

# Computer Vision Tasks

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This repository is created by

In this Repository we present a variety of Image processing Techniques implemented from scratch using `Python` programming language with Numpy and Pure Python. Each Category of Algorithms is presented in its tab in the UI which we will discover next.

Our UI present a tab for each category of the implemented algorithms. We first load our image and apply the selected algorithm.

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# 1. Image Processing

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## 1.1 Adding Noise To an Image

We implemented 3 types of noise: **Uniform**, **Gaussian** and **Salt & Pepper** Noise.

### Implementations Added:

1. Noise Functions (Simulation of Different Noise Types): Uniform, Gaussian and Salt & Pepper.
2. Edge Detection Techniques: Prewitt, Sobel and Roberts.
3. Image Histogram Equalization and Normalization.
4. Local and Global Thresholding
5. Transformation to Gray Scale
6. Frequency Domain Filters: Low Pass and High Pass Filters

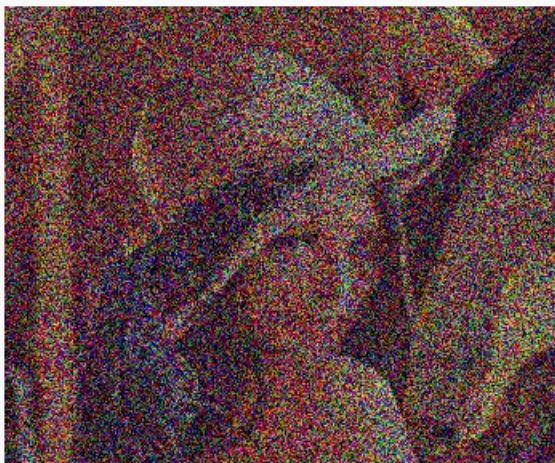
In addition to histogram and distribution curve drawing for the loaded image and the option to mix 2 input images.

### Results:

#### 1. Noise Addition:

##### 1.1 Uniform Noise

Noisy Image



##### 1.2 Gaussian Noise

Noisy Image



### 1.3 Salt & Pepper Noise

Noisy Image



## 2. Noise Filtration:

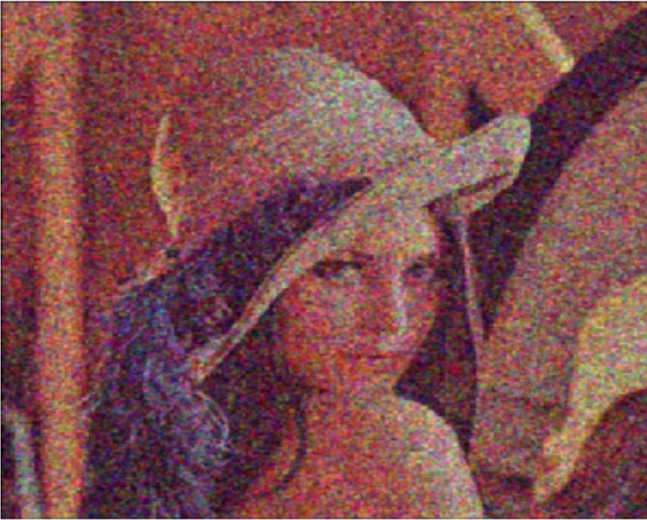
### 2.1 Average Filter (Applied on Gaussian Noise)

Filtered Image



## 2.2 Gaussian Filter (Applied on Gaussian Noise)

Filtered Image



## 2.3. Median Filter (Applied on a Salt & Pepper Noisy Image)



Filtered Image



### 3. Edge Detection Techniques:

#### 3.1 Sobel

Edge Detection Image



#### 3.2 Prewitt

Edge Detection Image



### 3.3 Roberts

Edge Detection Image



### 3.4 Canny

Filters

Histograms

Hybrid

Hough

Active Contour

Load Image

Name: Bikesgray.jpg

Size: 640x480

Add Noise

SNR

0 0.5 1.0

Sigma

0 128 255

Apply Filter

Mask Size

3x3 5x5 7x7 9x9

Sigma

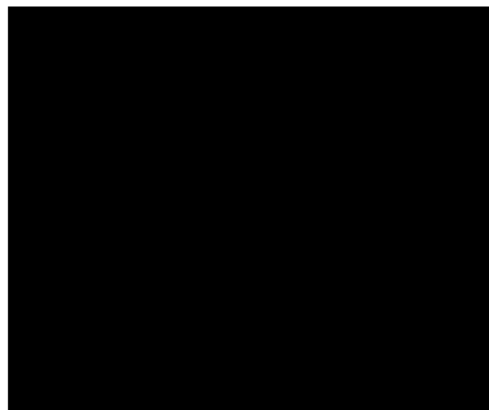
0 128 255

Canny Mask

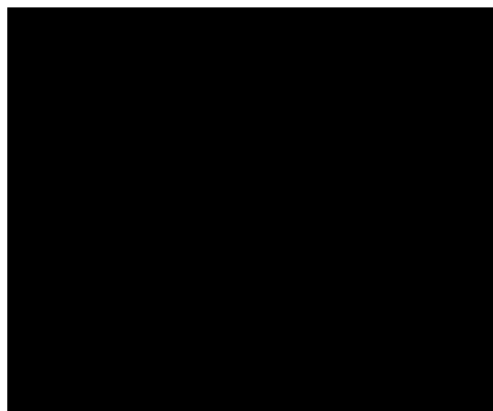
Input Image



Filtered Image

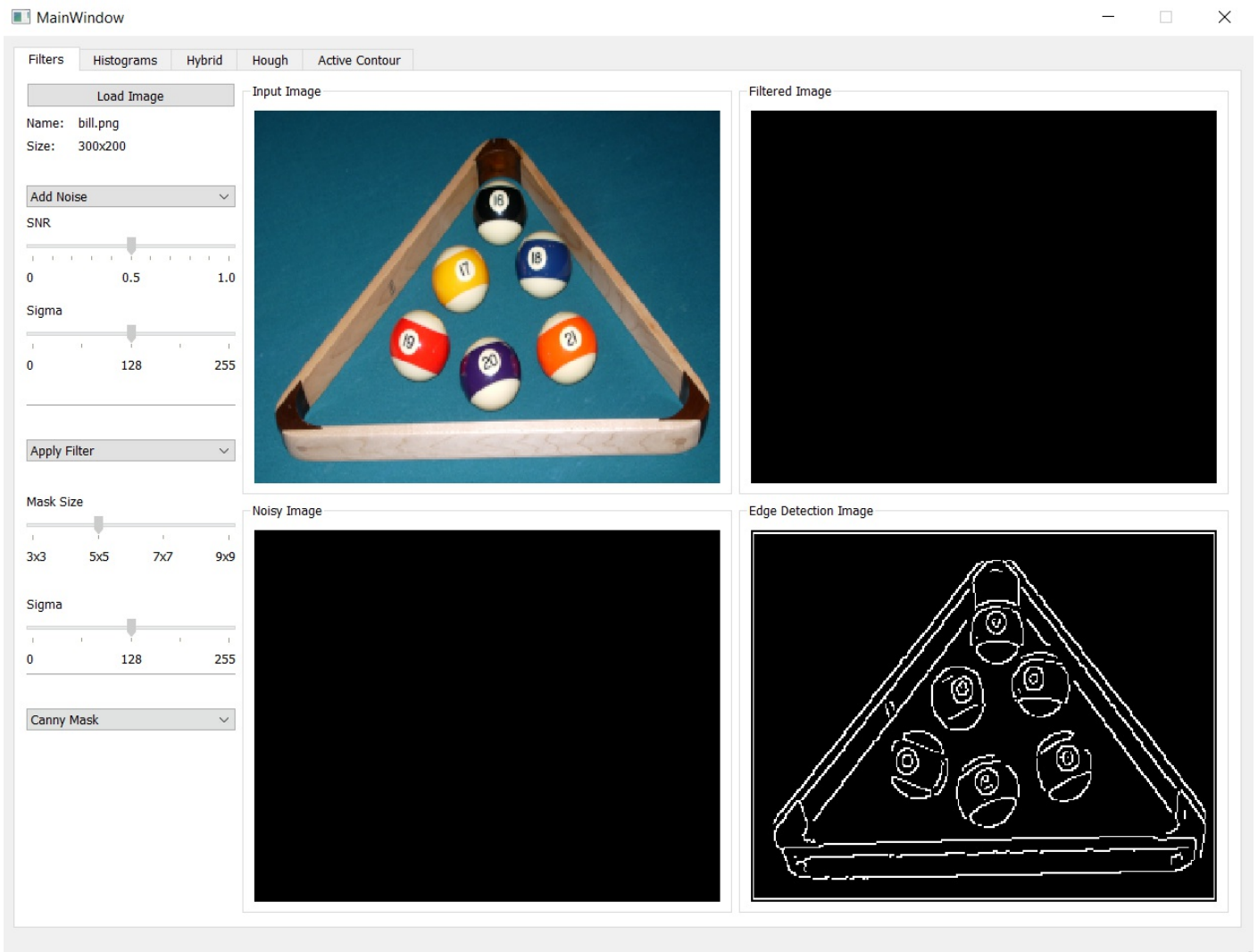


Noisy Image



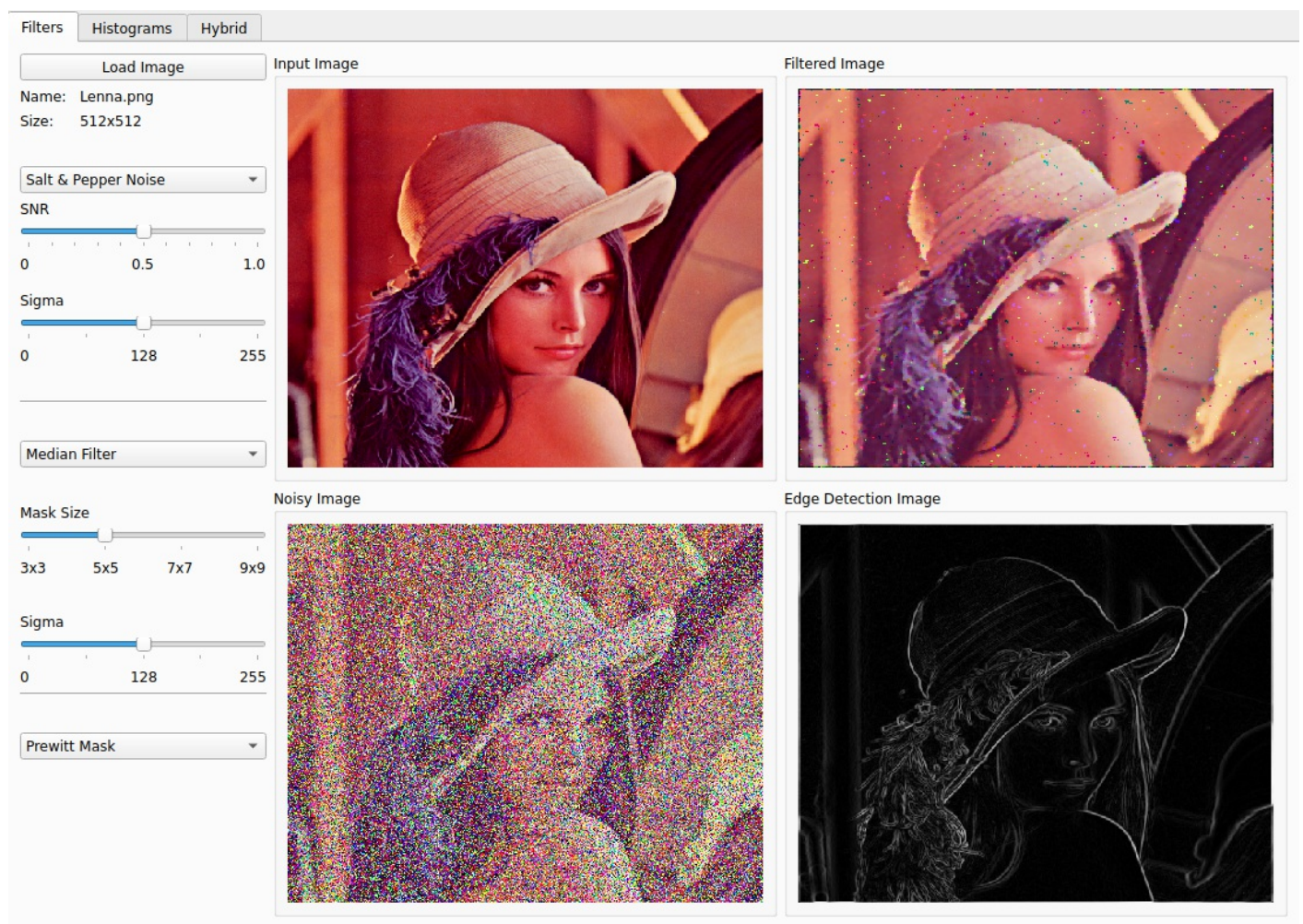
Edge Detection Image





You can apply different SNR ratios and choose the Sigma of Each Algorithm implemented from the sliders added on the left, each cell is marked with its contents and the application of the change in the sliders is instant.





#### 4. Histogram Equalization with input and output histograms

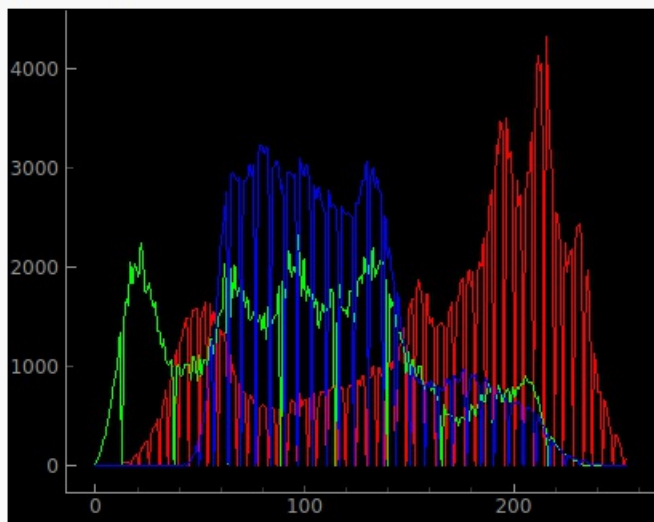
Input Image



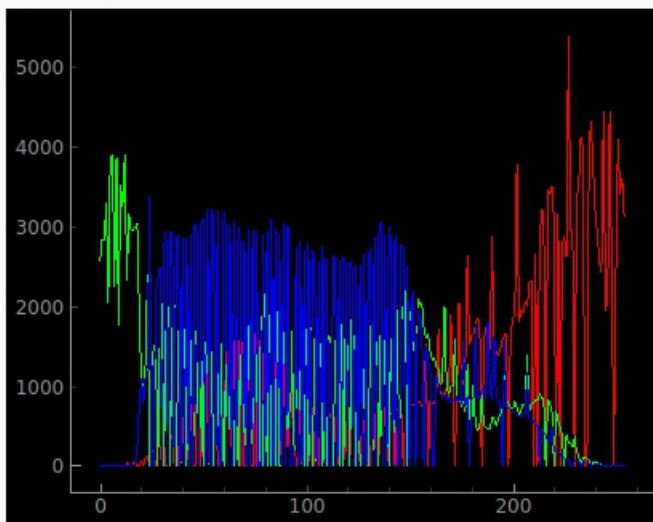
Output Image



Original Histogram



Output Histogram



## 5. Local and Global Thresholding

Output Image





Output Image



## 6. Gray Scale Transformation

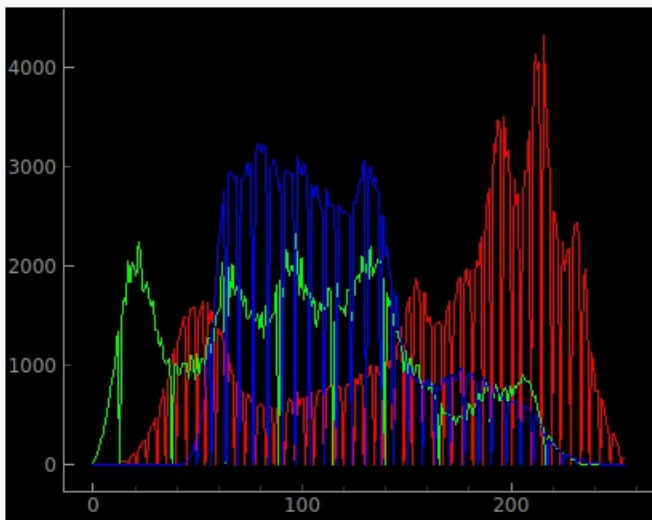
Input Image



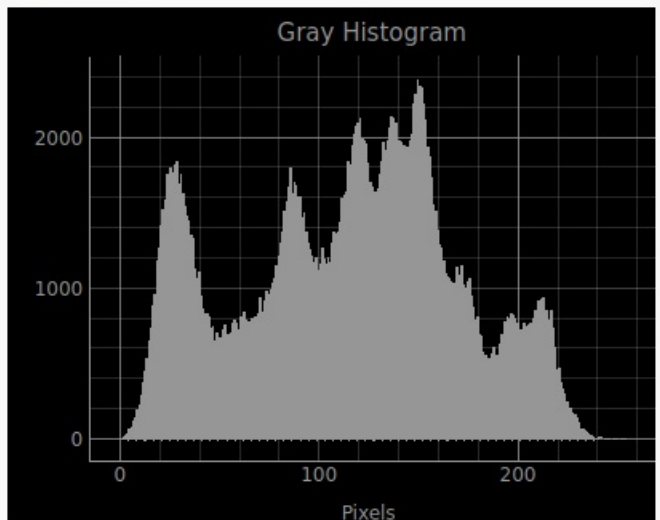
Output Image



Original Histogram



Output Histogram



## 7. Frequency Domain Mixing

Input Image A



Input Image B



Output Image



# Edge and Boundary Detection

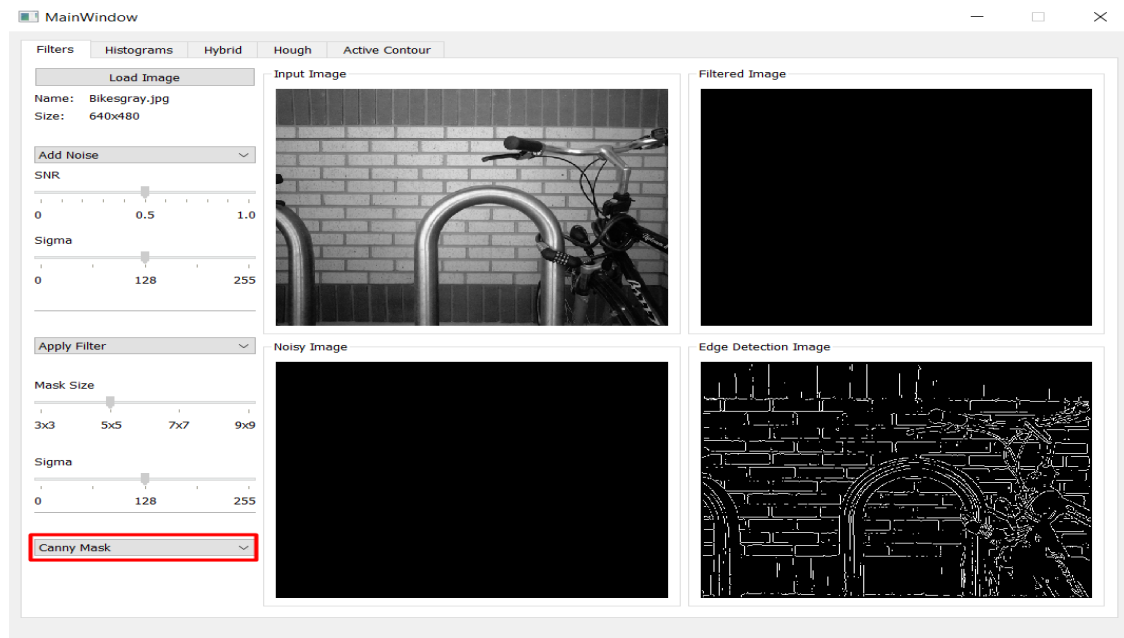
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1. Edge Detection Using Canny Mask
2. Hough Transformation (Lines and Circles Detection)
3. Active Contour Model (Snake)

## Edge Detection Using Canny Edge Detector

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images.





Load Image

Name: bill.png

Size: 300x200

Add Noise

SNR

0 0.5 1.0

Sigma

0 128 255

Apply Filter

Mask Size

3x3 5x5 7x7 9x9

Sigma

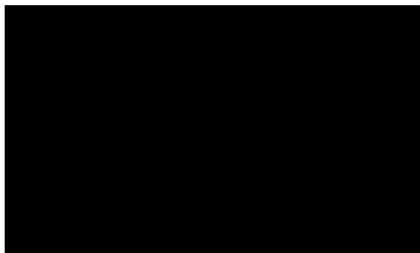
0 128 255

Canny Mask

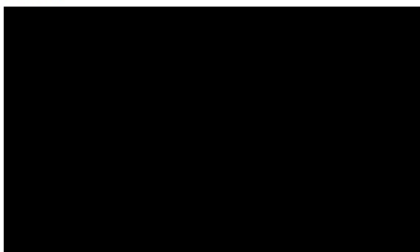
Input Image



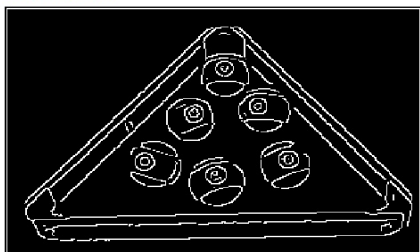
Filtered Image



Noisy Image



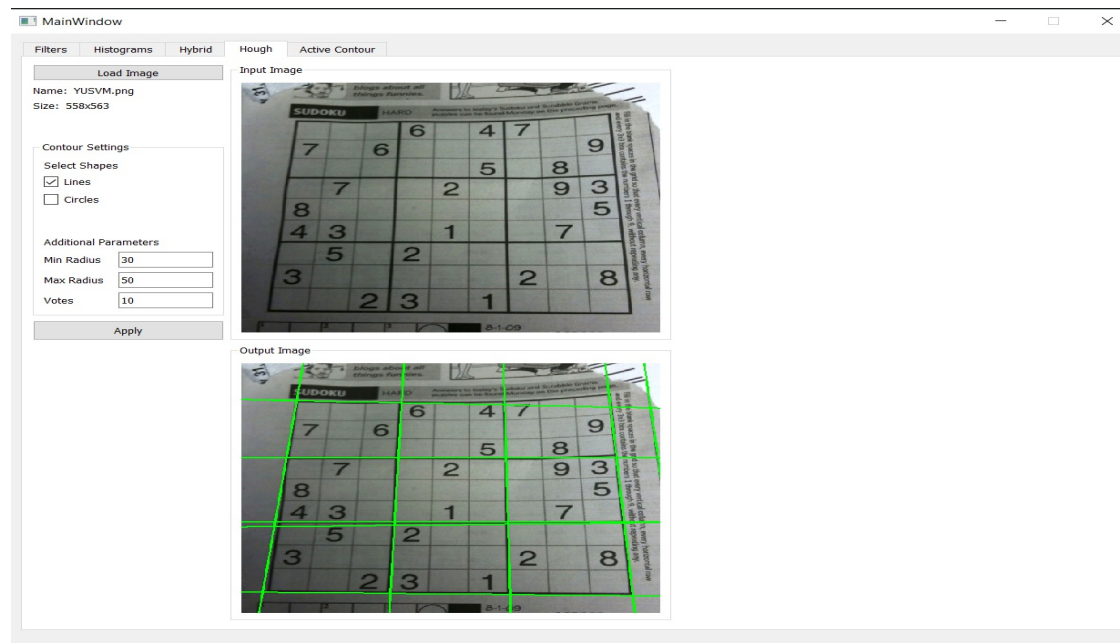
Edge Detection Image



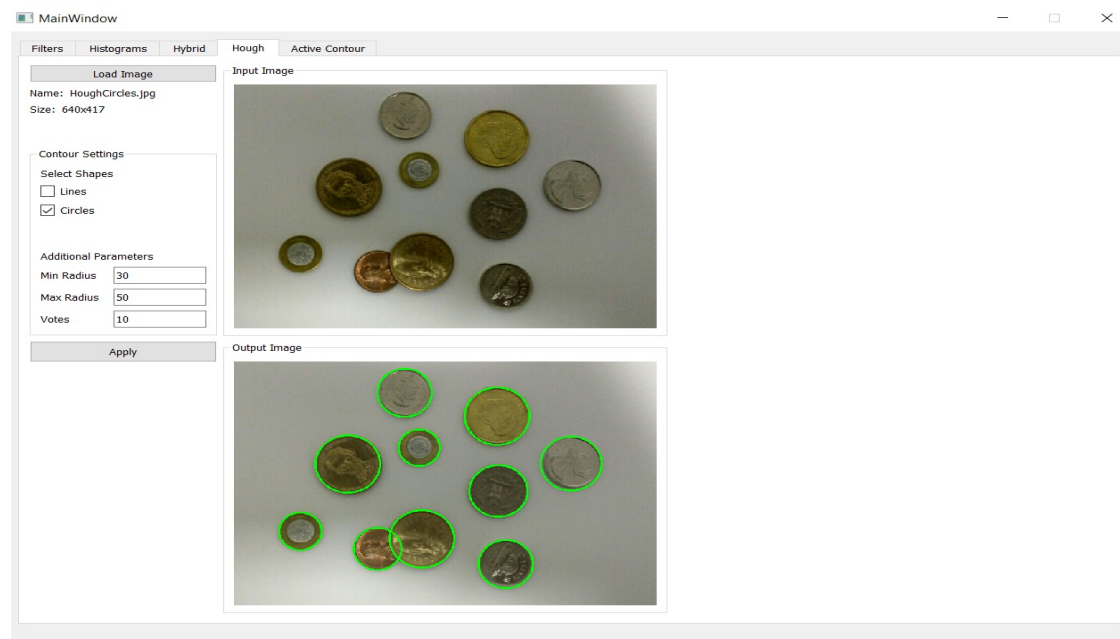
# Hough Transformation

The Hough transform is a technique that locates shapes in images. In particular, it has been used to extract lines, circles and ellipses if you can represent that shape in mathematical form.

## Line Detection



## Circles Detection

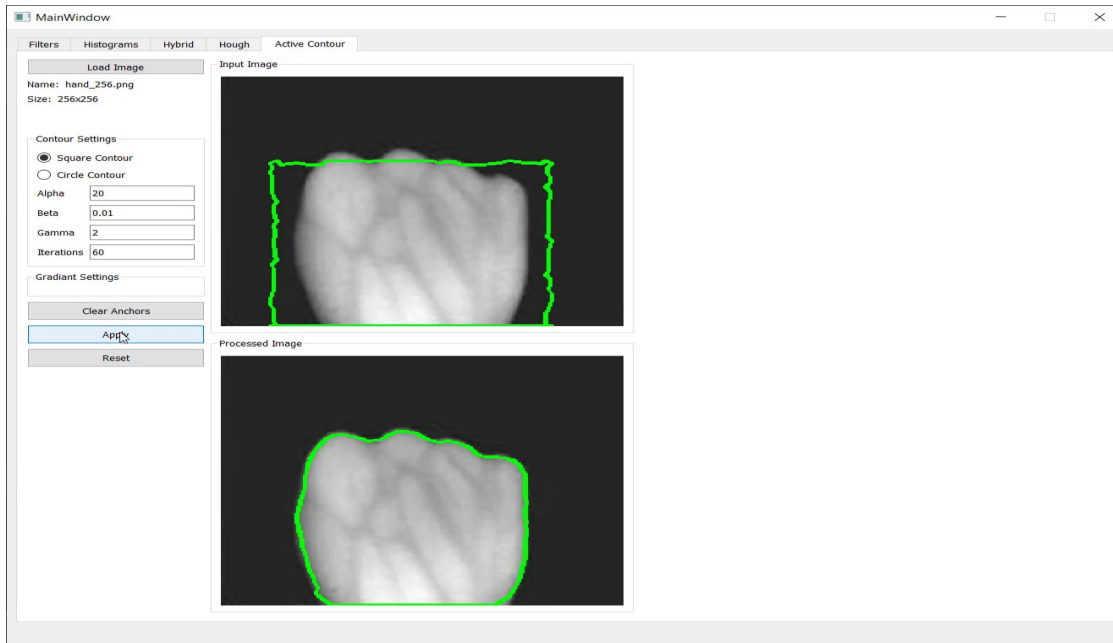


## Active Contour Model (Using Greedy Algorithm)

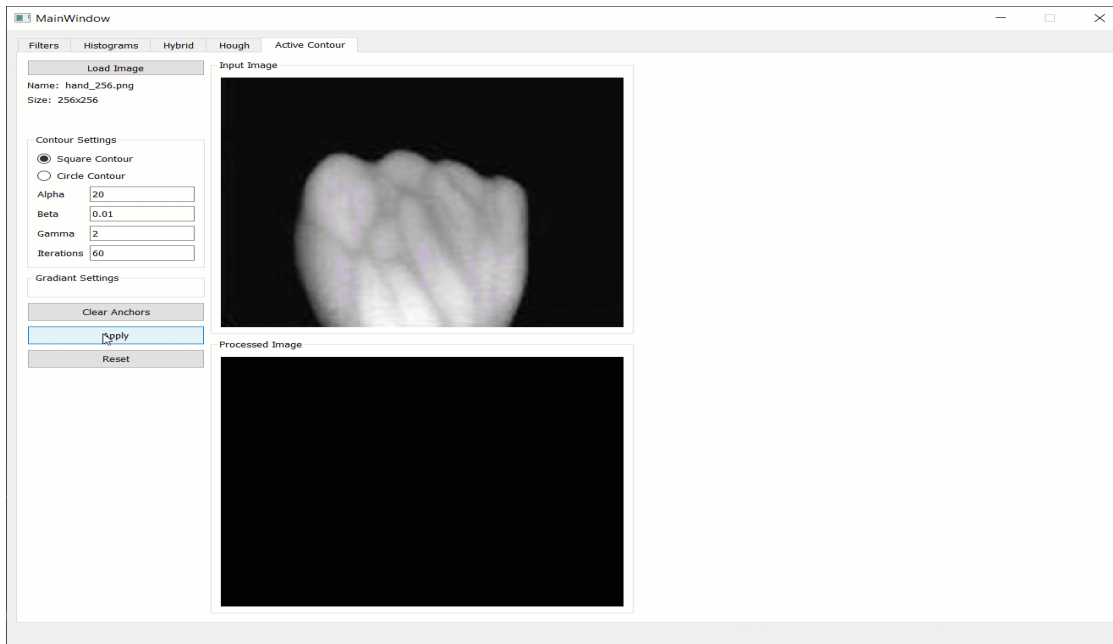
Active contour is one of the active models in segmentation techniques, which makes use of the energy constraints and forces in the image for separation of region of interest.

Active contour defines a separate boundary or curvature for the regions of target object for segmentation.

### Result of applying the algorithm on hand image



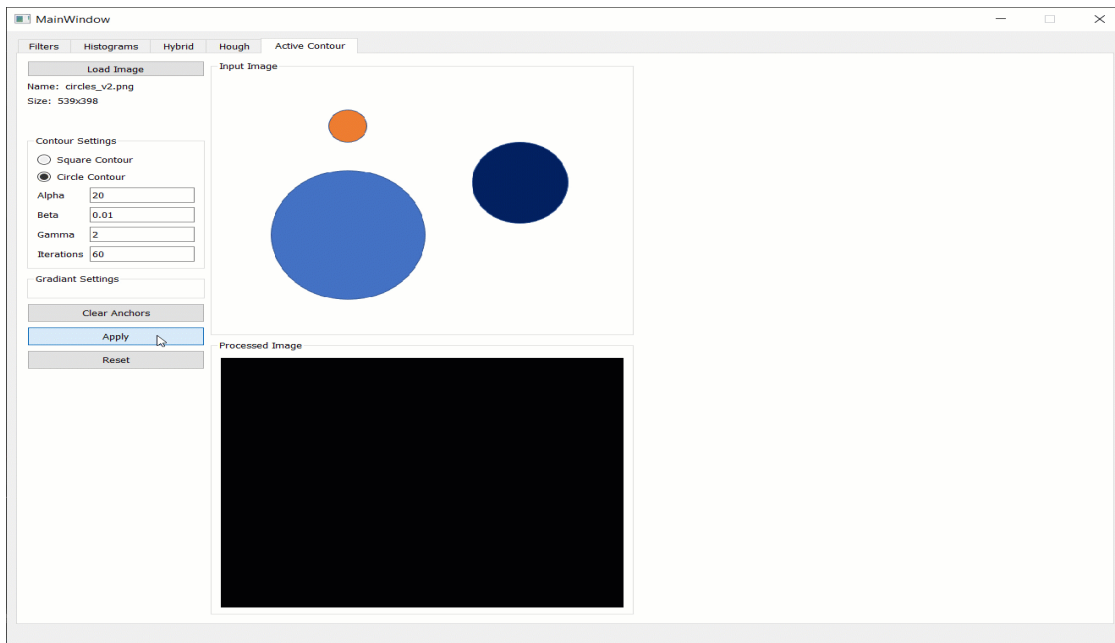
This GIF shows the process in a better way



## Result of applying the algorithm on hand image



## This GIF shows the process in a better way



# Features Detection and Image Matching

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## Table of content

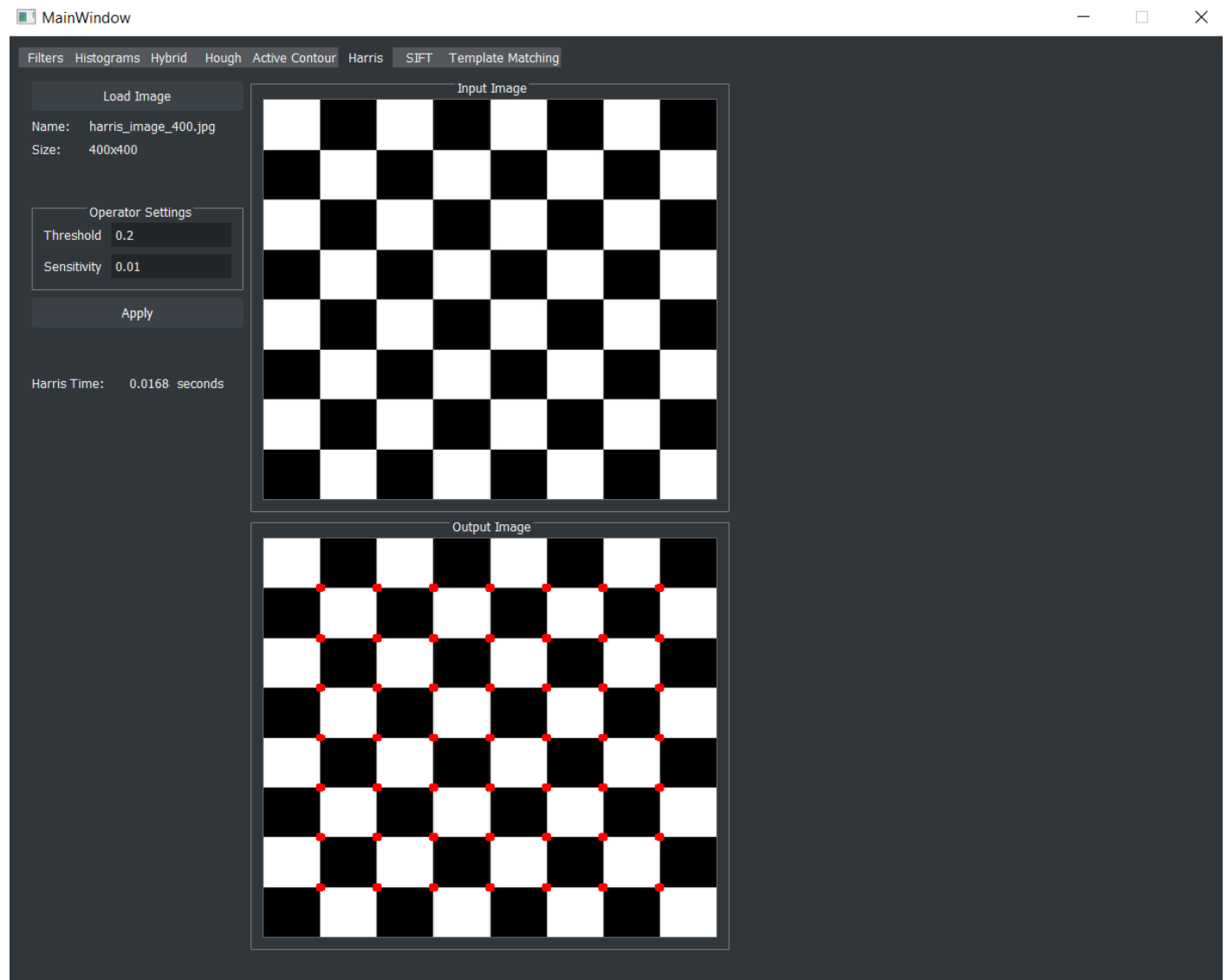
1. Extract the unique features in all images using Harris operator
2. Generate feature descriptors using scale invariant features (SIFT)
3. Match the image set features using sum of squared differences (SSD) and normalized cross correlations



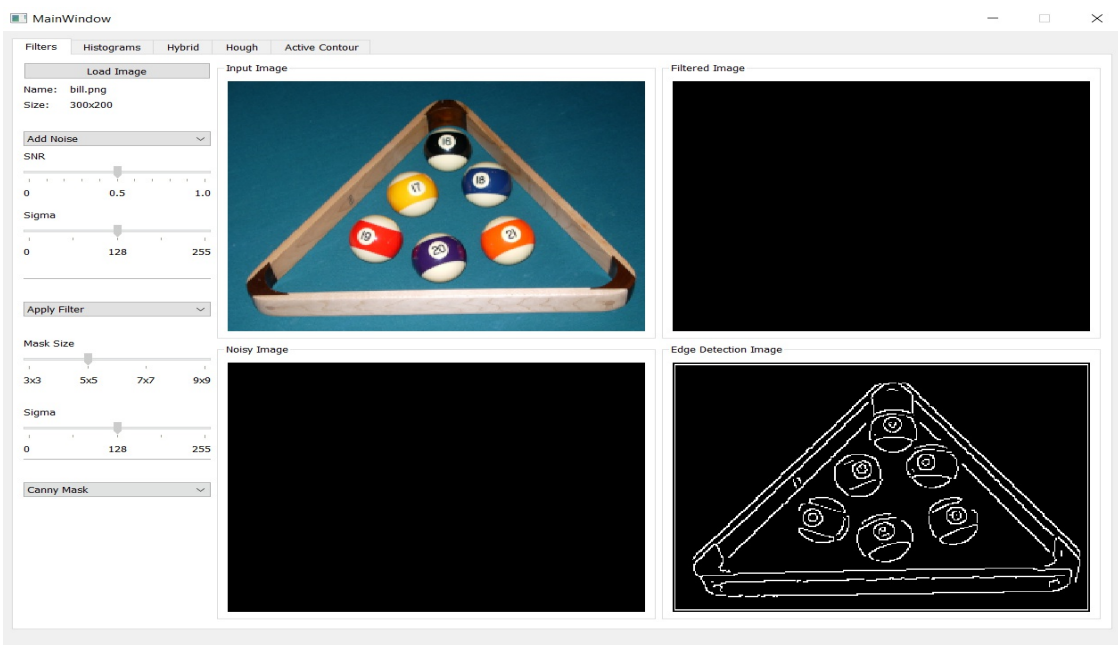
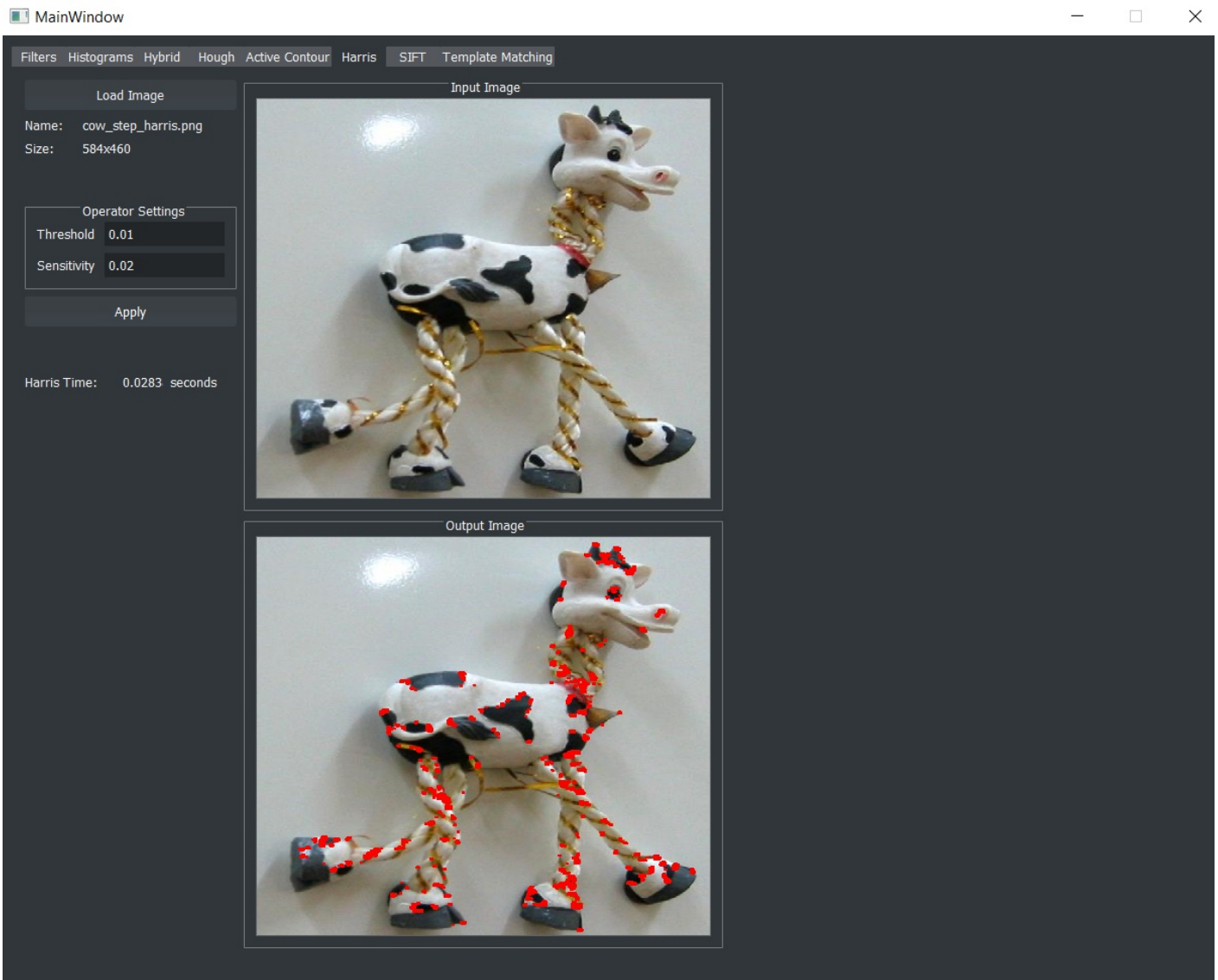
Each Algorithm Applied was thrown onto a thread for faster better experience

## Extract the unique features in all images using Harris operator

Applying a threshold 0.2 it only took about 0.01 second to detect all Image Corners



We also applied the harris operator on a harder image with the same threshold this time it only took 0.02 seconds



## Using Sift Descriptors and Harris Operator to Match the image set features

Using Harris Operator to Detect Image Key Points and Applying the SIFT Algorithm to Generate each Feature Descriptor, Applying Two Matching Algorithms SSD And NCC

using sum of squared differences (SSD)

☐

Using Normalized Cross Correlations (NCC)

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