Experiment-9

Morphological Image Processing

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Aim: To perform image morphing (erosion and dilation) along with watershed algorithm implementation in python.

Resources Used: Anaconda Python Environment

Google Collab Jupyter Notebook

Theory :

OpenCV stands as an open-source library designed for computer vision and machine learning applications. Its primary goal is to offer a unified foundation for computer vision projects and to facilitate the integration of machine perception into various commercial products.

On the other hand, NumPy serves as a Python library, enabling support for large, multi-dimensional arrays and matrices, accompanied by an extensive array of high-level mathematical functions for manipulating these arrays.

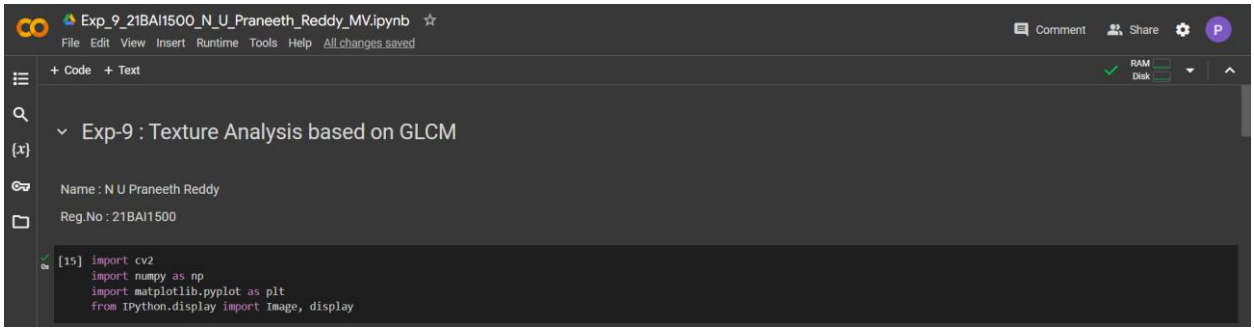
Additionally, Matplotlib functions as a Python plotting library, directly connected to the numerical mathematics capabilities of NumPy. It delivers an object-oriented API for seamlessly embedding plots within applications.

Tasks:

1) Perform morphological erosion and dilation operation of an input image and observe the output. Use different structuring element and compare the morphological output.
2) Perform segmentation of the COIN image using watershed algorithm. Prepare the input image suitable for watershed algorithm to work namely
    a. conversion to binary
    b. performing morphological operations to remove noises
    c. determine the markers for initializing the seed point for the image. Finally display the segmented output namely coins in different colors.

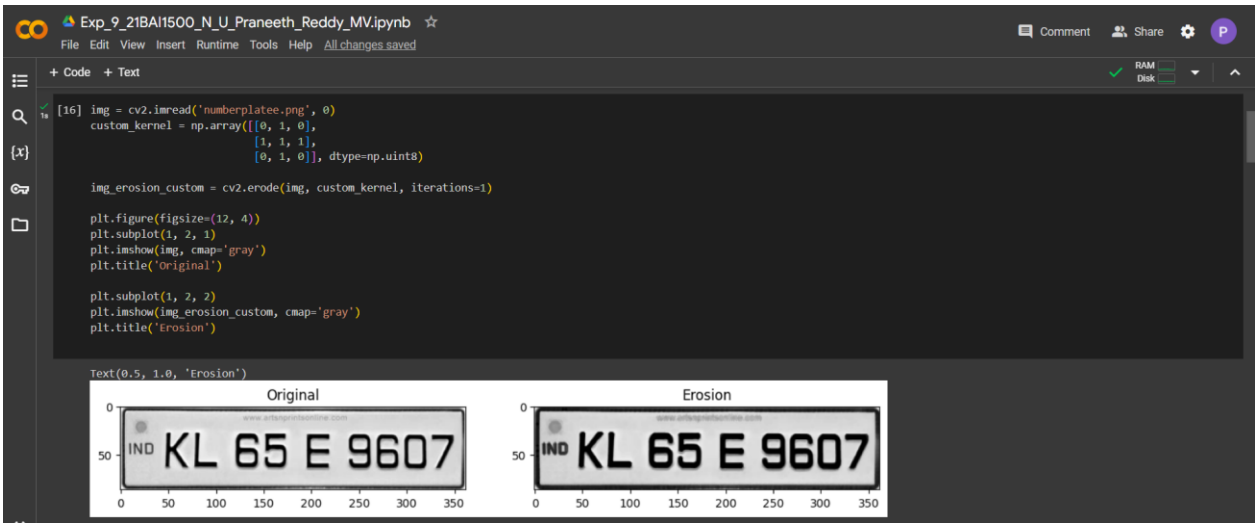
Procedure :

- Open Google Collab and create a new Jupyter Notebook.
- Import important libraries namely OpenCV, Numpy and Matplotlib.



Task 1: Perform morphological erosion and dilation operation of an input image and observe the output. Use different structuring element and compare the morphological output.

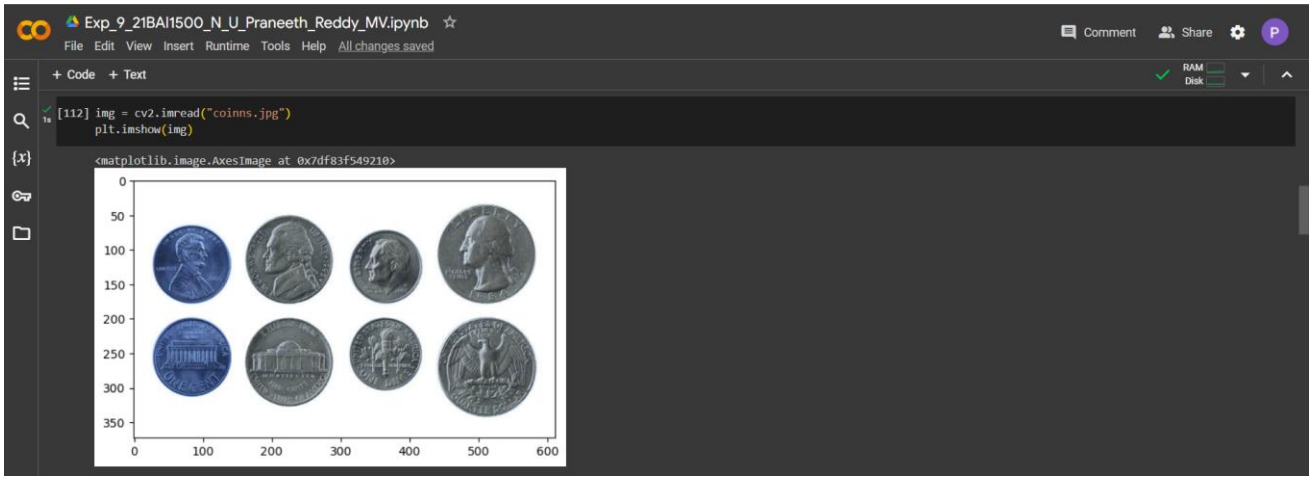
- Define a custom kernel for erosion and dilation operations then perform erosion and dilation on the grayscale image using the custom kernel and display the results of erosion and dilation.



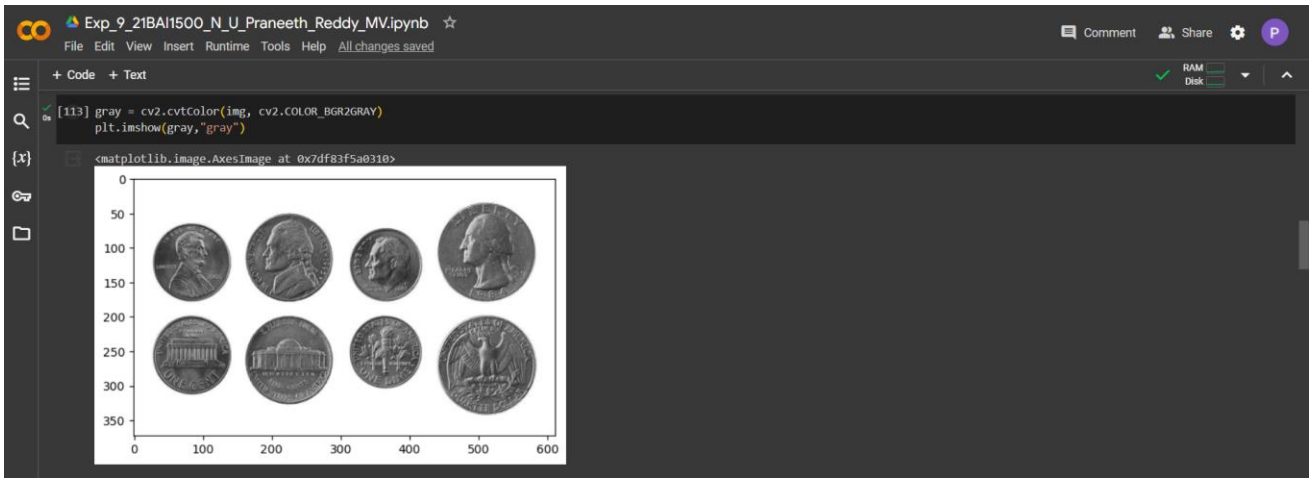
Task-2: Perform segmentation of the COIN image using watershed algorithm. Prepare the input image suitable for watershed algorithm to work namely

a. conversion to binary
b. performing morphological operations to remove noises
c. determine the markers for initializing the seed point for the image. Finally display the segmented output namely coins in different colors.

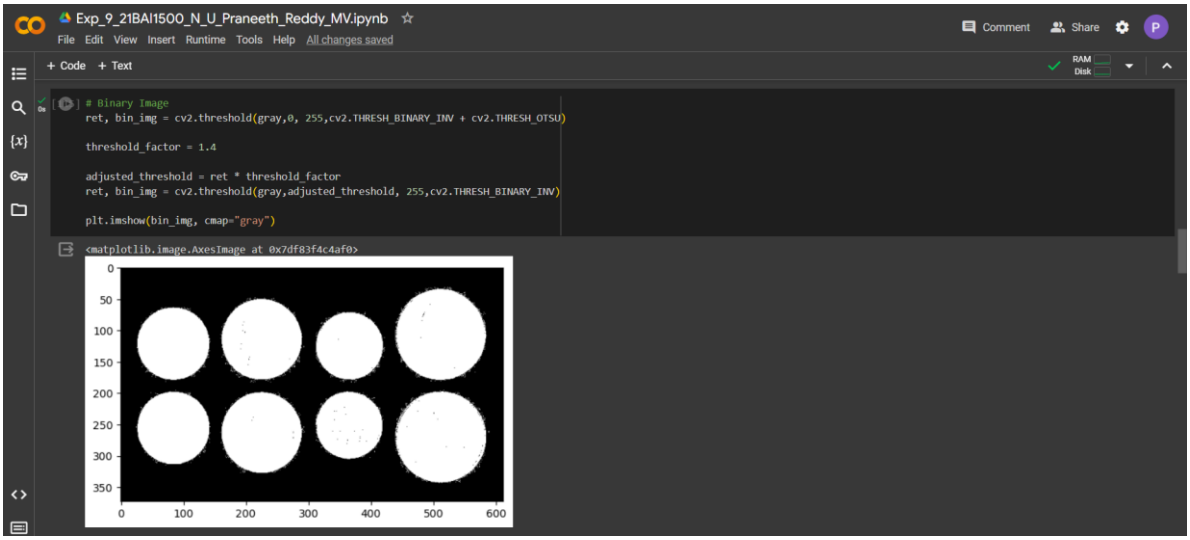
- Read the image of coins.



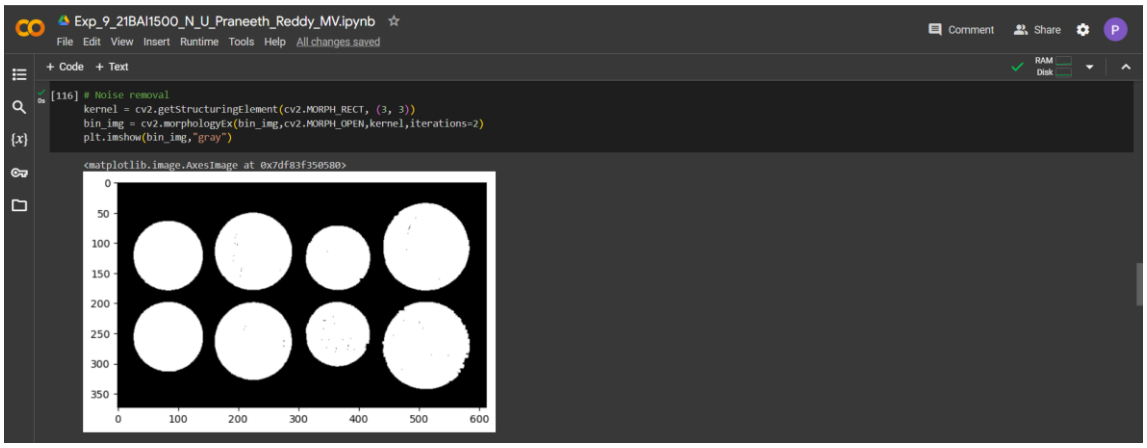
- Convert the image to grayscale.



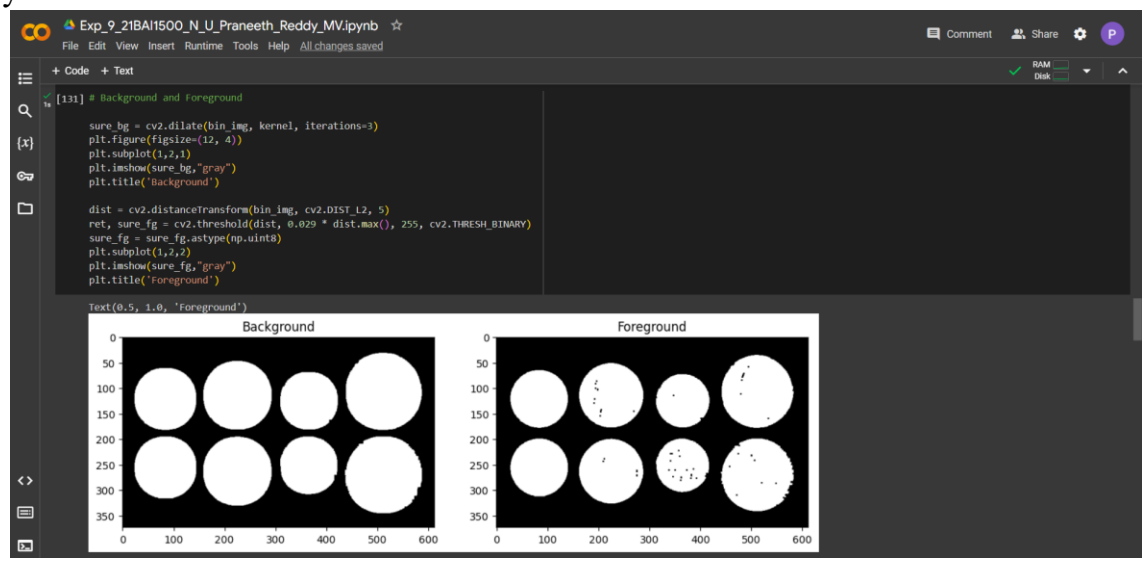
a. Apply thresholding to create a binary image.



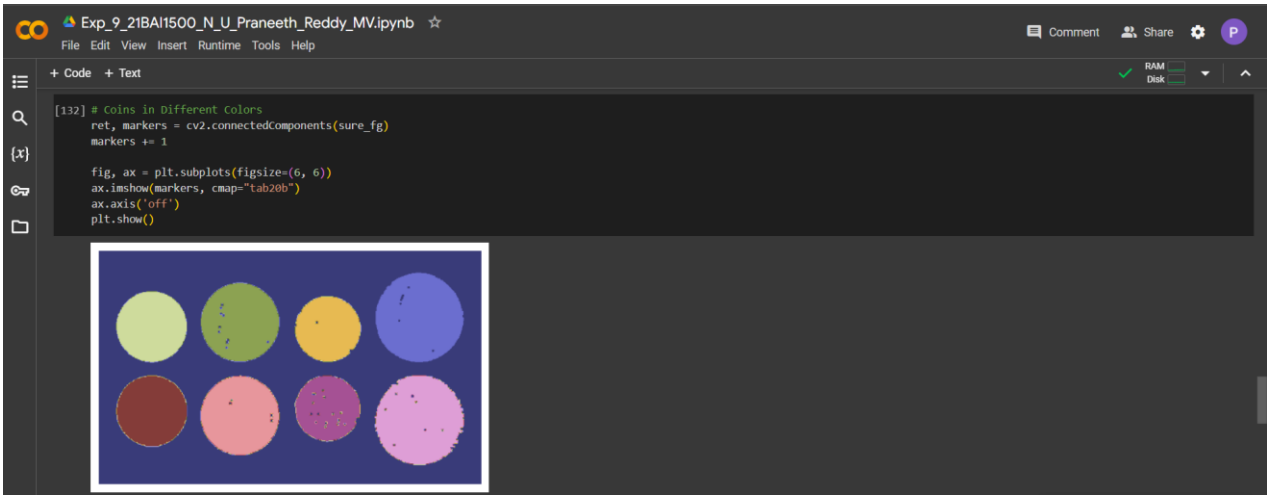
b. Perform morphological opening to remove noise from the binary image. Noise Removed binary image



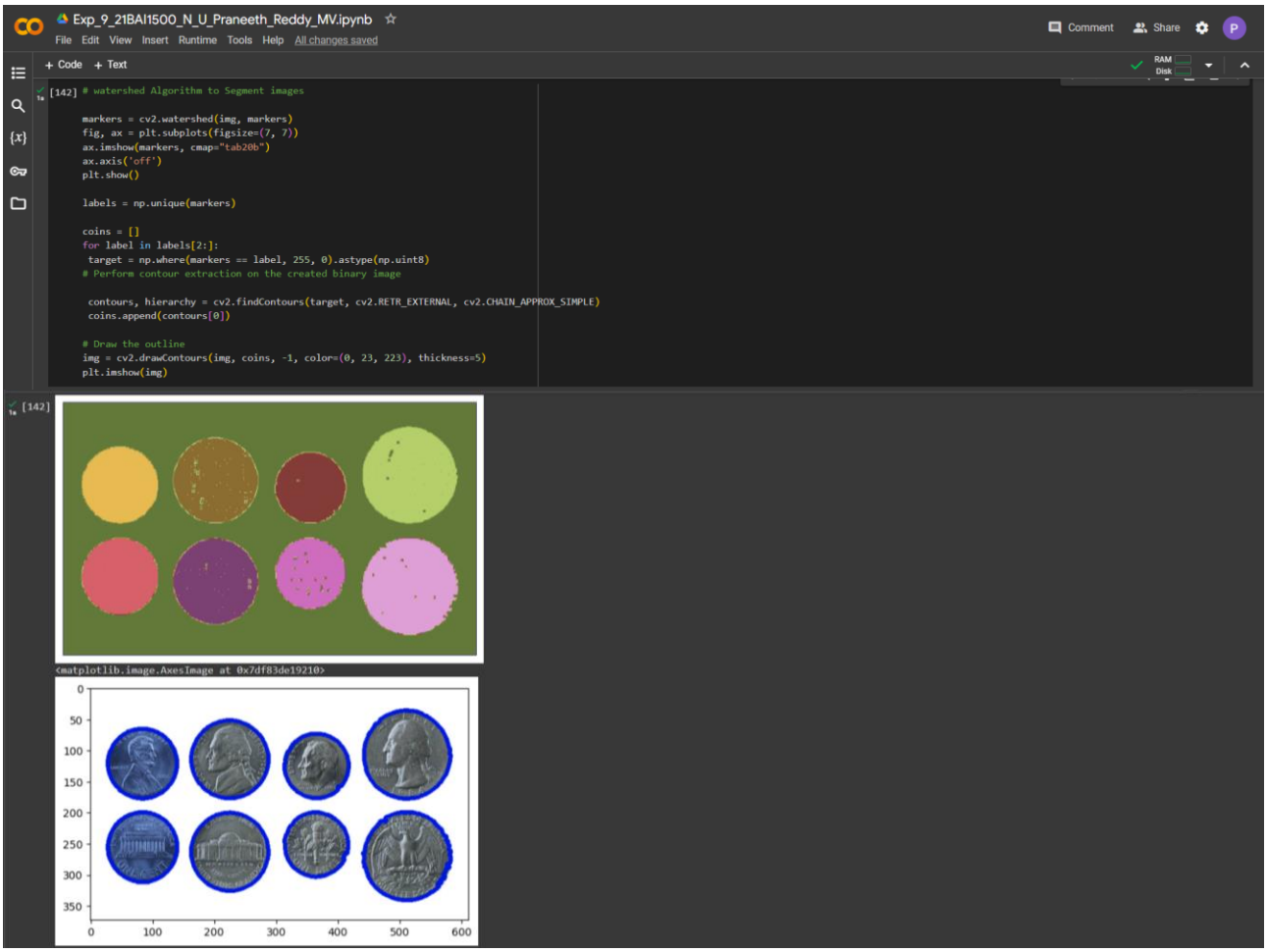
- Dilate the binary image for background, compute distance transform for foreground and apply threshold for marker creation



- Here we apply connected components analysis to the foreground markers to identify distinct regions. It assigns unique labels to each region using cv2.connectedComponents, and then visualizes the labeled regions with different colors.



- This segment uses watershed algorithm to segment the image based on markers, extracts contours for each segment, and outlines them on the original image.



Results: The given tasks have been done using programs in Python using Numpy, Matplotlib, OpenCV and Image libraries.

Conclusion: Python program have been created to perform Erosion Dilation using morphological operations and applying watershed algorithm to segment coins from a coin's image, to output the coins in different colors and outline them.

Google Collab Link :
https://colab.research.google.com/drive/1iAUYyzlCD2vAbrqysyKTgeztVK2gQyjP?usp=sharing