

# Visual Recognition Assignment 1 (Part 2)

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## **Abstract**

The aim of this assignment is to implement Hough Transform from scratch and use circle fitting to fit coins in images

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# 1 Introduction

In this assignment, we implement Hough Transform from scratch and use it for circle fitting to detect coins in images. For verifying the implementation, we identify all the coins in the image.

## 2 Image Data



Figure 1: Image showing four coins of different radius placed on a book

## 3 Method

First of all, we apply Canny Edge detector on the images. We pass the image directly to OpenCV's *canny()* function and get all the edges in the image. The output of Canny Edge detector is shown below:



Figure 2: Detected edges in image using Canny Edge Detector

After this, we implement Hough Transform to convert the image space to parameter space. The accumulator array used for this purpose will be 3 dimensional since we don't know the radius of the coins. The  $x$ ,  $y$  and  $z$  axes in parameter space are used for the  $x$  coordinate and  $y$  coordinate of the center of the circle and the radius of the circle.

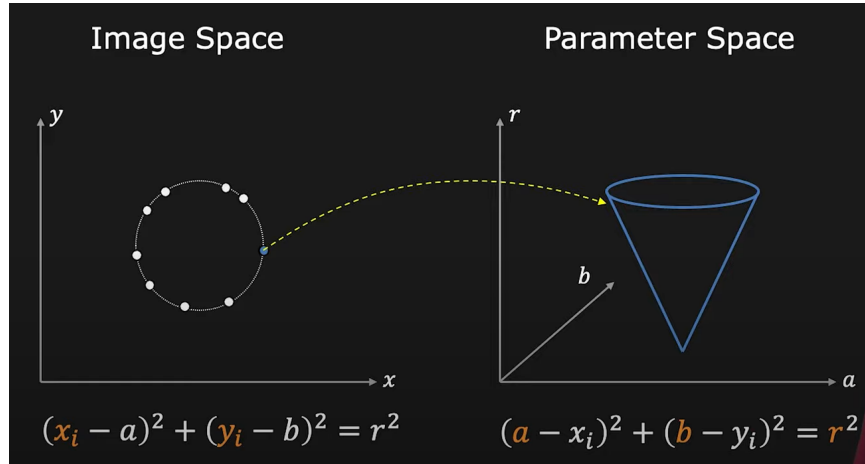


Figure 3: Equation of circle that passes through a point in image space and parameter space

From the accumulator array, we get four pairs of  $a$ ,  $b$  and  $r$ . Each pair contains the coordinates of the center of the circle and the radius of the circle. Since there are four coins, we get four pairs.

We use OpenCV's `circle()` function to fit the circles at the appropriate location in the image.

## 4 Results

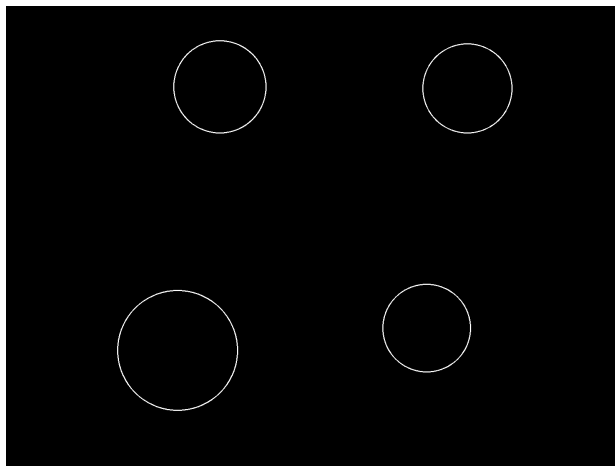


Figure 4: Circles fitted at the location of the coins

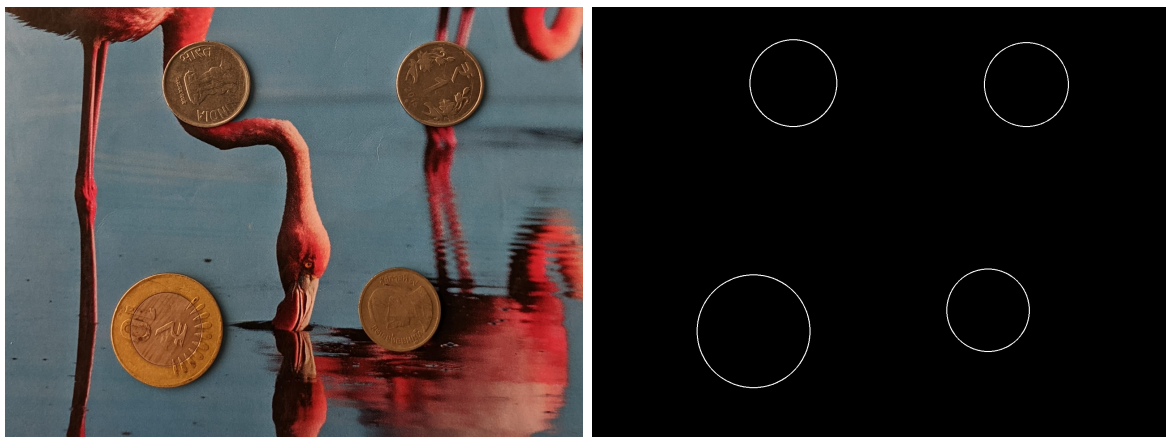


Figure 5: Input and output images

We have successfully detected the coins using Hough transform and used circle fitting to plot the circles. While implementing Hough transform, some things need to be taken care of. The image size should not be too large otherwise the accumulator array will consume a lot of memory leading to RAM crash. Moreover, the time taken for running the notebook increases exponentially with image size.