s use another image. Open the image at [http://www.acm.caltech.edu/~acm11/2008/FALL/projects/moreCoins.jpg](http://www.acm.caltech.edu/~acm11/2008/FALL/projects/moreCoins.jpg). This image is a color image, so first convert it to grayscale using `rgb2gray`. We will again “cheat” by using the knowledge that the largest coin in the picture is a quarter.

Your project should consist of a file called `main.m` that produces two figures, both similar to Figure 1, corresponding to `coins.png` and `moreCoins.jpg`. There is no need to attach the actual image files. Put the files in a folder called `Firstname_Lastname_proj_coin`, where you replace `Firstname` and `Lastname` with your first and last names, respectively, and upload this via ftp.