

# HOUGH TRANSFORM



**Raffy Bekhit**

3248

Computer Vision

## INTRODUCTION

For a given image containing egyptian coins, our goal is to detect the coins, classify them and count their total value.

So, we do this by using Hough transform to detect the circles in the image and by knowing the radius of each coin category we can classify the coins.

## Implementation

1. **Convert to grayscale**
2. **Smoothing:** We smooth the grayscale image using median filter of window 7x7 in order to reduce the noise
3. **Canny:** Canny's algorithm is used to detect the edges with minimum threshold = 250 and maximum threshold = 280. Where any pixel above or equal the maximum threshold is kept and the pixels connected to them between the minimum and maximum thresholds are kept. The others that are below maximum thresholds are suppressed.
4. **Hough Transform**

## Hough Transform

The CHT method takes two parameters the edges matrix and the radius of the wanted circles to be detected.

Here the radii of the coins are given by:

One Egyptian Pound	135 Pixels
50 Piastres	120 Pixels
25 Piastres	107 Pixels

So, for each image we do CHT 3 times with the 3 radii. Each time it detects a type of coins.

In the CHT method we loop on every pixel belonging to the edges and for each point we draw a circle with radius  $r$ . Considering the point on the edge as the center  $(x,y)$  of the circle we obtain the other points on the circle by:  $(x - a)^2 + (y - b)^2 = R^2$

The circle is simply drawn by calculating each possible pixel position (a,b) from the above equation and incrementing  $H[a,b]$ . Where H is an accumulator.

The b ranges from (y-r) to (y+r) and for each b for a given (x,y) edge point and radius R, “a” is calculated

After finishing this step we only keep the points which have a value greater than or equal a threshold. The threshold here is the maximum value in H minus 20 which gives correct results.

## Coins counting

The images has no coins overlapped so when using CHT for a specific coin type we count this types of coins by counting the peaks that has at least euclidean distance of  $2r$  between it and the previous peak.

We multiply the coin count by its value and add it to the total value to get the total value of coins in the image.

## Coins Classification

The color\_pixel() colors a given pixel red, green or blue according to the type of the coin passed to it.

After thresholding step in CHT and having the final peaks we use mark\_coin() method which modifies the original colored image. It takes the hough transform accumulator and draw a circle around each peak according to its class. So, we run CHT() with radius of 1 pound coin then highlight the coins red. Then we run CHT with radius of 50 piasters and highlight the coins in the image then the 25 piasters blue.

One Egyptian Pound	red
50 Piastres	green
25 Piastres	blue

## Test Cases

The coins are highlighted. The colors maybe not very obvious but they are clearer in the images in the source code folder.







The result count from the program:

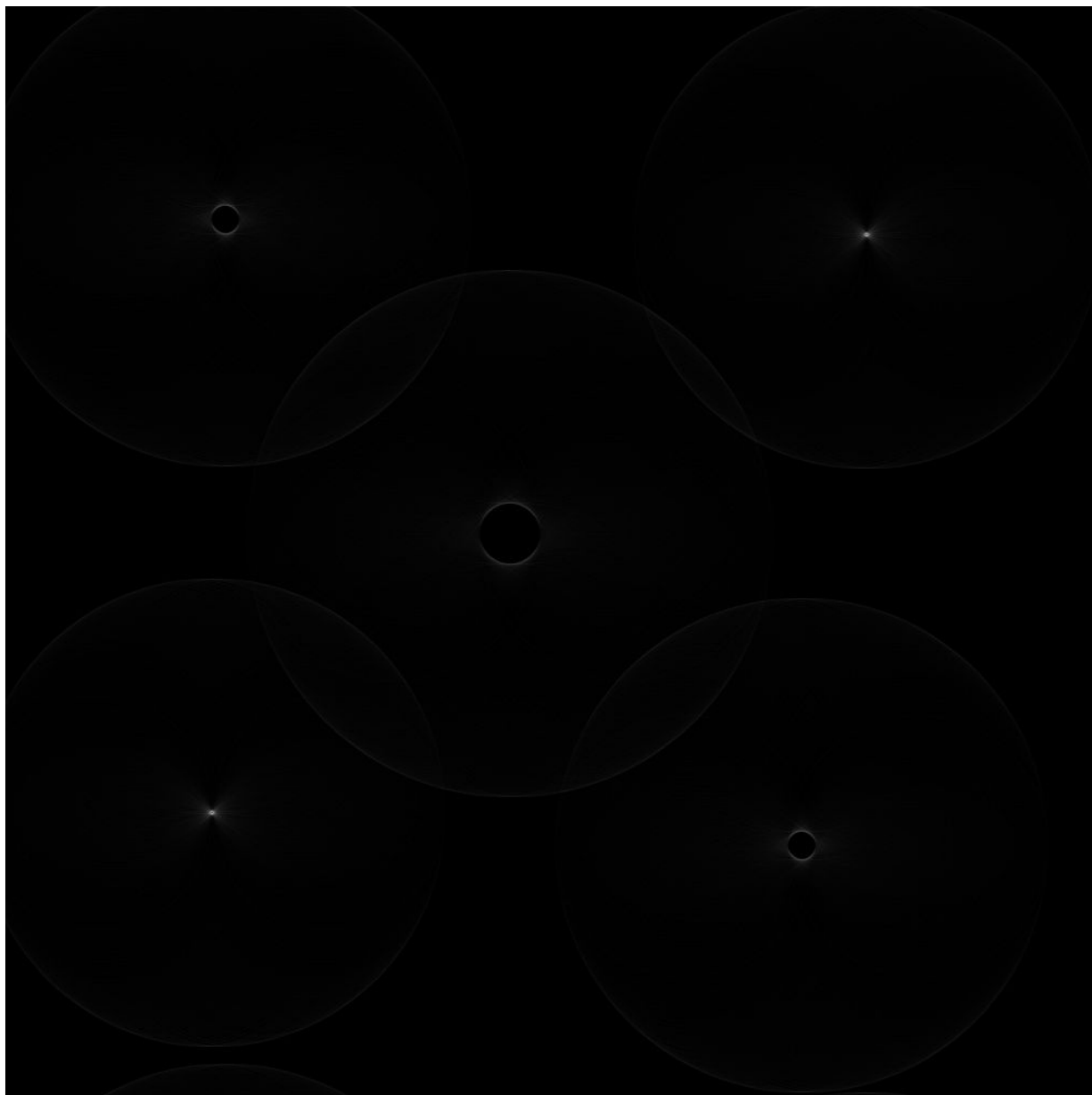
```
coins_1 image has 13 circles
coins_1 image has value: 8.0
coins_2 image has 5 circles
coins_2 image has value: 2.5
coins_3 image has 3 circles
coins_3 image has value: 1.75
coins_4 image has 16 circles
coins_4 image has value: 10.75
coins_5 image has 11 circles
coins_5 image has value: 5.5
coins_6 image has 17 circles
coins_6 image has value: 10.25
coins_7 image has 6 circles
coins_7 image has value: 2.75
coins_8 image has 8 circles
coins_8 image has value: 5.0
```

Hough Transform for the second image before keeping the peaks only:

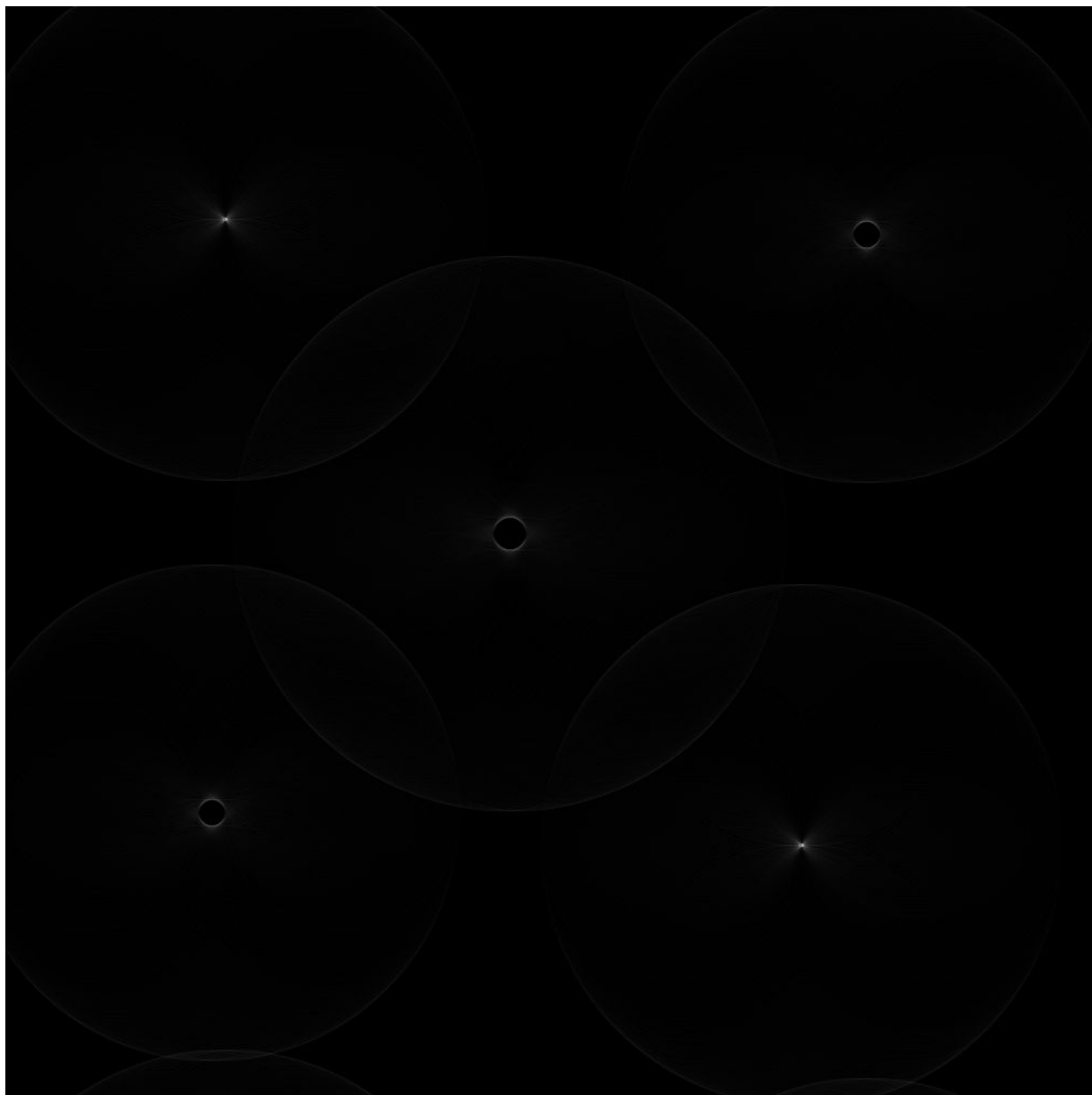




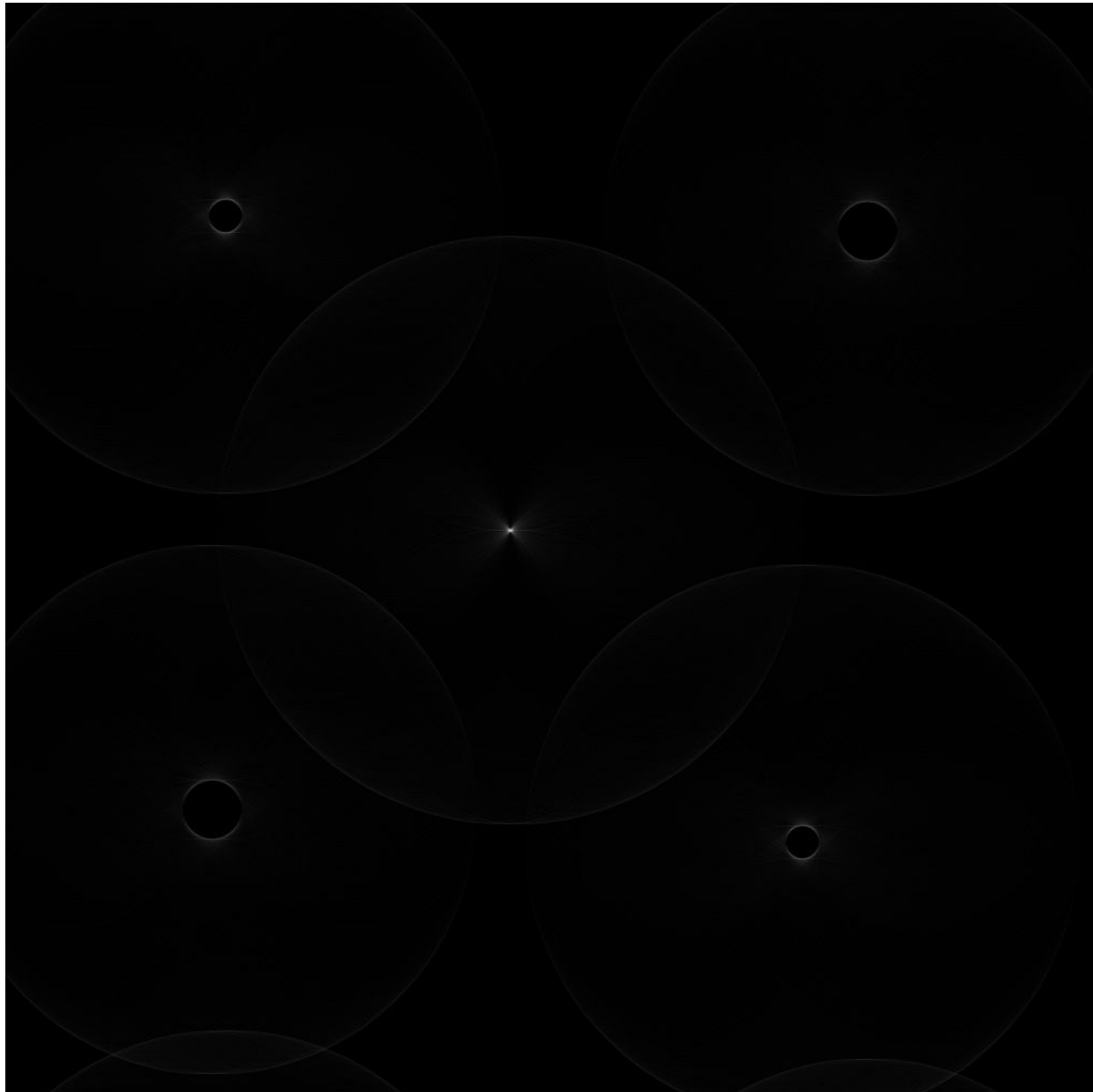




25 piasters



For 50 piasters



For one pound

## CONCLUSION

We observe that for each given radius every coin make circles but only the center of the coins of the given radius are the peaks of the transform and are significantly higher than the others. This shows how Hough Transform is efficient here because even when the unwanted circles vote their vote is always less than the correct votes made by the wanted coins.