Image Processing using OpenCV

20i-0649 Muhammad Mujtaba

October 2023

1 Introduction

In this assignment, we aim to explore various techniques and algorithms to extract valuable information from images. The tasks span a diverse range of challenges, from geometric shape detection to gender classification in cartoon images and the identification of blurred images. The assignment comprises six distinct tasks, each focusing on a specific aspect of image analysis. This assignment is about the practical implementation of all the concepts of digital image processing which we have studied in class,

- Image Processing Fundamentals.
- Intensity Transformation.
- Histogram Processing.
- Spatial Filtering.

2 Proposed Solution

2.1 Question 1

After loading the image, white and black part of image is highlighted using threshold. Image is converted into grey-scale and than finding contour. Check if the polygon has exactly 4 vertices. Calculating the perimeter and centroid of the polygon. Draw the detected rectangle or square on the original image, display the centroid as a red circle, and add text with perimeter and centroid information. Displaying the modified image. If the image is not found or a polygon is not found function will return false.

2.2 Question 2

After loading the image. It is converted to grayscale, applies thresholding to create a binary image, and then calculates the darkness density—a measure of the proportion of dark pixels in the image. By comparing these darkness densities, the script decides which image appears to have more darkness (and

potentially more hair). And more hairs means female. in this way the code decides which picture is of a boy and which picture is of a girl.

2.3 Question 3

In question 3, first the function takes input of the two images. Than it converts the images into grey-scale. It than calculates their pixel variance, and then compares the variances to determine which image is blurred and which is the original. The result is returned as a pair of strings indicating whether the "Blurred Image" or the "Original Image" is detected as such. Than displays the image with the title.

2.4 Question 4

First the image is inserted and converted to grayscale for ease of processing. than a threshold value of 200 is used to differentiate the different colors. The boundaries of these colored regions are identified within the thresholded image. A loop then iterates through these detected contours, calculating the area and centroid of each region. These area and centroid values are superimposed onto the original image as text and red circles.

2.5 Question 5

Its main objective is to calculate and display the percentage area covered by each colored bar within a predefined region of interest outlined by the red arrow. First the image is uploaded and converted to grey-scale. After thresholding, contours representing the colored bars are identified. It then proceeds to define the region of interest, which is represented as a rectangular area around the red arrow. It creates masks for each contour and extracts the mean color within each mask. Finally, it compiles and presents the results, displaying the percentage areas covered by each color category

2.6 Question 6

Performing an in-depth analysis of an image featuring multiple distinct bone segments. Its primary objective is to segment these individual bone regions, extract them from the original image, compute their maximum width and height, and display this dimensional information. First the image is uploaded and converting it to grayscale to simplify further processing. Subsequently, it applies thresholding to generate a binary mask that distinguishes the bone segments from the background. Using contour detection, each segment of bone is separately marked.

3 Solution and topic relevance

3.1 Image Processing Fundamentals:

- Question 1: The solution involves loading an image, highlighting white and black parts using thresholding, converting to grayscale, finding contours, and calculating polygon properties. These steps showcase fundamental image processing techniques such as thresholding, contour detection, and basic geometric calculations.
- Question 2: Here, the conversion to grayscale, thresholding, and calculation of darkness density align with fundamental image processing operations. These operations form the basis of many image analysis tasks.
- Question 3: Converting images to grayscale, calculating pixel variance, and comparing variances for detecting blur contribute to the foundational concepts in image processing.
- Question 4: Conversion to grayscale, thresholding, and contour detection are fundamental steps in image processing, and calculating area and centroid adds a geometric dimension.
- Question 5: Grayscale conversion, thresholding, contour identification, and region of interest definition are fundamental concepts applied to extract specific information from images.
- Question 6: Grayscale conversion, thresholding, and contour detection for segmenting distinct bone regions demonstrate fundamental image processing techniques.

3.2 Intensity Transformation:

Question 2: The transformation of an image to grayscale and subsequent thresholding to calculate darkness density involves intensity transformation, especially in the context of analyzing pixel intensity variations.

3.3 Histogram Processing:

Question 2: While not explicitly mentioned, the process of thresholding involves considerations related to image histograms. Analyzing darkness density is akin to exploring pixel intensity distribution.

3.4 Spatial Filtering:

- Question 1: The use of thresholding and contour detection can be seen as spatial filtering operations, where certain spatial characteristics of the image are enhanced or extracted.

- Question 4: Thresholding to differentiate colors and subsequent contour detection can be viewed as spatial filtering operations applied to extract specific spatial features.
- Question 5: Defining a region of interest and creating masks for contours involve spatial considerations, aligning with spatial filtering concepts.
- Question 6: Thresholding to generate a binary mask for distinguishing bone segments represents a spatial filtering operation.

4 Conclusion

In conclusion, this exploration of image processing tasks showcased the practical application of fundamental concepts, from grayscale conversion and thresholding to contour detection and spatial filtering. The solutions effectively addressed diverse challenges, including geometric shape detection, gender classification, image clarity assessment, color analysis, and bone segmentation. By doing this, we connected what we learned in theory to practical situations. While we got a good grip on the main concepts, there's room to make things work even better. These picture tricks are quite handy and can help us understand and do more with visual information.