

**Problem Statement :** To identify coins in the provided images and detect their denominations as well.

**Dataset :** Made by using taking images of around 6-7 coins of 1,2,5,10 Rupees. For Detection part Individual images of each coin is captured under different light and background conditions (conditions in which other images to test were taken) Each image is passed through same preprocessing and cropped and saved in the Benchmark Folder. Crude dataset is also available here [https://drive.google.com/open?id=1hhQAiE\\_hOEUqsJ0L4gC3SDRKWjov4zM1](https://drive.google.com/open?id=1hhQAiE_hOEUqsJ0L4gC3SDRKWjov4zM1) .

**Methodology :** A series of processes have been done to accomplish the desired task which are as follows :

Detection:

- Input image is resized to 0.2 scale of its original.
- To overcome the problem of **Non-Uniform Luminosity** the input image is transformed into LAB colorspace and only the L channel of image (corresponding to Luminosity) is processed with Histogram Equalisation using CLAHE which is a Adaptive Histogram Equalisation method. Again image is merged and changed back BGR.
- **Filtering** BGR is filtered using Mean Shift Filter to suppress the textures of background as well as that are present on the coins. To make it more effective first image is passed through Median Blur filter and image is changed to grayscale.
- **Thresholding** Otsu Thresholding is used to make the mask. But to overcome the problem that **background is relatively light or bright** Decision is made by mean value of pixels.
- Watershed Algorithm is applied instead of Hough Transform as the parameters given as argument were not spanning to the need of problem. After much tweaking I decided to use watershed algorithm following the tutorial by **Adrian** (PyImageSearch) for watershed algorithm.
- As a first step Distance map is generated for threshold image(euclidean distance of foreground from nearest background pixel). Markers used for the watershed are given by 8-connected components. Again as the markers are maxima in distance map before giving it to watershed it has to inverted as it takes it to be minima.
- Watershed return a image with pixel values as labels equal labels forms a region. Contours are then detected on this image. And result is returned.

Recognition :

- I have used SIFT descriptors to calculate similarity between two images but theses all are coins some of the features are always common in them so results which I got were not satisfactory.
- I used the dataset consisting of individual cropped images of the coins. And performed 1 to N matching from the test image to all images in the benchmark dataset.

- I have quantized the similarity on the basis of common features between images and classified on the basis of similarity score.
- For Recognition **only front side of 1 , 2 and 5 Rupees coins are used.**

Observations :

Detection :

Image No.	Actual	Identified	Spurious
1	7	7	0
2	7	6	0
3	6	6	0
4	7	7	0
5	7	7	0
6	7	7	0
7	7	7	2
8	6	5	11
9	7	7	0
10	6	3	7
11	7	6	0
12	7	7	0
13	6	6	0
14	6	6	0
15	7	6	0
16	6	6	0
17	6	1	0
18	6	1	0
19	6	6	1

Below Images are in order :

1.jpg



2.jpg



3.jpg



4.jpg



5.jpg

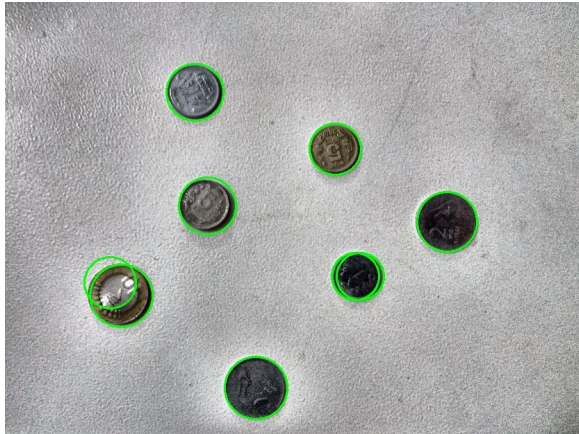


6.jpg





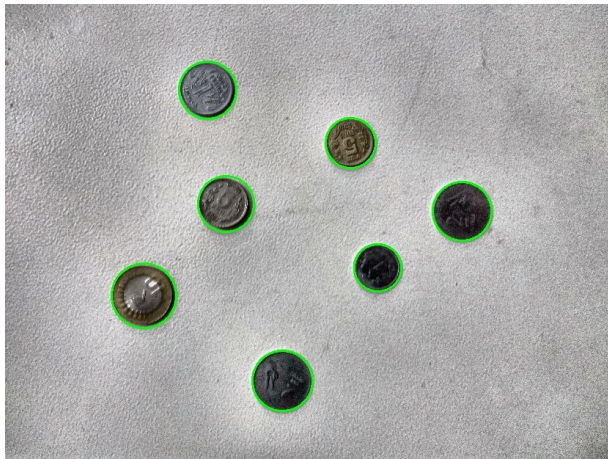
7.jpg



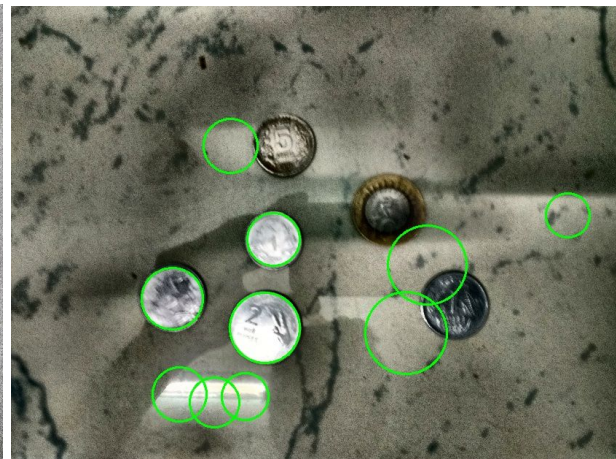
8.jpg



9.jpg



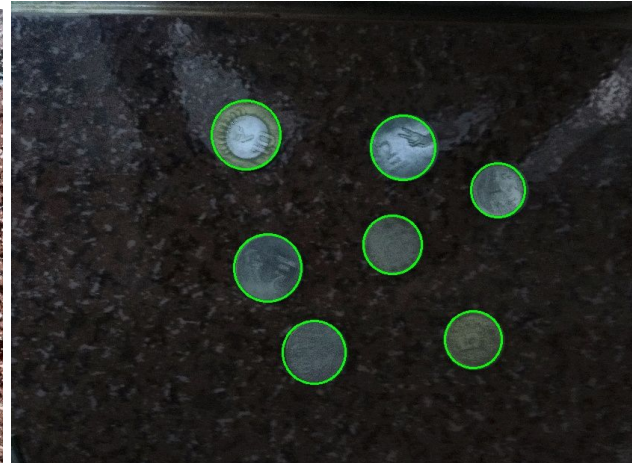
10.jpg



11.jpg

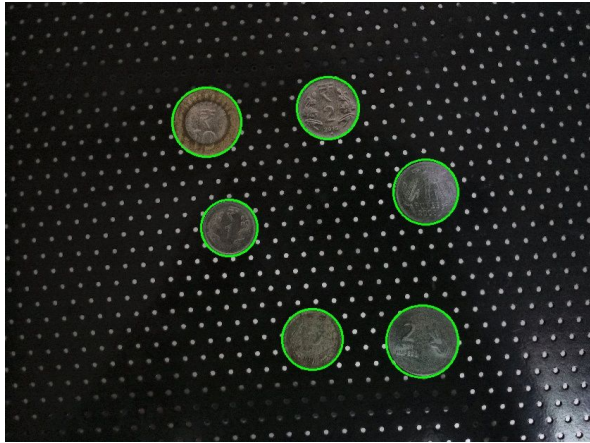


12.jpg





13.jpg



14.jpg



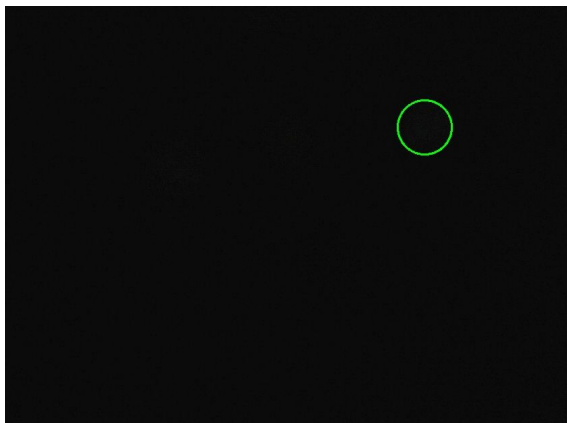
15.jpg



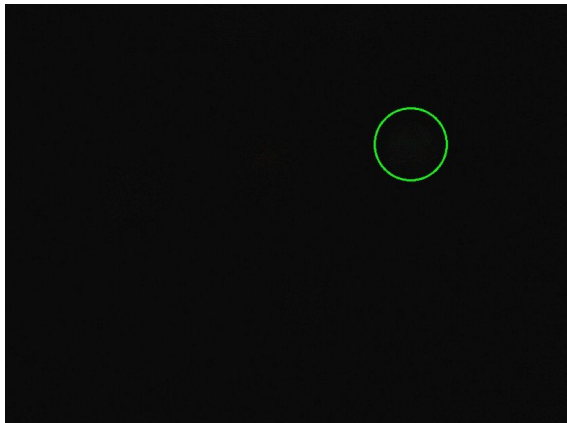
16.jpg



17.jpg



18.jpg



19.jpg



- Images such 8,10,15,17,18 had a lot of deviation from the real answer. Low luminosity in the case 15,17,18 caused the system to not detect the present coins.
- In Contrast Image 11 got one coin missed because of high luminosity on its surface.
- Image 10 failed because of presence of absurd shadow.
- Image 8 failed because of the vertical bands present in the background texture which cause detection of many spurious circles.

Recognition : Below are the results providing the instanced where system got failed and where passed for various coins.

Image No.	1 Rupee		2 Rupees		5 Rupees	
	Correct	Wrong	Correct	Wrong	Correct	Wrong
1	0	2	1	1	2	0
2	1	0	0	2	2	0
3	0	1	0	2	2	0
4	0	2	0	2	2	0
5	1	1	0	2	1	0
6	2	0	0	2	1	1
7	1	2	0	2	2	0
8	0	2	0	1	1	0
9	0	2	1	1	2	0
10	1	0	0	1	0	0
11	1	0	1	1	1	1
12	1	1	0	2	1	1
13	0	2	0	1	1	0

14	1	1	1	1	1	0
15	NA	NA	NA	NA	NA	NA
16	2	0	0	2	1	1
17	NA	NA	NA	NA	NA	NA
18	NA	NA	NA	NA	NA	NA
19	1	1	0	2	1	0

- 5 Rupees coins were best classified followed by 1 and the 2. It was because of good number of SIFT descriptors in 5 rupees coin and also because of resemblance of 2 rupees coin and 5 rupees coin.

#### **Extension:**

To replace the existing mechanism of recognition and use of Bag of Visual words and SIFT features.