# Virtual Reality Assignment 1: Coin Detection and Panorama Creation

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## 1. Introduction

This project focuses on two key computer vision tasks:

- Coin Detection and Segmentation: Identifying and isolating coins from images using edge detection and contour analysis.

- Panorama Creation: Stitching multiple overlapping images into a single panoramic image using feature detection and homography.

The project demonstrates the application of fundamental computer vision techniques, including image preprocessing, feature detection, and geometric transformations.

## 2. Coin Detection and Segmentation

Mutliple tests were done in coin\_detection\_tests.ipynb to figure out which method works best for the images chosen on the dataset

And the final best method was put in coin\_detection.ipynb, so that output and flow of work looks clean.

## 2.1 Image Preprocessing

The input image is first converted to grayscale to simplify processing.

Inverted grayscale was also tried, but good results could not be seen.

Gaussian blur is then applied to reduce noise and smooth the image, which helps in improving the accuracy of edge detection.

Gaussian kernel which gave best results in coin\_detection\_tests.ipynb was used in coin\_detection.ipynb for results

## 2.2 Edge Detection

The Canny edge detection algorithm is used to identify the boundaries of objects in the image.

This algorithm works by detecting sharp changes in intensity, which typically correspond to edges.

The edges of coins are clearly highlighted using this method.

Marr-Hildreth was also used for trying out a different method, but no good results were seen.

## 2.3 Contour Detection

After edge detection, contours are identified in the image.

Contours are continuous curves that represent the boundaries of objects.

The algorithm filters out small or irrelevant contours by checking their area, ensuring that only significant objects (like coins) are considered.

## 2.4 Visualization

The detected contours are drawn on the original image to visualize the results.

Each coin is outlined with a bounding box, and the total number of detected coins is displayed.

This step provides a clear and intuitive representation of the algorithm's output.

## 3. Panorama Creation

In previous commits, which can be seen on the repository, ORB and homographic estimation was used to stitch images, however they did not yield any accurate result, as whenever more than 2 images were being stitched together, only 2 would be visible in the output, and the other images would not influence the stitched output.  
Attempt was made to fix the issue, but to no avail

So, now there is only one file, image\_stitching.ipynb, that only implements SIFT to detect keypoints, and then stitches images.

## 3.1 Feature Detection

The Scale-Invariant Feature Transform (SIFT) algorithm is used to detect keypoints and compute descriptors for each image.

SIFT is robust to changes in scale, rotation, and lighting, making it ideal for identifying matching features across images.

## 3.2 Feature Matching

Keypoints between images are matched using a FLANN-based matcher.

This matcher efficiently finds the best correspondences between keypoints.

A ratio test is applied to filter out poor matches, ensuring that only reliable matches are used for further processing.

## 3.3 Homography Estimation

A homography matrix is computed to align the images.

This matrix represents the geometric transformation required to map one image onto another.

The RANSAC algorithm is used to estimate the homography robustly, even in the presence of outliers.

## 3.4 Image Warping and Blending

The second image is warped using the computed homography matrix to align it with the first image.

The warped image is then blended with the first image to create a seamless panorama.

This step ensures that the transition between images is smooth and visually appealing.

## 4. Results and Observations

## 4.1 Coin Detection

The algorithm successfully detected and segmented coins in all test images.

Contour filtering ensured that only circular objects (coins) were detected.

The results were robust even in images with varying lighting conditions and backgrounds.

## 4.2 Panorama Creation

The stitching algorithm effectively combined three images per panorama.

Feature matching and homography estimation ensured accurate alignment.

The results were mostly seamless, with one image showing a seam due to different intensity of sunlight. However, there is warping of the images at the edges.

## 5. Conclusion

This project successfully demonstrates the application of computer vision techniques for coin detection and panorama creation.

The methods used are robust and produce high-quality results.

Future improvements could include:

- Enhancing coin detection for overlapping coins.

- Improving panorama blending for better visual quality.

- Fixing warping at the edges of the images in panoramas.