DIGITAL IMAGE PROCESSING USING LOCAL SEGMENTATION

BY

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Master Science of Management Information System

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APPROVAL

This Project titled "**Digital Image Processing Using Local Segmentation**" submitted by **Fevsal Moahmmed Ahmed** to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.sc in Management Information System and approved as to its style and contents. The presentation has been held on Jan-2025

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DECLARATION

I hereby declare that this project has been done by me under the supervision of Dr. SHEAK RASHED HAIDER NOORI Professor & Head Department of CSE Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

We look at how local segmentation techniques are used in digital image processing. Local segmentation is the process of dividing an image into different parts based on local features like pixel brightness, texture, or color. This paper reviews common local segmentation methods like thresholding, clustering, edge detection, and region-based approaches. We also discuss the advantages and limitations of these methods, with examples of how they are used in image processing tasks.

In digital image processing, local segmentation divides an image into meaningful sections by focusing on specific areas rather than the whole image. This method helps handle issues like uneven lighting, noise, and complex textures by applying different segmentation techniques to different parts of the image. Techniques such as adaptive thresholding, region growing, and graph-based methods provide precise and reliable image division, making them useful for fields like medical imaging, remote sensing, quality control, and document analysis.

This study looks at the methods, benefits, and drawbacks of local segmentation, showing how it can manage different image features effectively. While local segmentation increases accuracy and flexibility, it also faces challenges like high computing demands and finding the best settings. New technologies like AI and machine learning are expected to improve local segmentation, allowing for faster processing and better scalability. This paper gives an overview of the current state of local segmentation and its potential impact on digital image processing.

To conclude, we highlight the importance of local segmentation in various image processing tasks, such as object recognition and image analysis. In general, local segmentation is a valuable tool for identifying and analyzing key features in digital images.

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CHAPTER: 1

1.1 PREAMBLE

Now-a-days taking selfie is very common thanks to the advancement in smartphones cameras. What exactly we see at a selfie image at first glance? Obviously the face itself. This is because human brains are trained to distinguished faces from other things in background. The same way computer can recognize between foreground (face) and background of the picture using Image Segmentation. Image Segmentation is a part of digital image processing which is designed to focus partitioning the image into different branches based on their properties and features. In this thesis we cover some of the Image Segmentation Techniques and their performances by analyzing different type of Images.

1.2 Background of research

Image segmentation is the division of a picture into many portions or segments. This procedure is used to identify objects or boundaries in a picture. Image segmentation can be done using different methods, such as edge-based, region-based, clustering, and threshold segmentation.

Edge-based segmentation identifies objects and boundaries by detecting edges in the image. This can be done using techniques like Canny edge detection, which detects edges based on changes in pixel gradients. A preprocessing step in edge detection is Gaussian smoothing, where the image is blurred with a Gaussian filter to reduce contrast.

Region-based segmentation divides an image into parts based on specific criteria, such as color or texture. For example, K-means clustering can be used, where the image is divided into K groups based on pixel colors. Areas with the same color are grouped together. Region-based segmentation relies on the fact that adjacent pixels often have similar intensity values.

Clustering-based segmentation groups similar pixels together. This can be done using techniques like Gaussian mixture models or K-means clustering.
Waterfa A region-based image segmentation technique known as segmentation is predicated on the notion of "flooding" an image from its boundary. Identifying the "basins" or regions in the image and subsequently "flooding" them until they merge with each other

at the boundaries is the essence of this method.
Watershed segmentation is crucial for medical image processing, such as in magnetic resonance imaging (MRI), where it is necessary to distinguish various organs (e.g., the brain and the intestines) from the background region, as the latter may obstruct the former's analysis. Watershed algorithms can also be employed to segregate urban areas

from forested areas in a remote sensing image or to distinguish between various types of soil in a geological map. In 1974, John O. Fleming introduced the concept of the watershed transformation. Threshold segmentation divides an image into different sections based on a set threshold value. Pixels with values above the threshold are placed in one segment, while those below the threshold are placed in another segment.
In summary, segmentation is the process of splitting an image into different parts or regions. Methods like edge-based, region-based, clustering, and threshold segmentation can be used for this purpose. The best method depends on the specific characteristics of the image, and each approach has its own strengths and weaknesses.

1.3 Objectives of the study

This thesis aims to explain the differences between various image segmentation techniques, such as edge-based, region-based, clustering, threshold, and clustering-based methods. The objectives of this research may include::

1.3.1 Evaluating the effectiveness of different image segmentation techniques across various image types, such as natural, medical, and satellite images, to identify the unique features and benefits of each method.

1.3.2. Examining the core concepts and algorithms behind each image segmentation method, and comparing their differences in terms of effectiveness, efficiency, and suitability for different types of images.

1.3.3 Exploring potential improvements or advancements that could enhance the performance of each image segmentation method, while also identifying the limitations and challenges associated with each approach.

1.3.4 Investigating the broader implications of the differences between these image segmentation techniques and identifying potential areas for further research and development in the field. Ultimately, the goal of this thesis is to improve the effectiveness and efficiency of image segmentation methods by gaining a deeper understanding of the distinctions among the various techniques.

1.4 Statement of Problem

This thesis has the potential to significantly impact the field of image processing and analysis. By comparing and contrasting these different techniques, it helps practitioners and researchers better understand the unique features and benefits of each method, allowing them to choose the most suitable approach for a specific task. Additionally, analyzing these differences may highlight areas for development or innovation in image segmentation, such as the creation of new algorithms or improvements to existing ones. Ultimately, this could lead to more efficient and effective image segmentation methods, which are applicable in diverse fields like remote sensing, medical imaging, and surveillance.

The primary goal of this study is to understand and explore the differences between four image segmentation techniques, although not all of them will be utilized here.

1.5 Research Methodology

The purpose of this thesis is to compare and contrast different image segmentation techniques, including those based on edges, regions, thresholds, and clustering. This can be achieved by evaluating the performance of each method on various types of images and comparing the results to highlight the unique features of each technique. The research will also explore the fundamental concepts and algorithms behind each approach, as well as the limitations and challenges associated with them. By understanding the differences between these methods, researchers and practitioners will be better equipped to select the most suitable technique for a specific application and identify potential areas for improvement or innovation in the field of image segmentation.

1.6 Conclusion

In conclusion, this chapter introduced the concept of image segmentation and its crucial role in digital image processing. It emphasized the importance of segmentation in identifying and analyzing different regions within an image, with applications in fields like medical imaging, remote sensing, and surveillance. The discussion covered various segmentation techniques, such as edge-based, region-based, clustering, and threshold methods, highlighting their unique features and use cases.

The chapter also addressed the challenges involved in implementing these techniques, such as selecting the right method for different types of images and dealing with their limitations. By understanding these challenges and utilizing the strengths of each approach, researchers and practitioners can make informed choices to improve the efficiency and effectiveness of image segmentation, ultimately advancing the field and its practical applications.

CHAPTER 2:
REVIEW OF RELATED LITERATURE

Image segmentation is the process of dividing an image into distinct, meaningful parts. It is widely used in fields like computer vision and image recognition. In object detection, for example, image segmentation helps break an image into segments, identifying parts that are most likely to be objects.

In digital imaging, segmentation allows for easier editing or modification by separating objects within images. In medical applications, such as tumor removal, image segmentation plays a crucial role by helping to isolate abnormal tissue from surrounding healthy tissue for more precise treatment.

Radiologists use segmentation to identify areas of interest in medical pictures [4]. It may be used for data labeling in data mining and machine learning. Image segmentation may be advantageous for several tasks requiring the extraction of pertinent information from pictures, such as scene understanding, 3D reconstruction, stereo vision, 3D object identification, object recognition, and video analysis.

In the past, several methods have been used for picture segmentation. Several of these techniques are covered in the review that follows. Using a probabilistic model that explains the kinds of items that are most likely to be found in various areas of the picture, region-based techniques identify regions of interest. Using edges that have been extracted, edge-based techniques may determine the boundaries of various objects in a picture. As a preprocessing step, Gaussian smoothing [6] is often employed to DE noise the picture. This technique preserves an image's borders while blurring its pixels. The object boundaries are then determined using the smoothed picture. Lastly, certain residual imperfections at the object boundaries are smoothed down using morphological techniques. A cluster or clusters of clusters (often tens to hundreds of clusters) are extracted using a clustering- based approach, and each cluster is then categorized according to its color, texture, form, and other characteristics. One method for segmenting images based on regions is the watershed algorithm [7].

This method uses the intensity of the pixel values inside each watershed to separate the picture into several parts known as watersheds. Based on the things that are most likely to be included in the component, each component is given a class. The threshold method is a set of methods that uses a threshold on the pixel value to determine an object's border. Since brighter regions tend to have higher intensities than darker ones, the line between light and dark areas may be discerned using a threshold established at a predetermined level. Thresholding is the most fundamental method of segmentation. 8 The watershed algorithm is a category of region- based picture segmentation methods. These approaches segment a picture into several contiguous parts by recursive processes assessing the luminosity of each pixel inside each area.

This thesis focuses on the development and enhancement of object segmentation algorithms in images, alongside its application across several domains. These approaches possess the capacity to enhance our capability to get valuable information from pictures and have been used in fields such .as computer vision, medical imaging, and security

CHAPTER 3:

METHODOLOGY

3.1 Methodology

In this Thesis we are using this method as you can see in *figure 3.1*, first we convert our colored image to gray in order to apply the segmentation techniques, when we get our result then we test the performance with Sensitivity, Specificity, Error rate, and Accuracy.

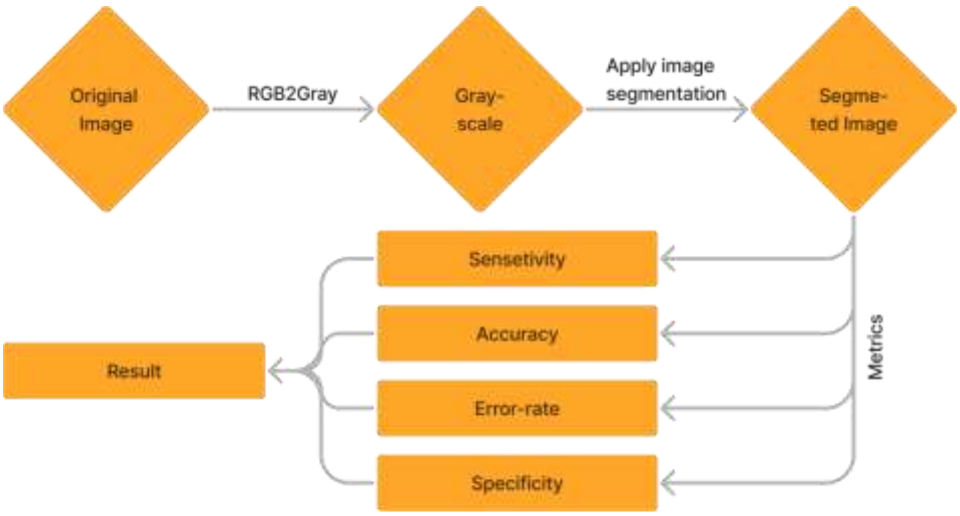

Figure 3.1: Thesis methodology

3.1 **Segmentation Technique**

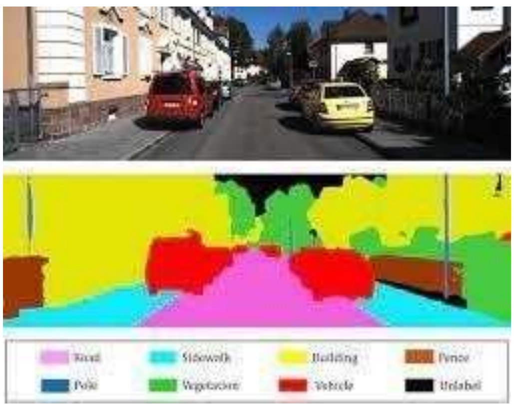

Figure 3.2 Segmentation example

Computer vision's image segmentation is a fairly large part of the process, and it can be used in various industries Like Face recognition, Medical imaging, and Number plate identification.

3.1.1 Edge-Based Segmentation

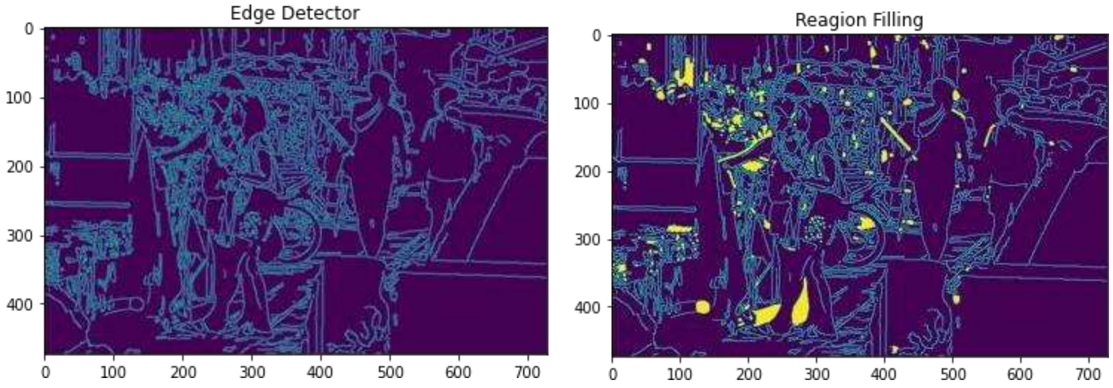

Figure 3.3 Edge Based Segmentation
(a) Original image (b) Edge detection (c)Region fillings

Due to its ability to assist you remove extraneous and superfluous information from images, edge detection is quite popular. It greatly decreases the size of the image, making image analysis simpler.

As you can see figure 3.3 Edge-based segmentation algorithms locate edges in an image based on variations in texture, contrast, grey level, color, saturation, and other attributes. Connecting all the edges into edge chains that more closely resemble the borders of the image will increase the quality of your output.

3.2 **Region-Based Segmentation**

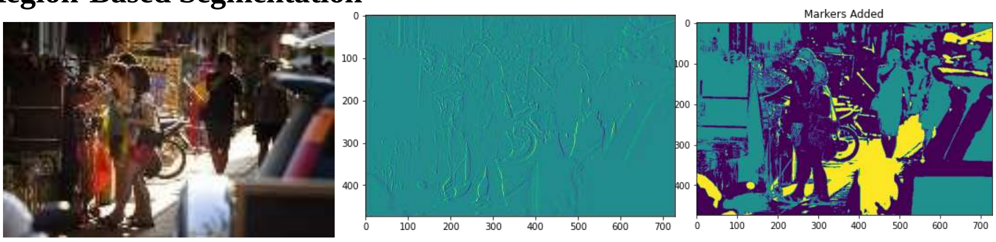

Figure 3.4 Region Based Segmentation
(a)Original image (b) Elevation map (c) Adding Markers

Algorithms for region-based segmentation separate the picture into regions with related characteristics. The method finds these areas, which are merely groups of pixels, by first selecting a seed point, which might be a little or substantial chunk of the source images.

3.3 **Clustering Segmentation**

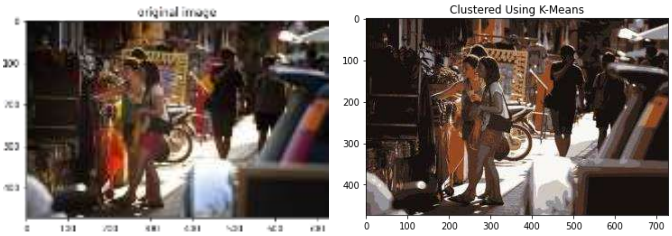

Figure 3.5 Clustering based

To split an image pixel by pixel, you can use this technique. To do this kind of segmentation, we look for groups of similarly-placed pixels and try to group them together. To implement we are using k-Means Clustering.

K-Means

In the realm of machine learning, K-means is one of the simplest unsupervised algorithms available. It uses a fixed number of clusters to determine how to categorize a picture. The first step is to divide the image into k groups, with each group represented by a set of k pixels. Then, they use the objects' distances from the group's centroid to determine where each one belongs. After all of the clusters' pixels have been assigned, the program can rearrange their centers.

3.4 **Threshold Based Segmentation**

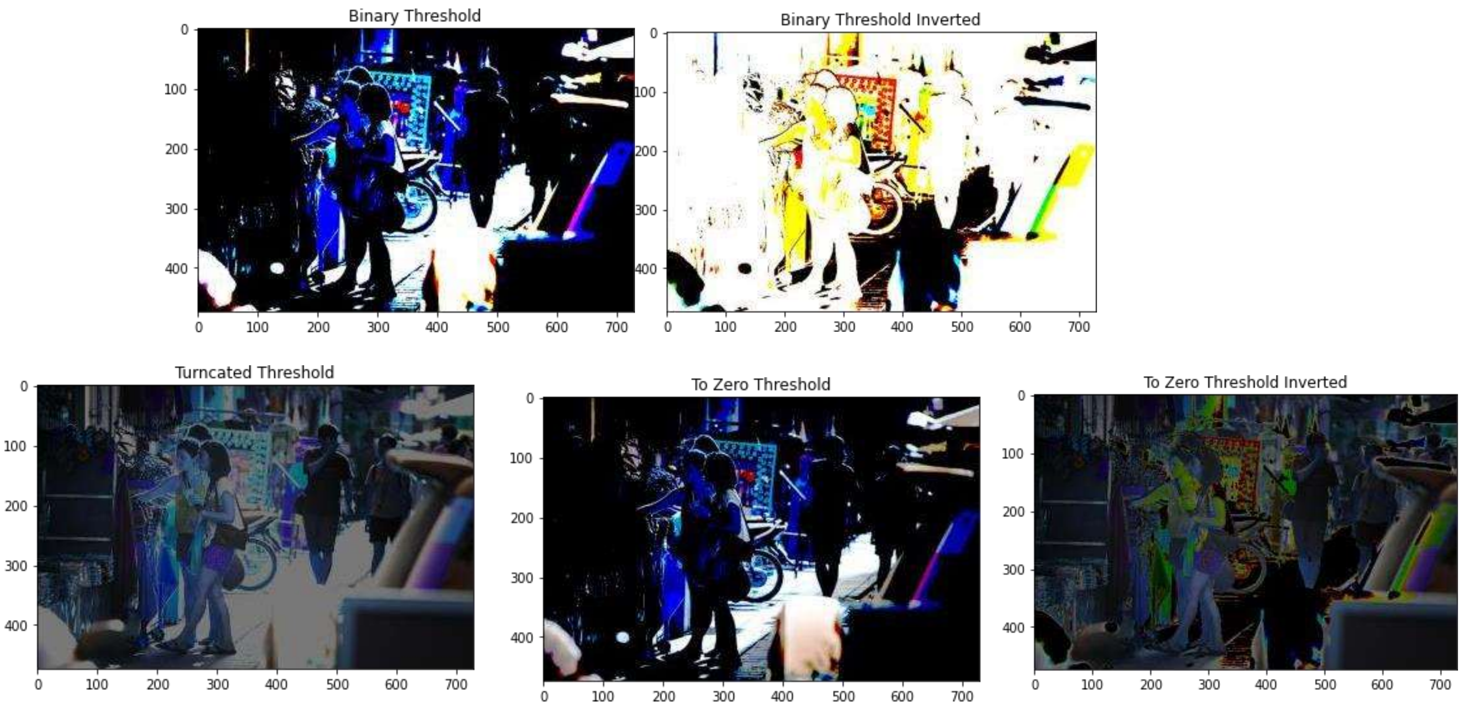

Figure 3.6 Threshold Based Segmentation

With thresholding, you'll check the intensity of each individual picture pixel against a predetermined limit. All of the pixels of the supplied image are then split into 2:

1. Pixels having intensity value lower than threshold.

2. Pixels having intensity value greater than threshold.

In figure 3.7 before thresholding types start the original RGB image is first converted to a grayscale image then the process starts,

(a) *Binary Threshold*

Of the two groups obtained earlier, the group having members with pixel intensity, greater than the set threshold, are assignment “Max_Value”, or in case of a grayscale, a value of 255 (white).

The members of the remaining group have their pixel intensities set to 0 (black).

(b) ***Inverted Binary threshold***

Inv. Binary threshold is the same as Binary threshold. The only essential difference being, in Inv.Binary thresholding, the group having pixel intensities greater than set threshold, gets assigned ‘0’, whereas the remaining pixels having intensities, less than the threshold, are set to “maxValue”.

(c) ***Truncate threshold***

The group having pixel intensities greater than the set threshold, is truncated to the set threshold or in other words, the pixel values are set to be same as the set threshold. All other values remain the same.

(d) ***Threshold to zero***

A very simple thresholding technique, wherein we set the pixel intensity to ‘0’, for all the pixels of the group having pixel intensity value, less than the threshold.

(e) ***Threshold to zero inverted***

Similar to the previous technique, here we set the pixel intensity to ‘0’, for all the pixels of the group having pixel intensity value, greater than the threshold.

CHAPTER 4:
DESIGN AND DEVELOPMENT

We are now attempting to analyze and compare the four various segmentation approaches that were mentioned in the chapters that came before this one in order to discover which one has the greatest results. This is being done by selecting images that have a range of color palettes and producing results. a performance. Within this chapter, we will also provide an explanation of the conception and development of this thesis.

4.1 DATASET

4.1.1 Input Images

We chose freely labeled diverse photographs from the Internet that are appropriate for our research. They include as many as seven distinct pictures, all of which are summarized in this chapter.

Figure 4.1: *Input image-1(4209x2769)*

Figure 4.1 depicts an initial input picture including various elements positioned on a gray backdrop, with intervening spaces among them.

...

Figure 4.2: *Input image-2 (500x315)*

A picture of apple tree with its ripped red apple and green leaves in background is our second input as shown in Figure 4.2.

Figure 4.3: *input image-3 (1920x1080)*

Figure 4.3 illustrates the next input image of a gaze of raccoons in an open field some are standing with two legs and others with four.

Figure 4.4: *input image-4 (728x473)*

A color full image of people in a market doing different activities is the next image shown in Figure 4.4.

Figure 4.5: *input image-5 (910x511)*

A picture of bunch of people in a busy road intersection of a town has been taken as input which illustrated in

Figure 4.6: *input image-6 (830x553)*

Figure 4.6 demonstrates another input image that has been used in this thesis. It is an image of few fruits and Vegetables of different shapes and colors.

Figure 4.7: *input image-7 (3180x2120)*

The last image we have used in this thesis is given in Figure 4.7. This is an image of apple stack with different colors of apples.

4.1 SOFTWARE AND TOOLS

We have used python as the programming language and Google Colab for the coding. Several methods from different libraries have been used to complete this thesis work. Such as,

- ✓ colors() from skimage library.
- ✓ Canny
- ✓ Matplotlib.pyplot
- ✓ Numpy
- ✓ Scipy.ndimage

CHAPTER 5:
RESULTS AND DISCUSSION

5.1 RESULTS

In this chapter, we will examine all of the results that were obtained from the diverse image segmentation methods employed in the research for this thesis. The efficacy of each technique will be assessed in accordance with the outcomes they generate.

5.1.1 EDGE-BASED SEGMENTATION.

Edge-Detection.

Edge detection functions by recognizing regions of significant contrast in a picture, characterized by abrupt variations in pixel intensity. We used the Canny edge detection technique, often utilized in image processing, since regions of high contrast are typically linked to the edges of objects.

A visual representation. Identifying these edges enables the segmentation of the picture into distinct sections, each corresponding to a different item inside the image. The numbers below indicate that some findings are favorable due to the strong contrast of the items in the picture.

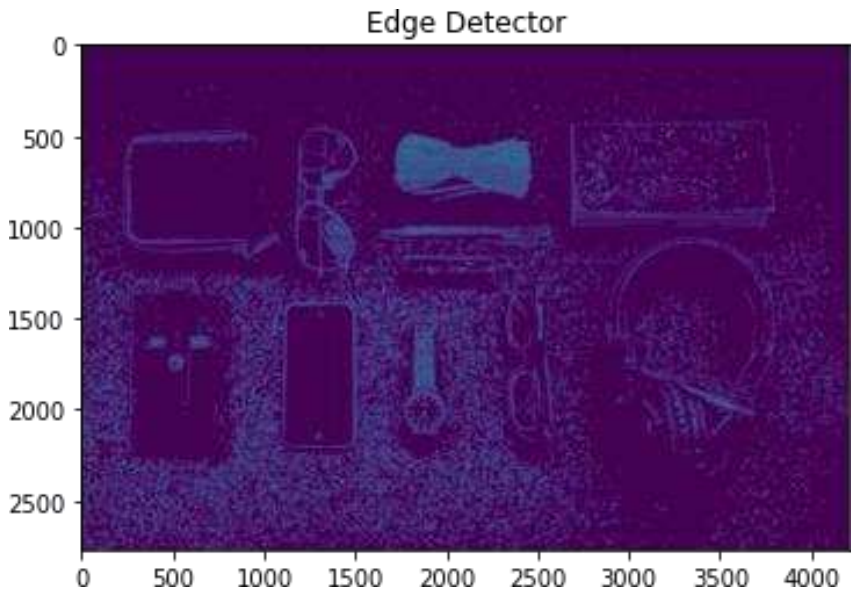

Figure 5.1: edge-Detector 01

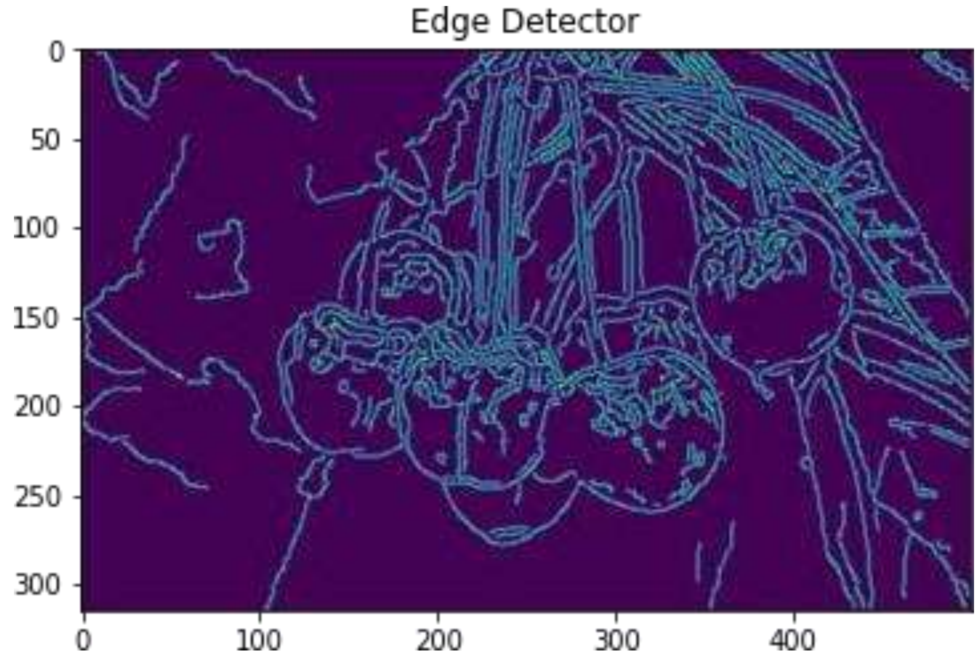

Figure 5.2: edge-Detector 02

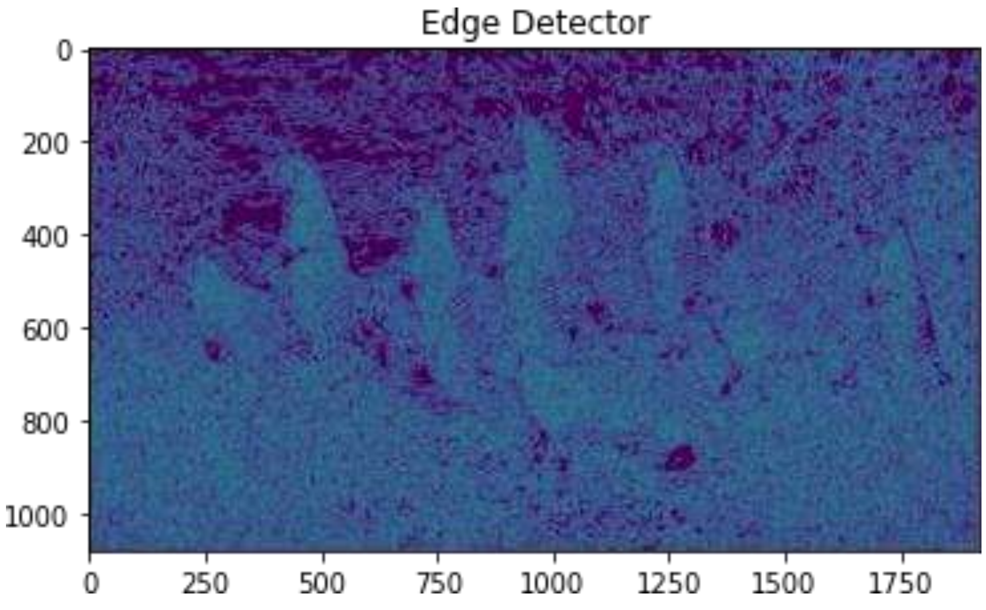

Figure 5.3: edge-Detector 03

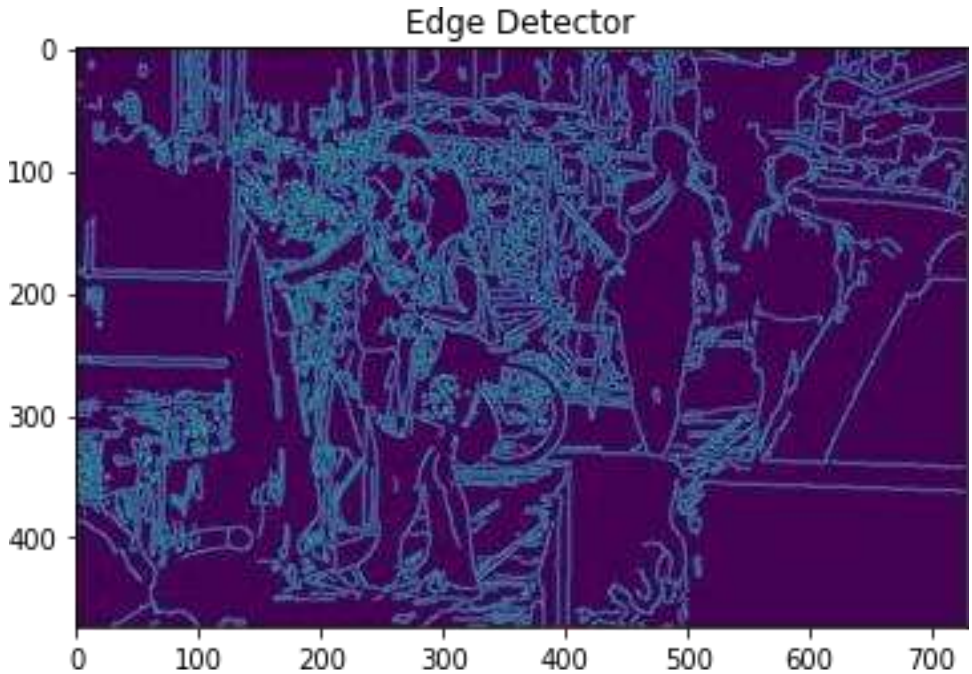

Figure 5.4: edge-Detector 04

Filling Regions

Upon edge detection, minor difficulties arise in some photos, characterized by holes or gaps resulting from the preceding procedure; to rectify this, we fill the areas. Filling areas entails recognizing gaps in the identified boundaries and "filling" them by adjusting the pixels in the adjust the hole to match the value of the adjacent pixels. This enables a more comprehensive and uninterrupted depiction of the identified edges, hence simplifying the segmentation of the picture into distinct sections. Filling in the gaps in the identified edges enables the generation of a more accurate and exact segmentation of the picture into distinct sections.

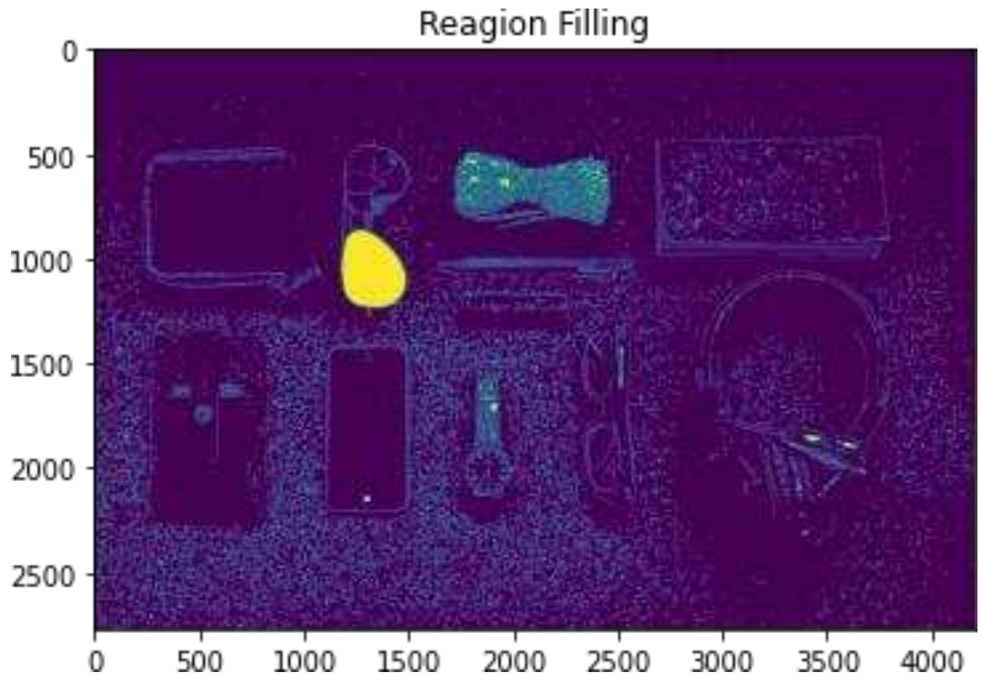

Figure 5.5: region filling 01

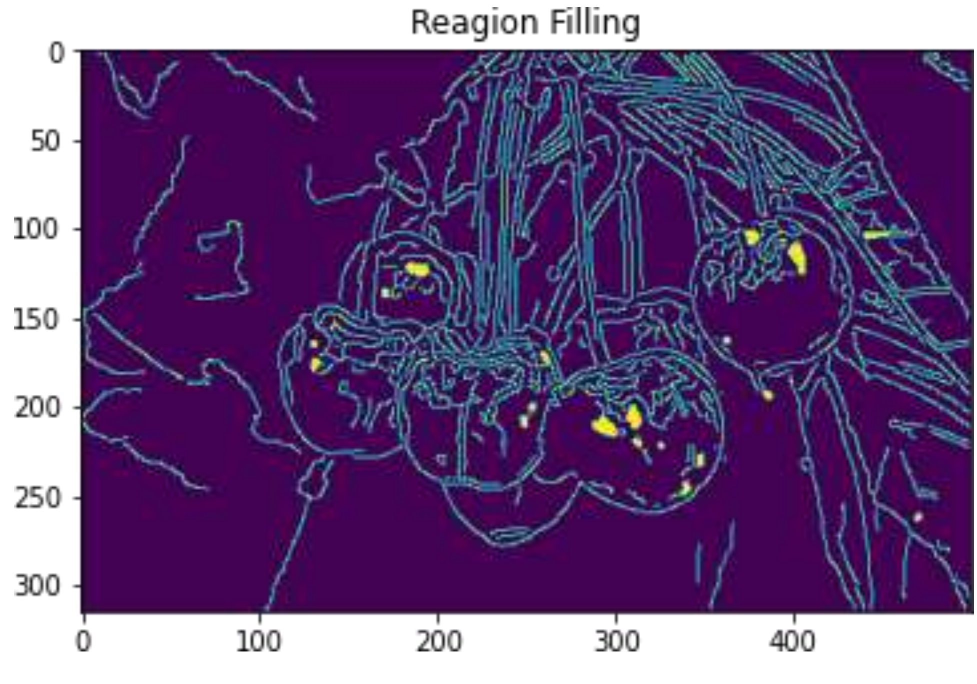

Figure 5.6: region filling 02

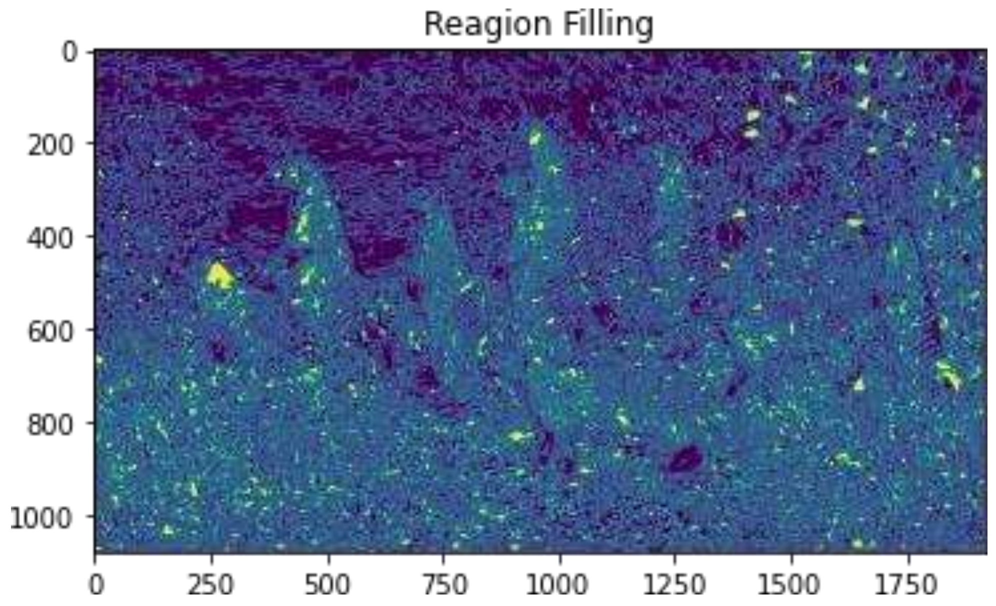

Figure 5.7: region filling 03

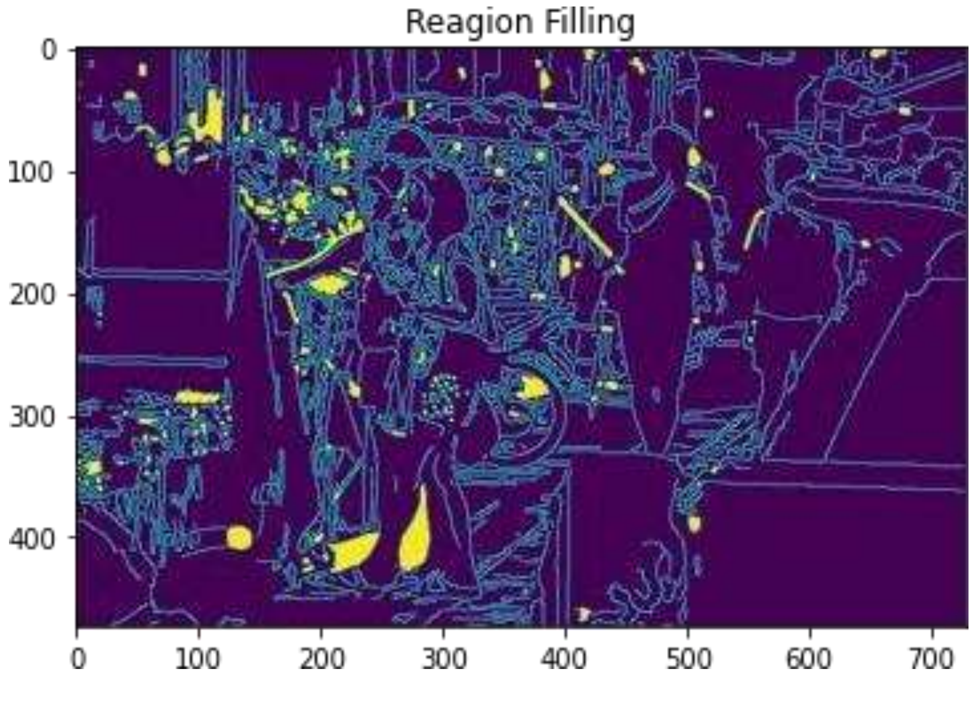

Figure 5.8: region filling 04

5.1.2 Region-Based Segmentation

Elevation Map

An elevation map is a 2D representation of a 3D surface, in which the brightness of each pixel corresponds to the height of the surface at that point. Elevation maps are often used in computer vision and image processing applications to help identify and extract features of interest from an image, such as mountains, valleys, or other topographic features.

Elevation maps can be created using a variety of methods, such as stereo vision, laser scanning, or radar imaging. They can be used to extract features such as contours, edges, and textures, and can be useful for tasks such as 3D modeling, terrain analysis, and object recognition. In region-based image segmentation, elevation maps can be used to help identify and separate different regions of an image based on their relative heights or depths.

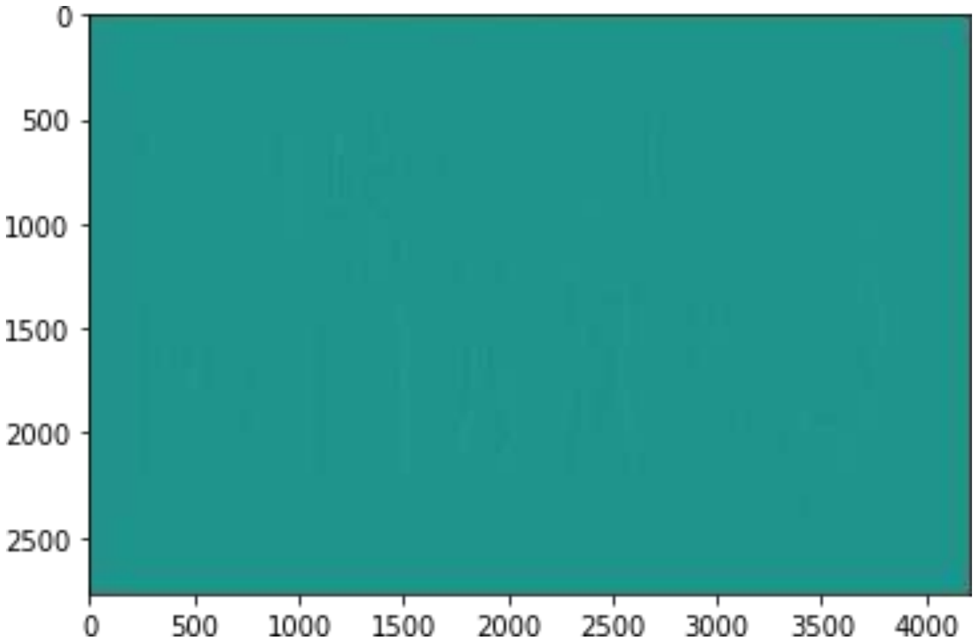

Figure 5.9: elevation map 01

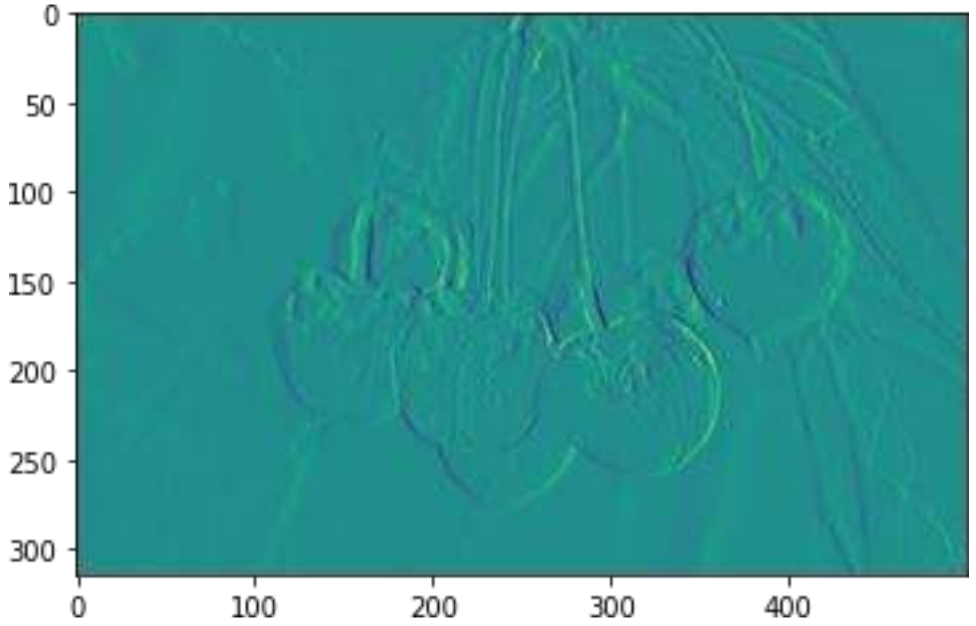

Figure 5.10: elevation map 02

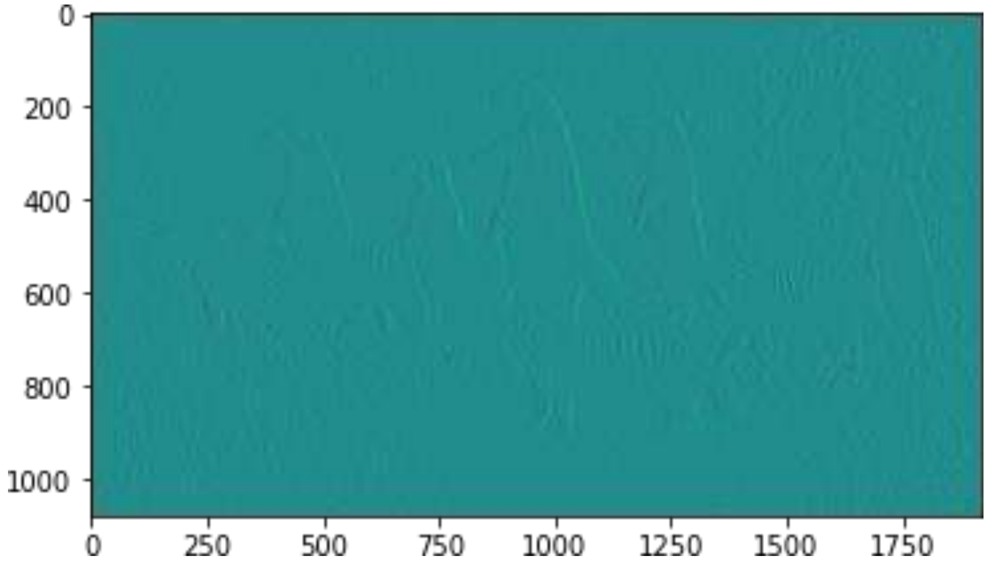

Figure 5.11: elevation map 03

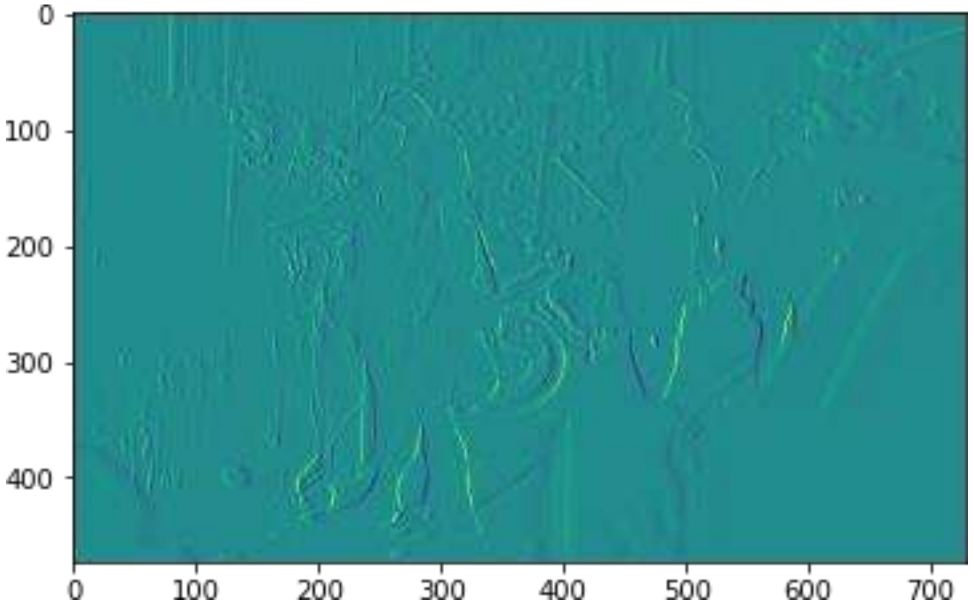

Figure 5.12: elevation map 04

Added Marks

Markers can be used to highlight specific regions or features within an image, to differentiate between different types of objects or regions, or to help visualize the boundaries or edges of different segments.

In region-based image segmentation, markers are often used in conjunction with other techniques, such as edge detection or thresholding, to help identify and separate different regions within an image. They can be particularly useful when working with images that have complex or subtle features, as they can help to highlight and distinguish these features more clearly.

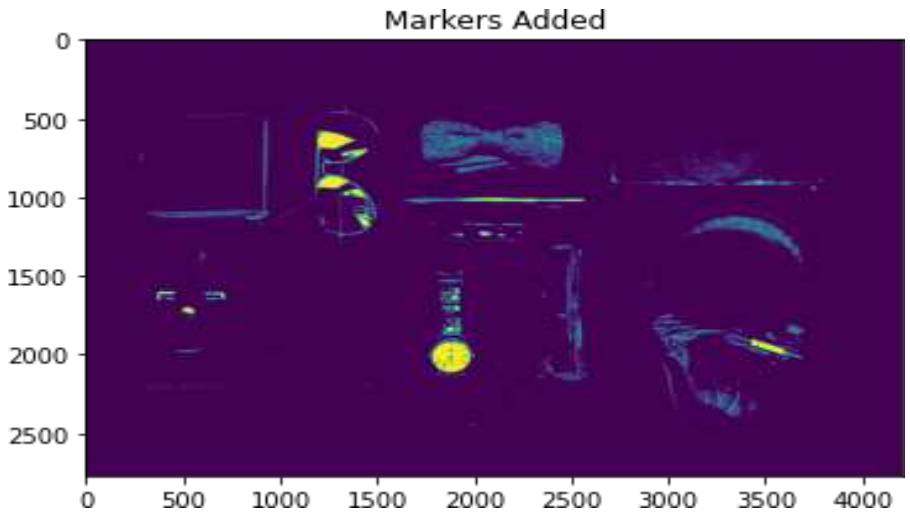

Figure 5.13: Added marks 01

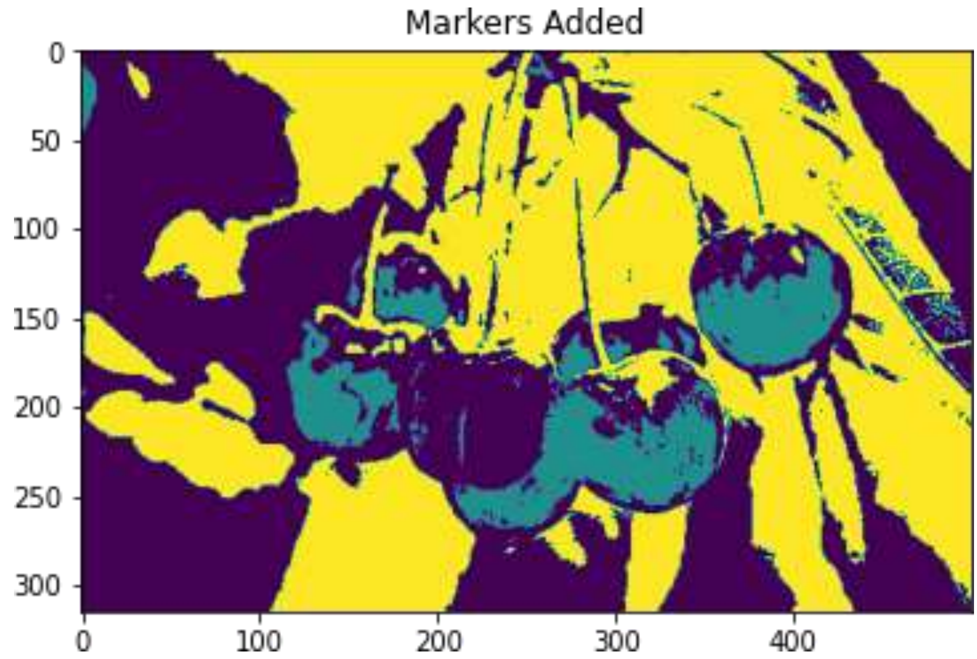

Figure 5.14: Added marks 02

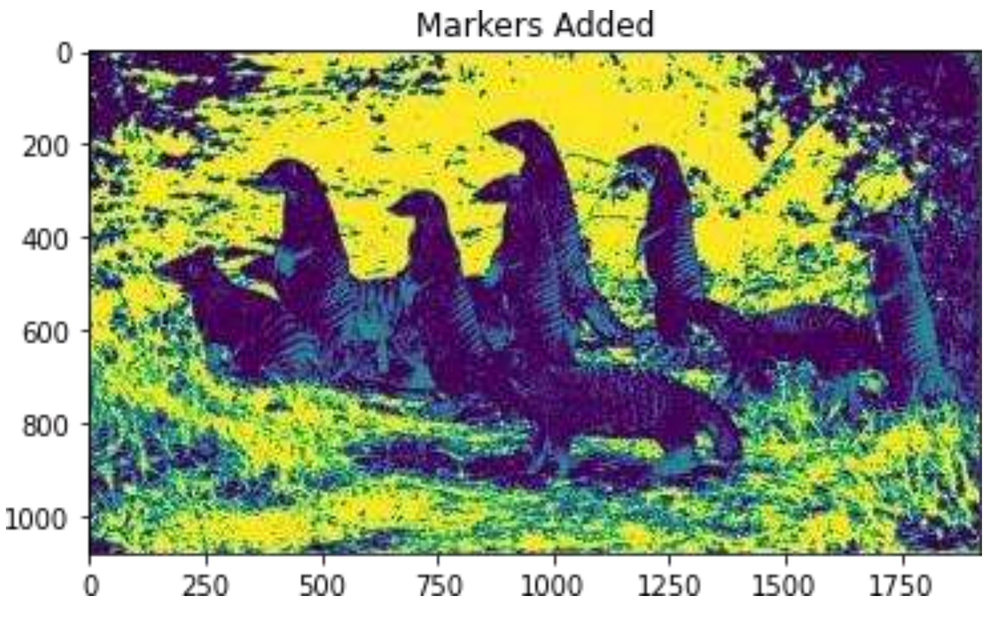

Figure 5.15: Added marks 03

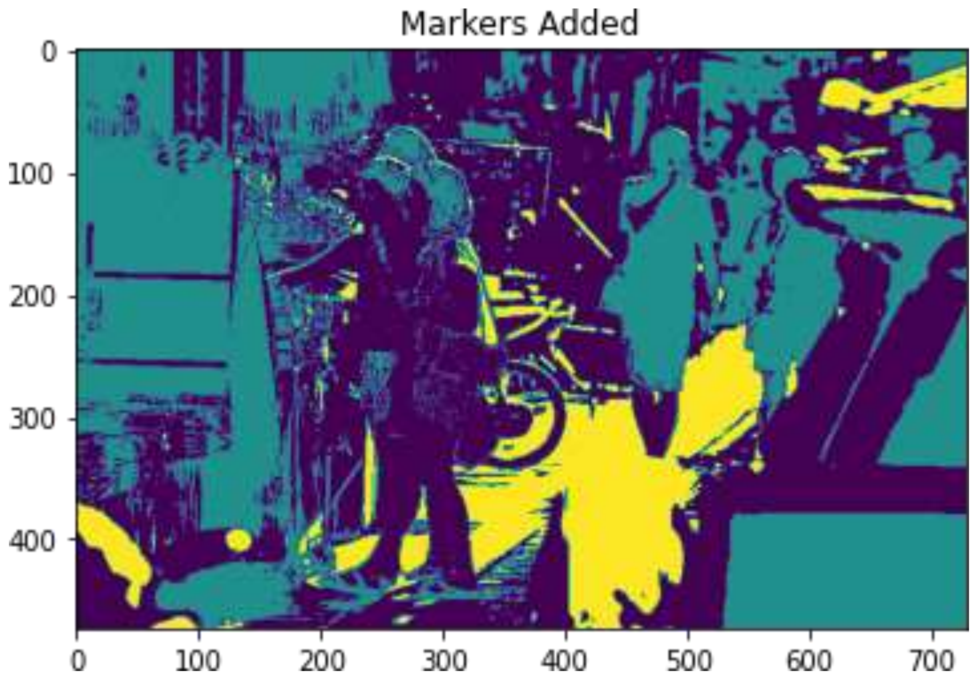

Figure 5.16: Added marks 04

Contour

Contours are often used in image processing and computer vision applications to help identify and extract specific features or objects within an image. For example, contours can be used to identify the boundaries of objects or regions, to separate different objects or regions from one another, or to extract features such as corners, edges, or shapes. In region-based image segmentation, contours can be used to help define and distinguish different regions within an image. For example, contours can be used to segment an image into multiple regions based on the edges or boundaries of objects or features within the image. Contours can also be used to help visualize the shape and structure of different objects or regions within an image, and can be useful for tasks such as object recognition or image analysis.

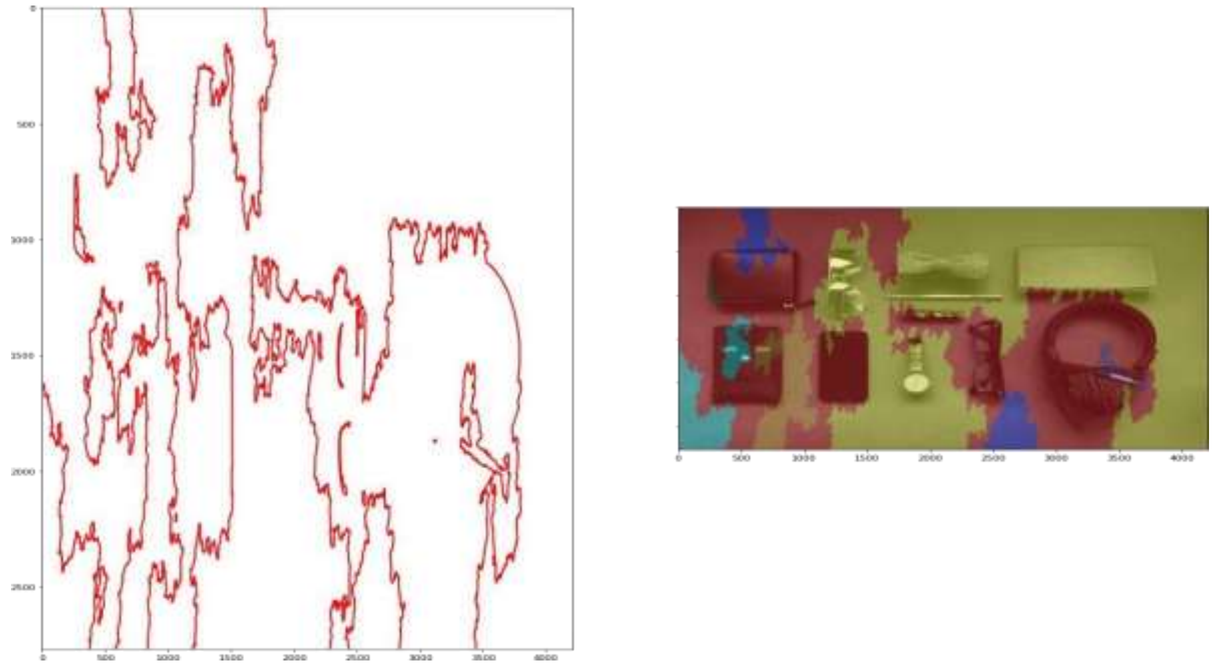

Figure 5.17: Contour 01

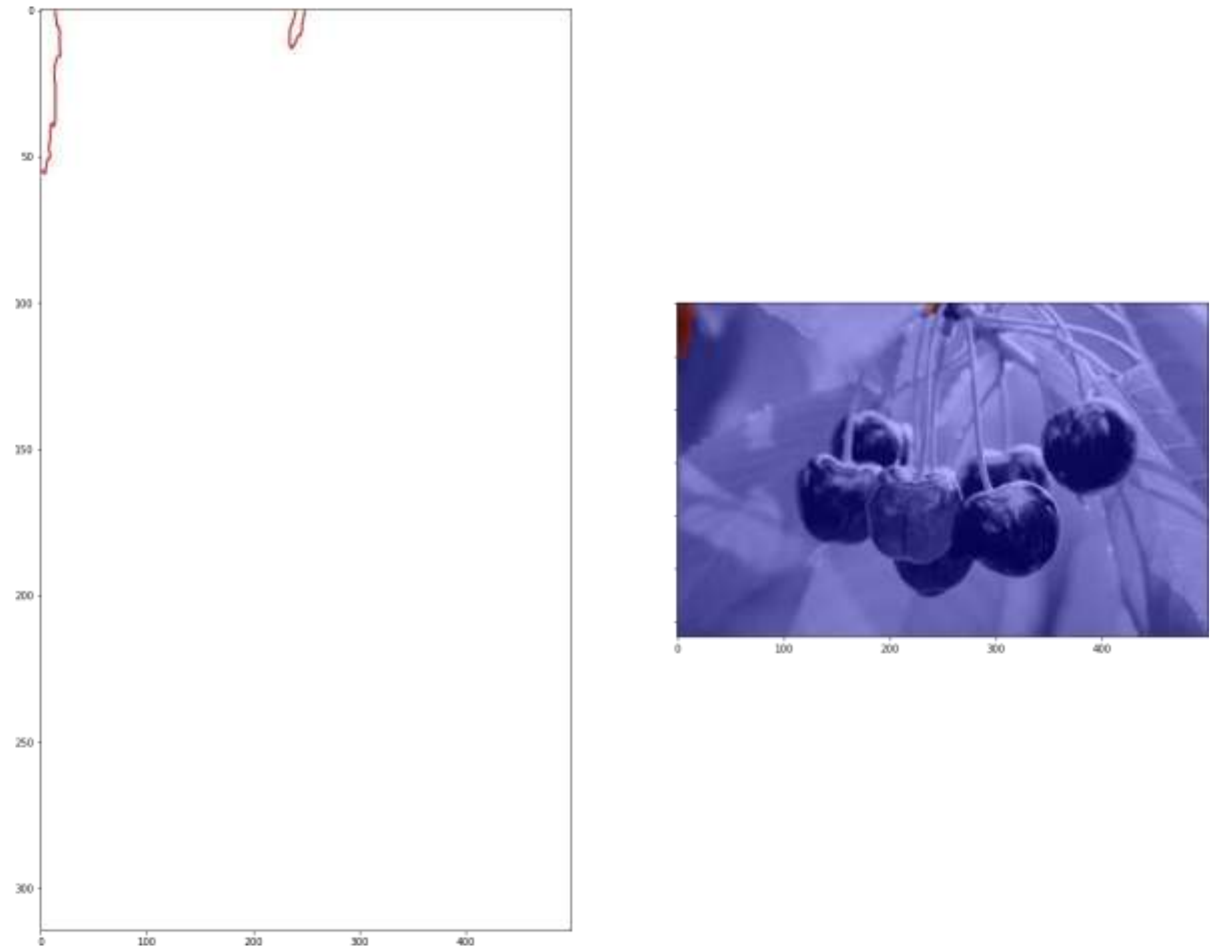

Figure 5.18: Contour 02

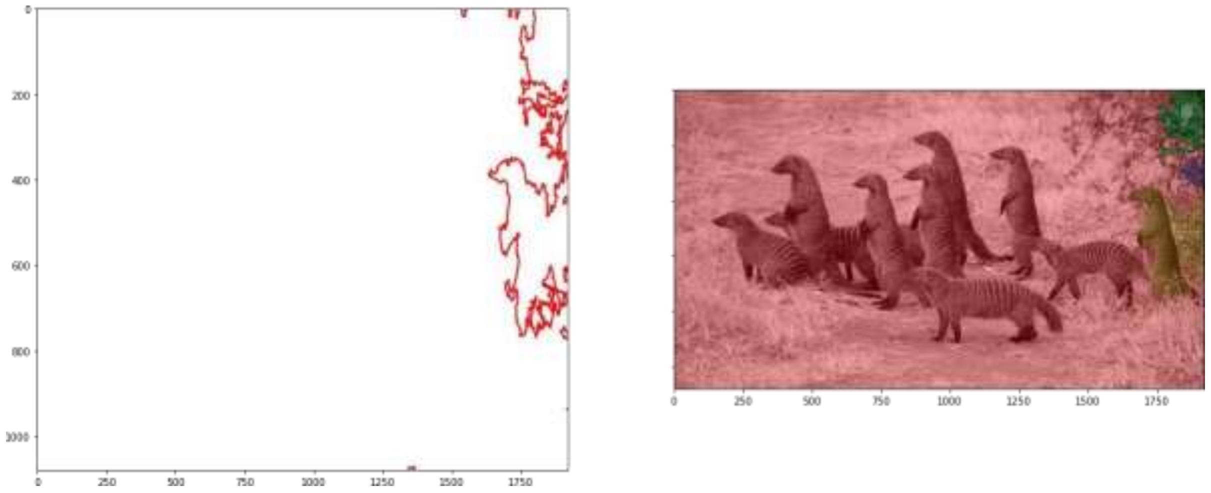

Figure 5.19: Contour 03

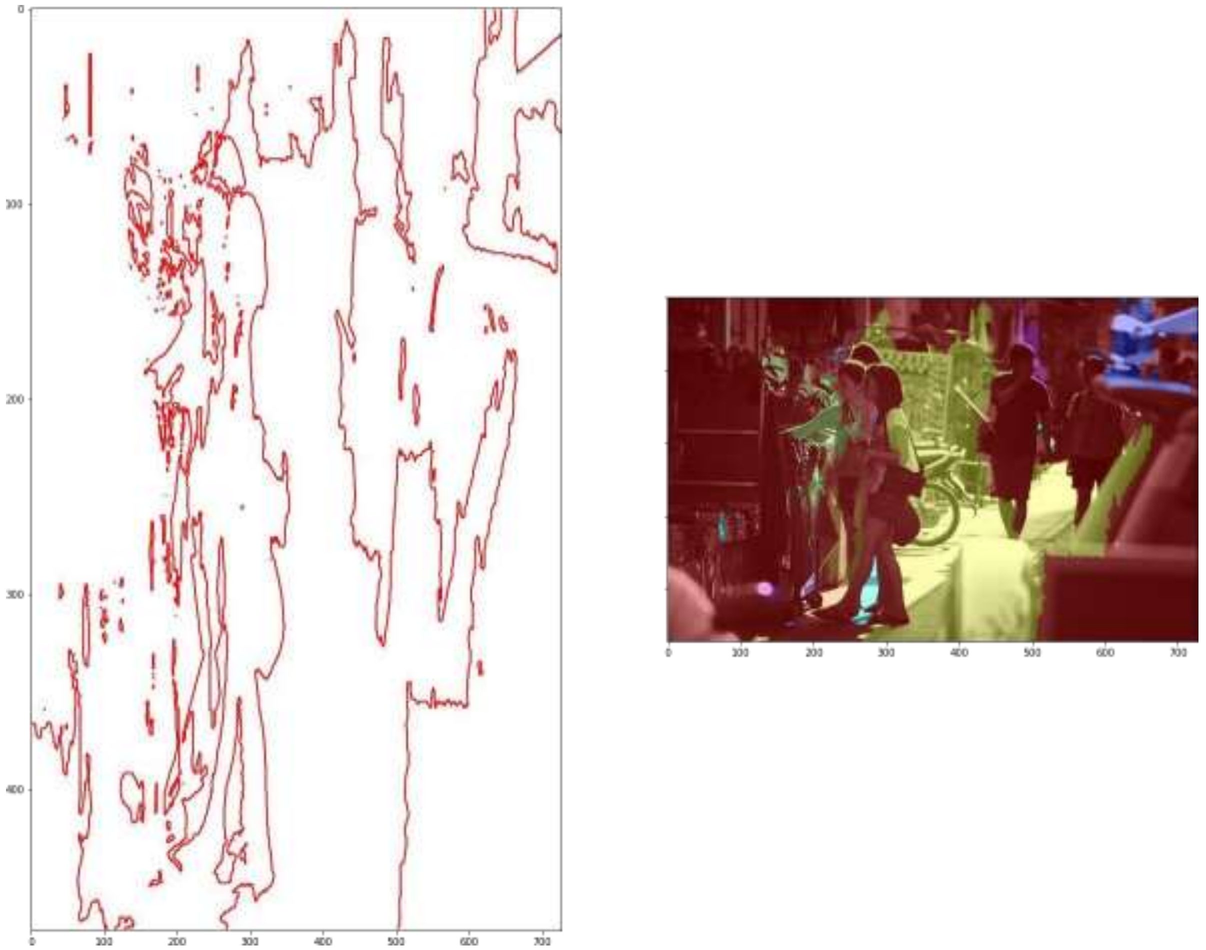

Figure 5.20: Contour 04

5.1.4 CLUSTER-BASED SEGMENTATION

There are many different algorithms and approaches that can be used for cluster-based image segmentation, and the specific method used will depend on the characteristics of the image and the goals of the segmentation. Some common approaches to cluster-based image segmentation include k-means clustering, mean-shift clustering, and spectral clustering.

K-means clustering is a popular method for cluster-based image segmentation that involves partitioning the image into k clusters based on the similarity of the pixels or image features. The algorithm begins by selecting k initial clusters, and then iteratively assigns each pixel or feature to the closest cluster based on a distance metric, such as Euclidean distance. The algorithm then adjusts the locations of the cluster centroids and repeats the assignment process until the clusters converge to a stable configuration.

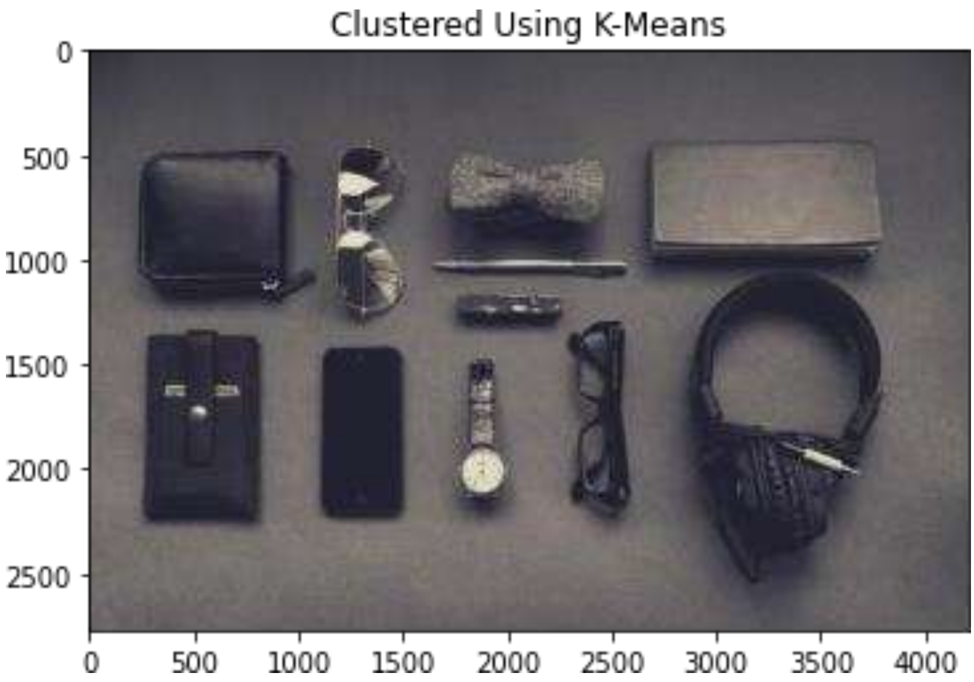

Figure 5.21: Cluster k-means 01

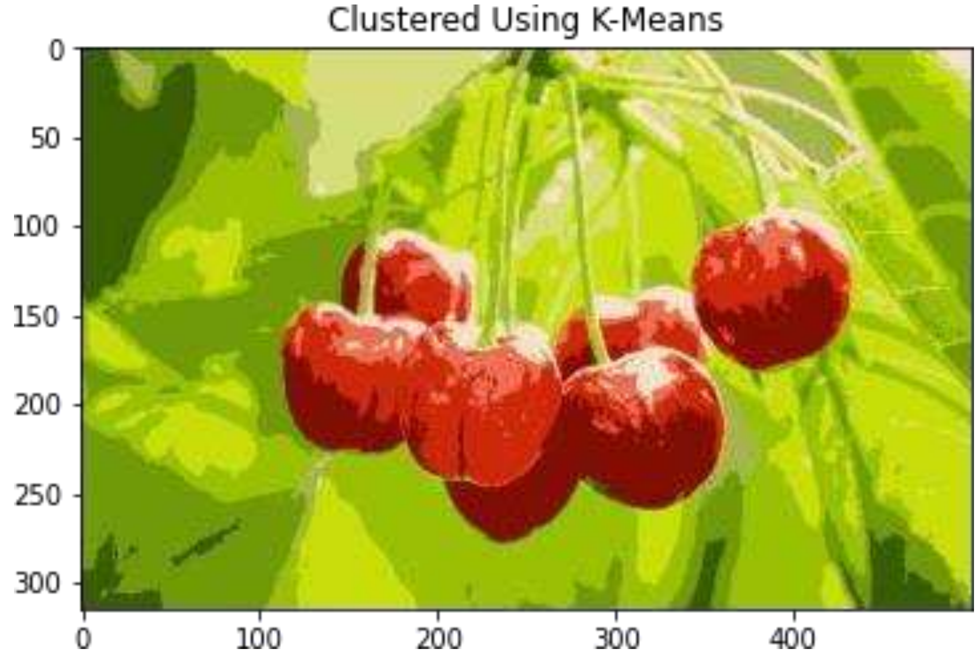

Figure 5.22: Cluster k-means 02

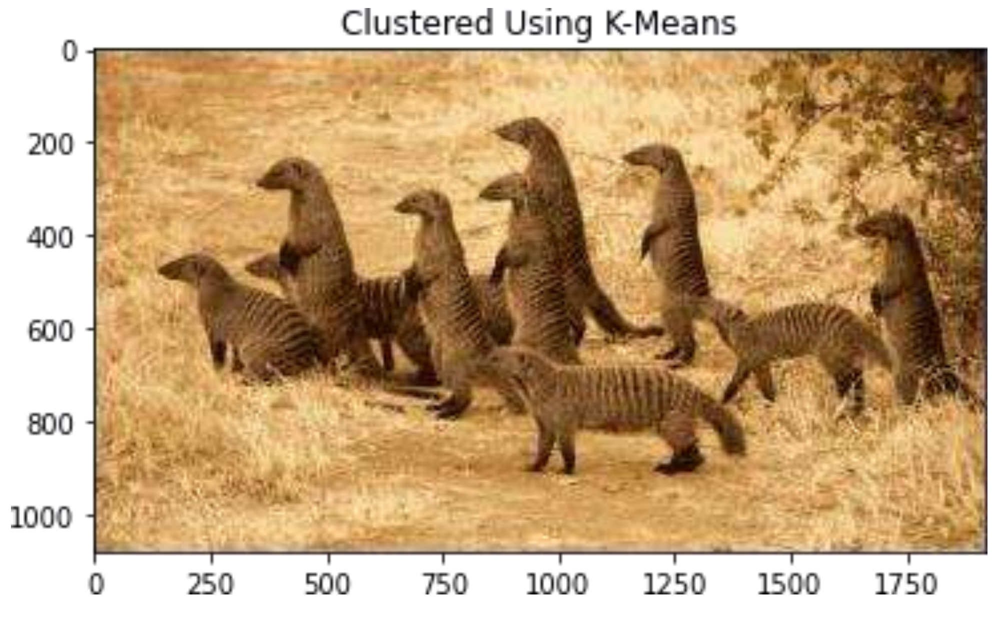

Figure 5.23: Cluster k-means 03

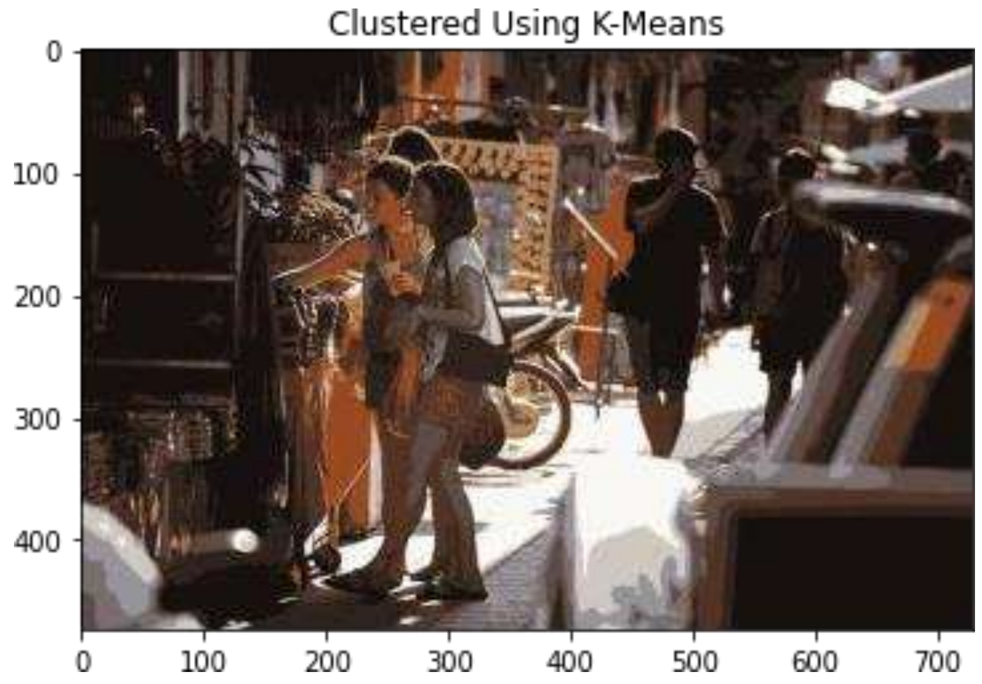

Figure 5.24: Cluster k-means 04

5.1.3 THRESHOLD-BASED SEGMENTATION

Threshold-based image segmentation can be a useful tool for separating different objects or regions within an image based on their intensity values, and can be particularly useful for images with simple or well-defined intensity distributions.

Binary Threshold

In this method of image thresholding that involves separating an image into two regions based on a threshold value. Pixels with intensity values above the threshold are assigned to one region, and pixels with intensity values below the threshold are assigned to another region. Binary thresholding is often used to separate the foreground and background of an image, or to identify and extract specific objects or features within the image.

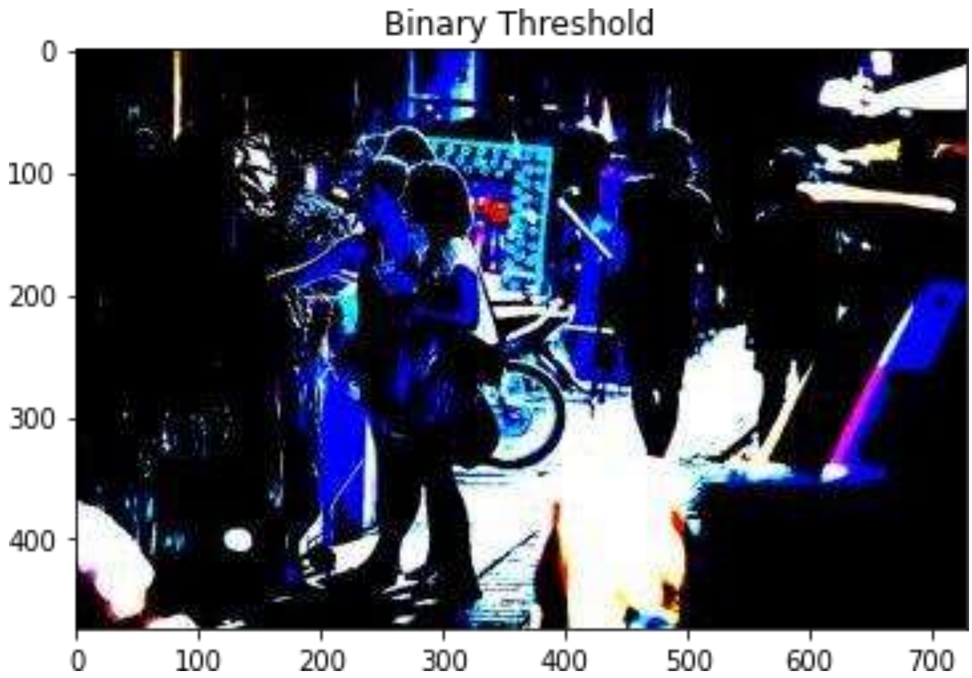

Figure 5.25: Binary threshold 01

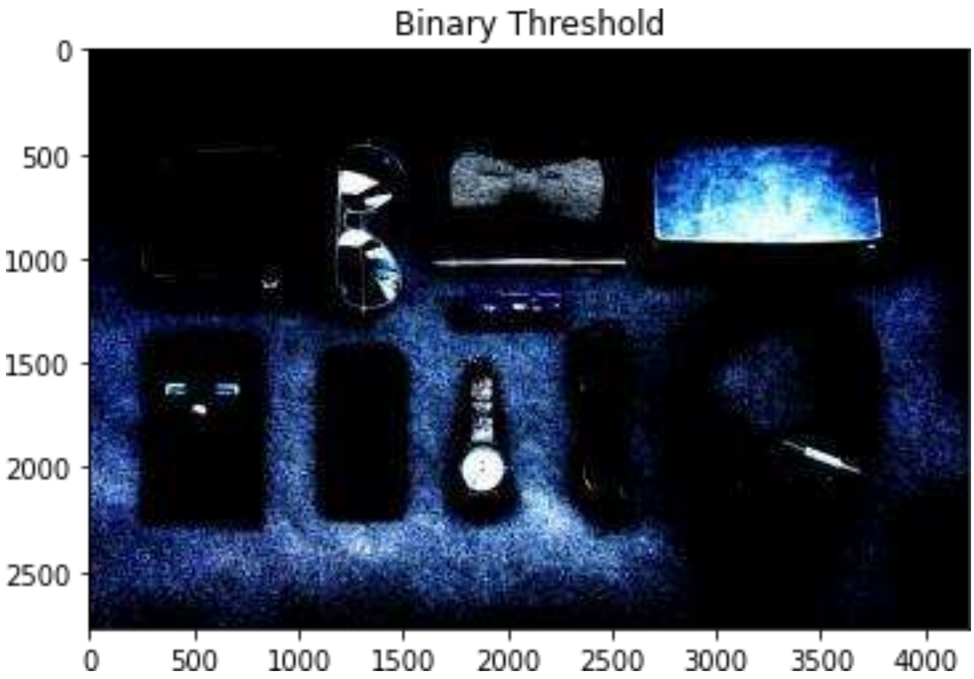

Figure 5.26: Binary threshold 02

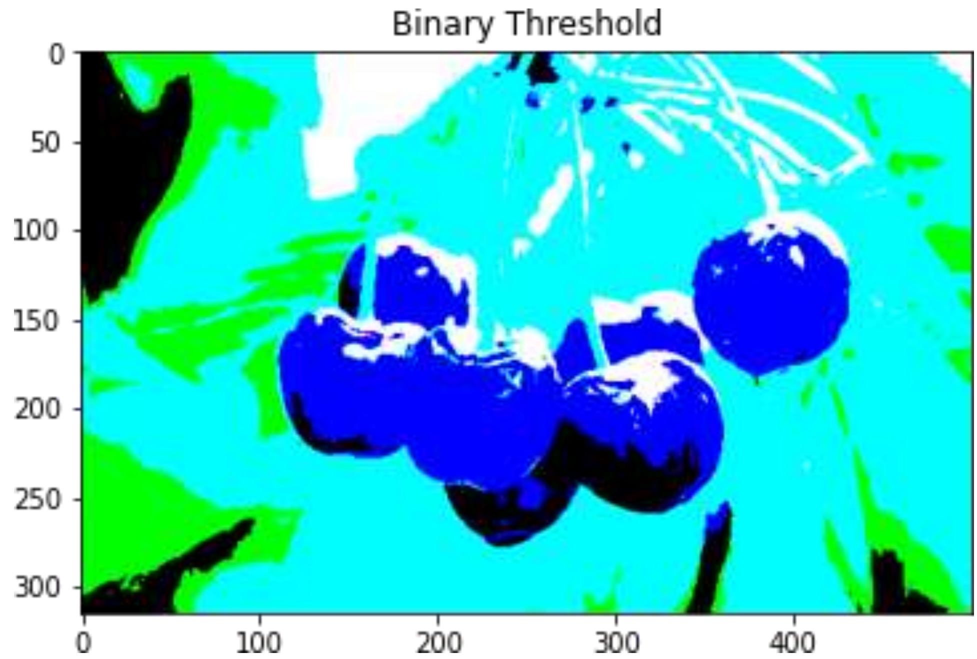

Figure 5.27: Binary threshold 03

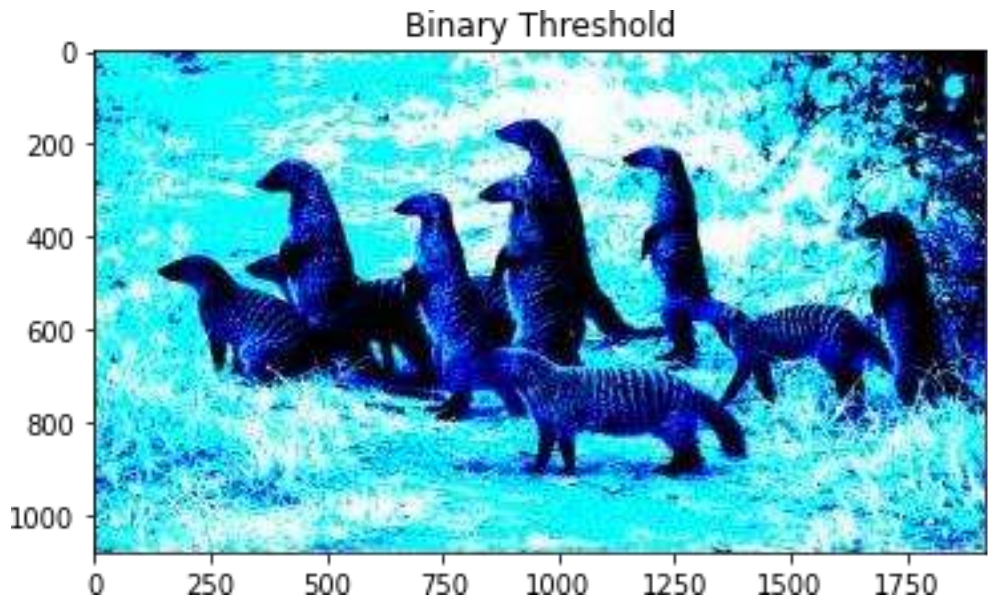

Figure 5.28: Binary threshold 04

Binary Threshold Inverted

Binary Threshold Inverted is similar to Binary Threshold only but the roles of the two regions are reversed. Pixels with intensity values above the threshold are assigned to the second region, and pixels with intensity values below the threshold are assigned to the first region. This method can be useful for inverting the contrast of an image or for identifying and extracting specific objects or features within the image that have a lower intensity than the background.

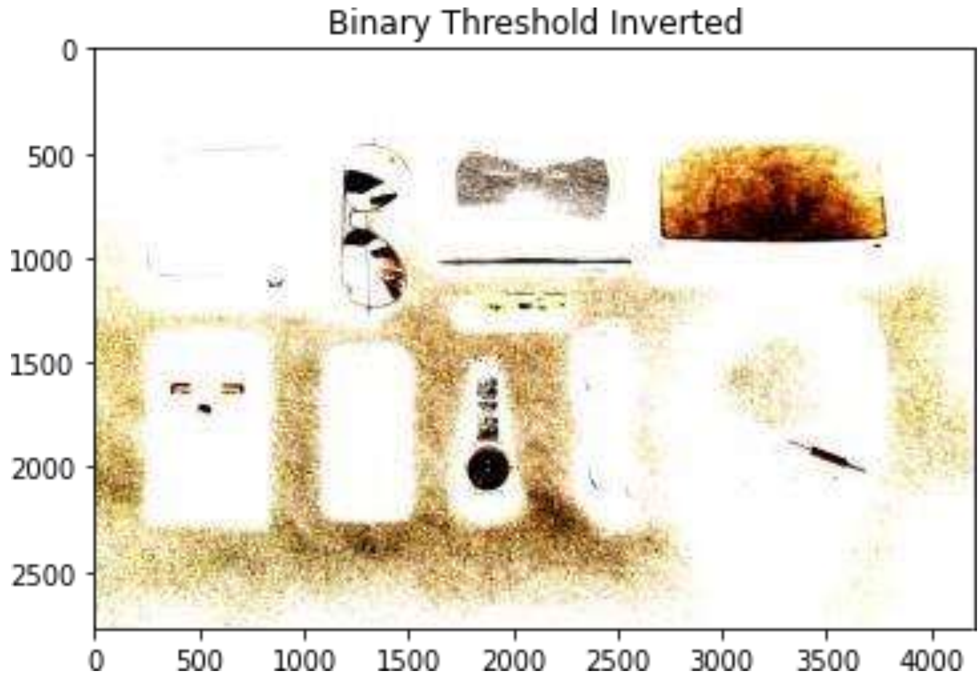

Figure 5.29: Binary threshold inverted 01

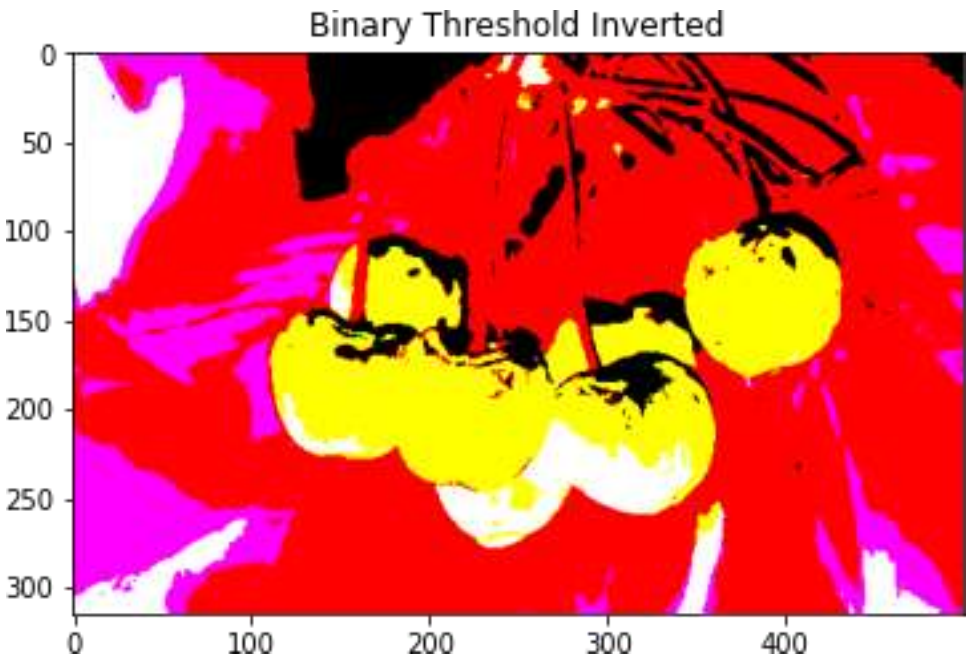

Figure 5.30: Binary threshold inverted 02

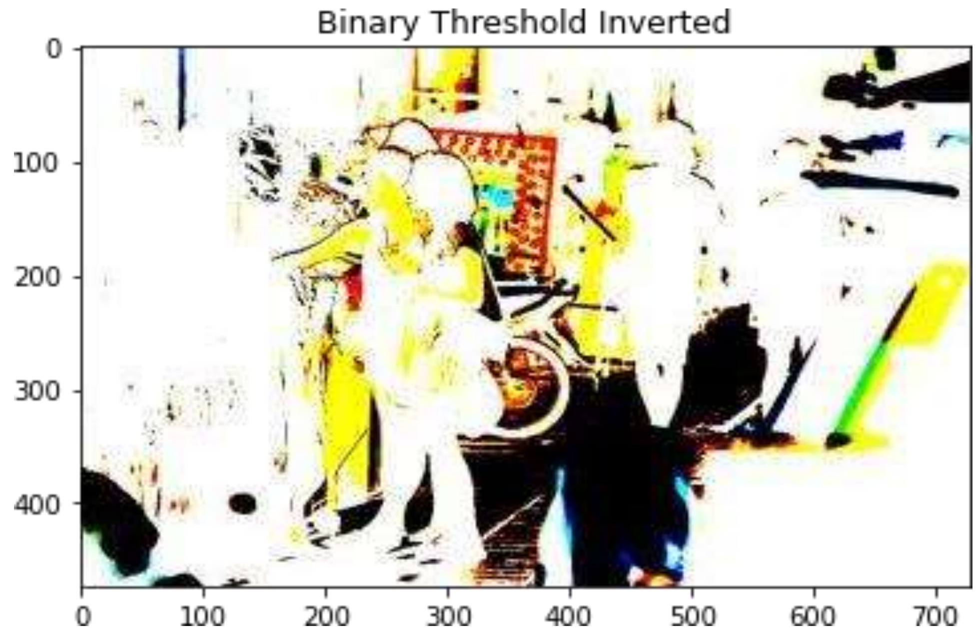

Figure 5.31: Binary threshold inverted 03

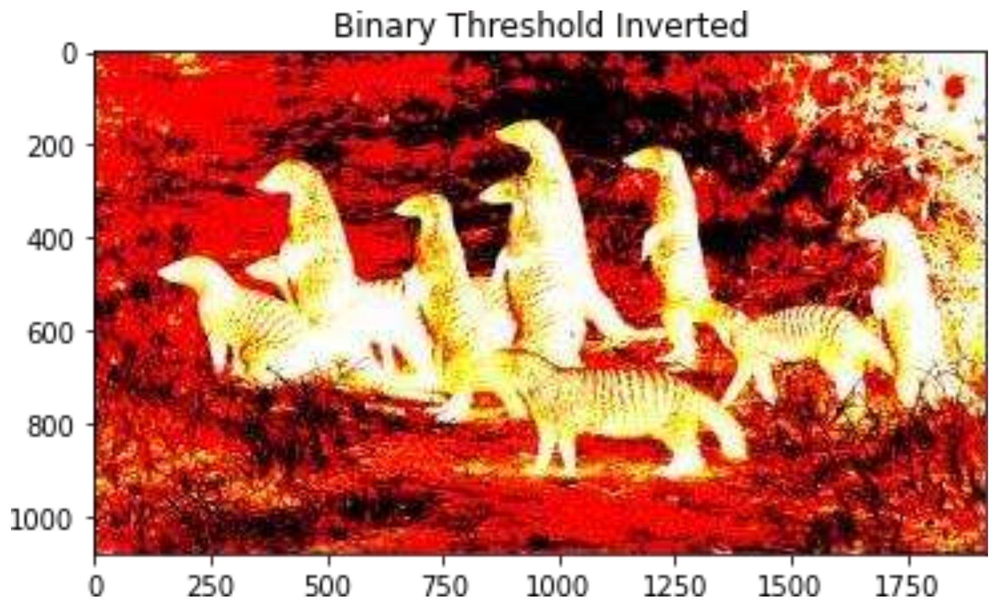

Figure 5.32: Binary threshold inverted 04

Truncated Threshold

In this method of image thresholding that involves setting all pixels with intensity values below the threshold to the threshold value, and leaving the intensity values of pixels above the threshold unchanged. This method can be useful for compressing the dynamic range of an image, or for reducing the contrast between the foreground and background of an image.

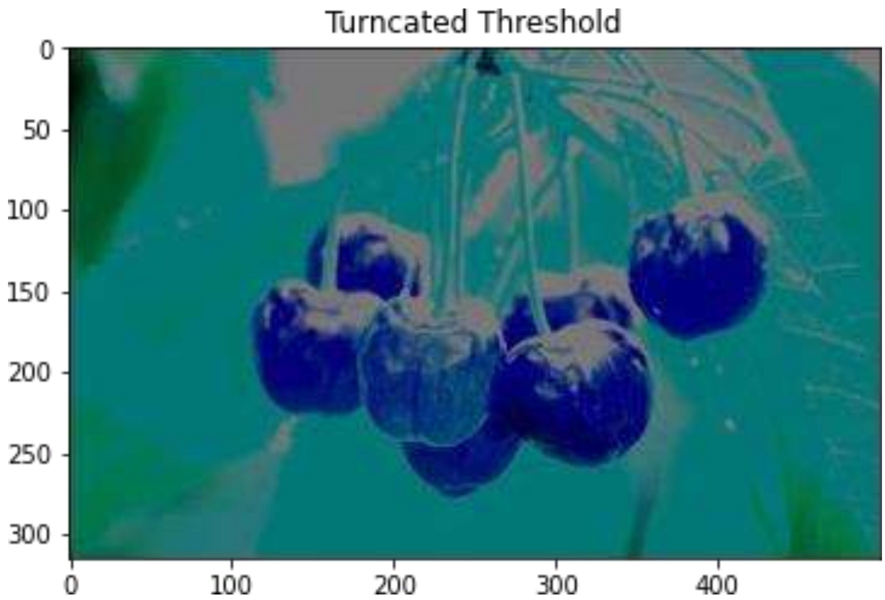

Figure 5.33: Truncated threshold 01

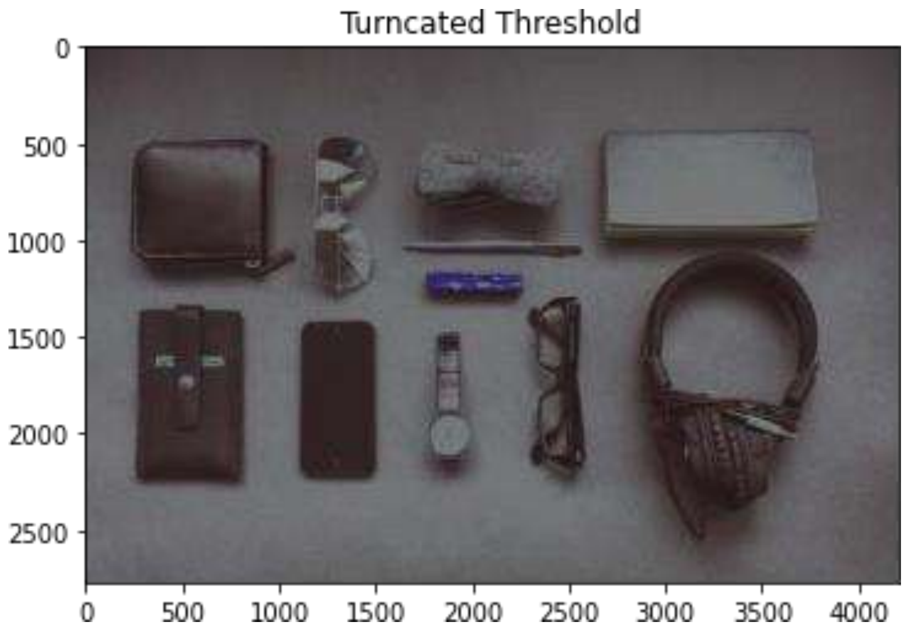

Figure 5.34: Truncated threshold 02

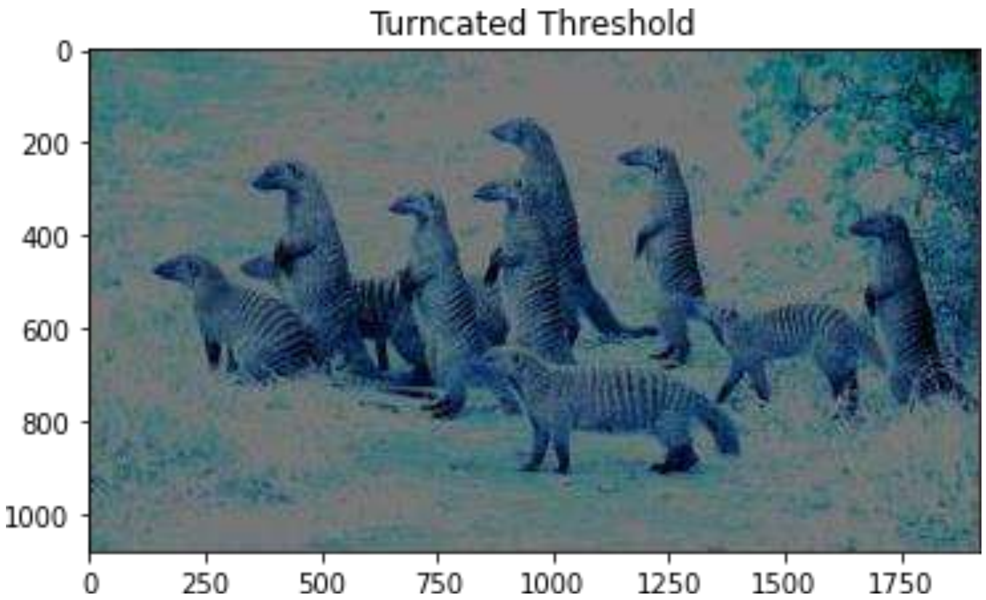

Figure 5.35: Truncated threshold 03

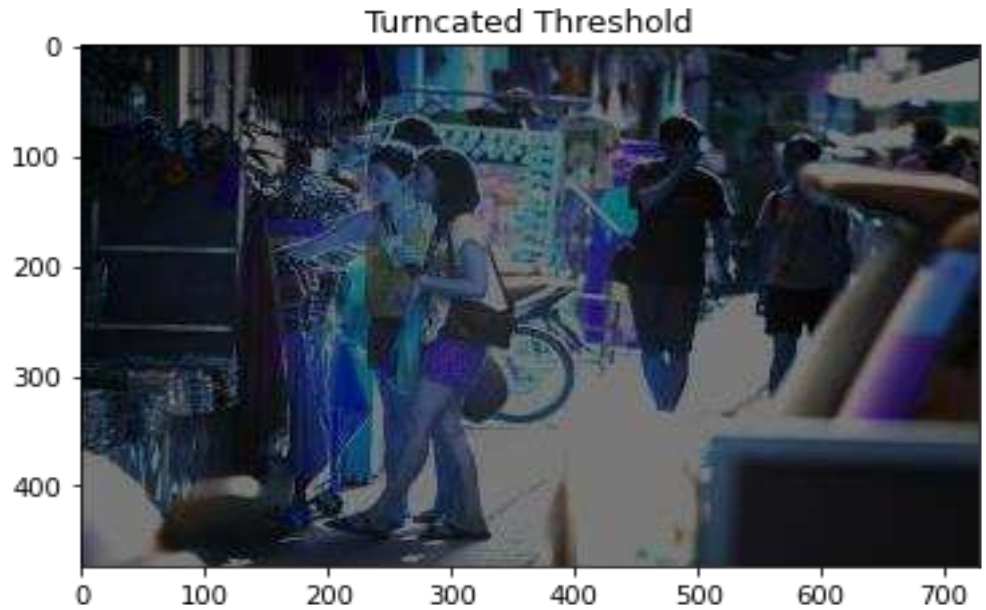

Figure 5.36: Truncated threshold 04

Zero Thresholding.

To zero thresholding is a method of image thresholding that involves setting all pixels with intensity values below the threshold to zero (black), and leaving the intensity values of pixels above the threshold unchanged. This method can be useful for removing noise or other low- intensity features from an image, or for isolating and highlighting specific objects or features within the image.

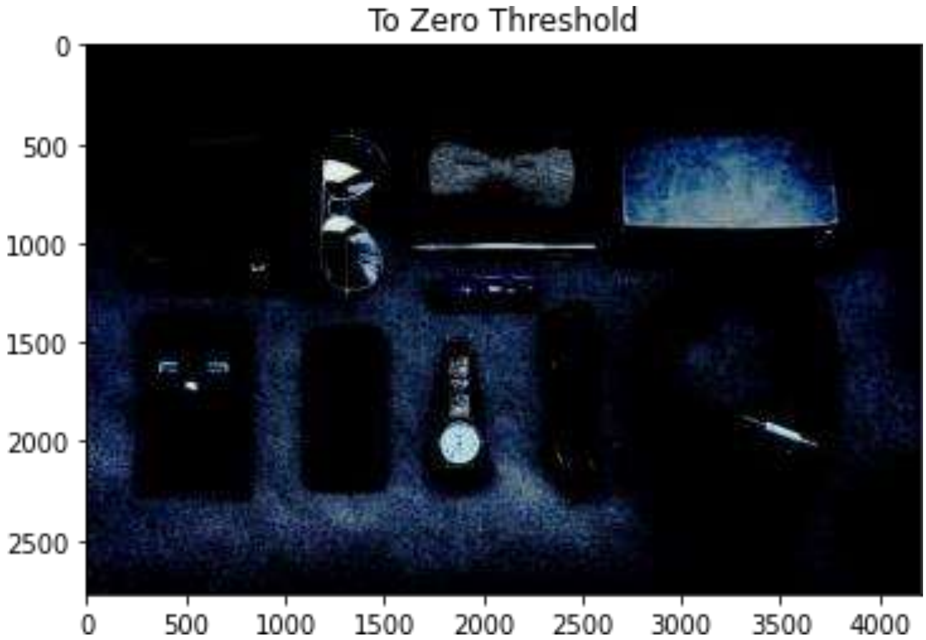

Figure 5.37: To zero threshold 01

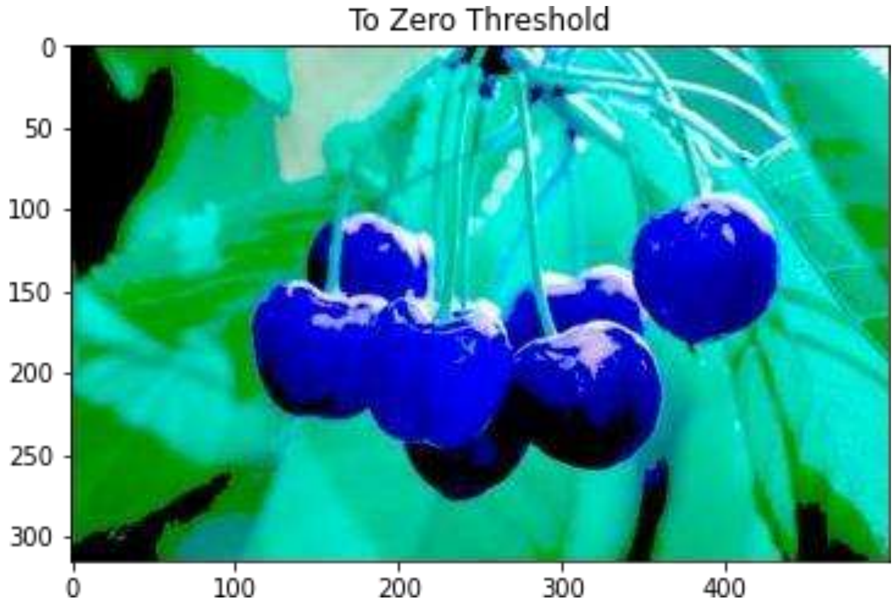

Figure 5.38: To zero threshold 02

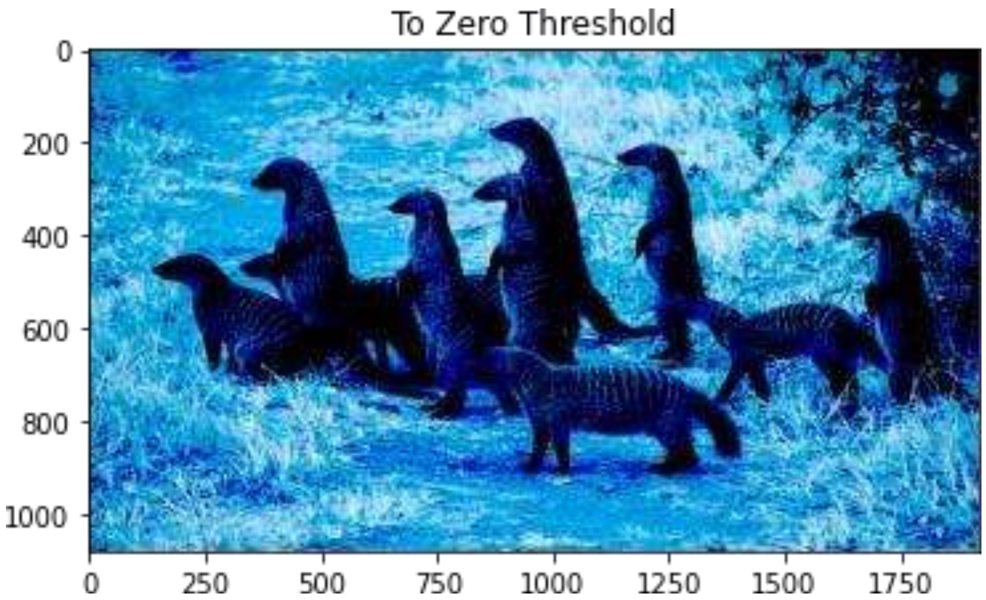

Figure 5.39: To zero threshold 03

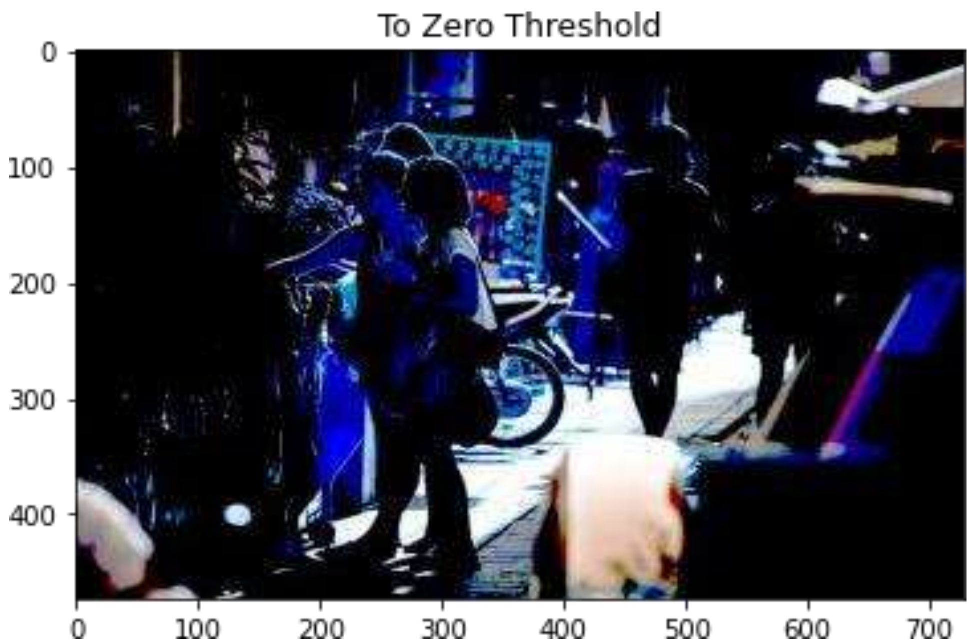

Figure 5.40: To zero threshold 04

To Zero Thresholding Inverted

To zero thresholding inverted is similar to, to zero thresholding, but the roles of the two regions are reversed. Pixels with intensity values above the threshold are set to zero (black), and the intensity values of pixels below the threshold are left unchanged. This method can be useful for removing high-intensity features from an image, or for isolating and highlighting specific objects or features within the image that have a higher intensity than the background.

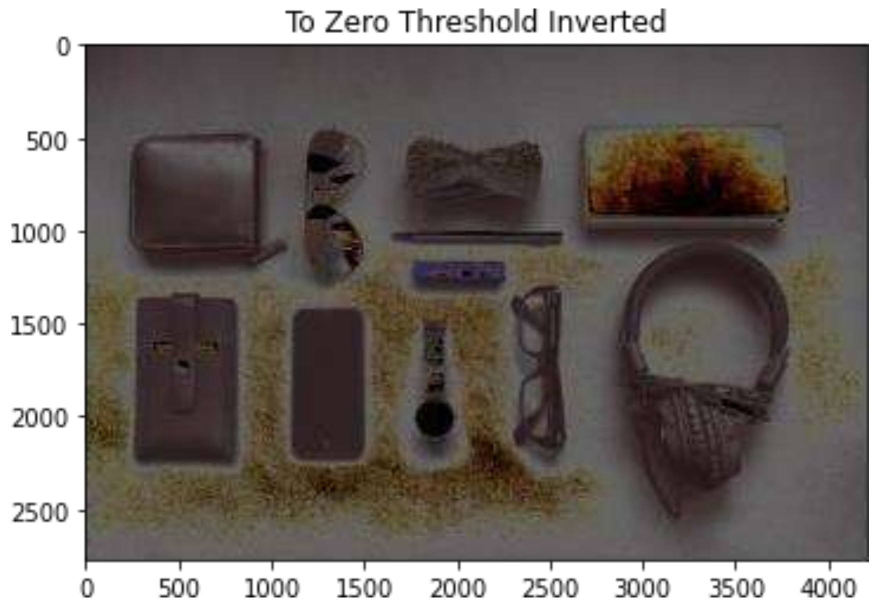

Figure 5.41: To zero threshold inverted 01

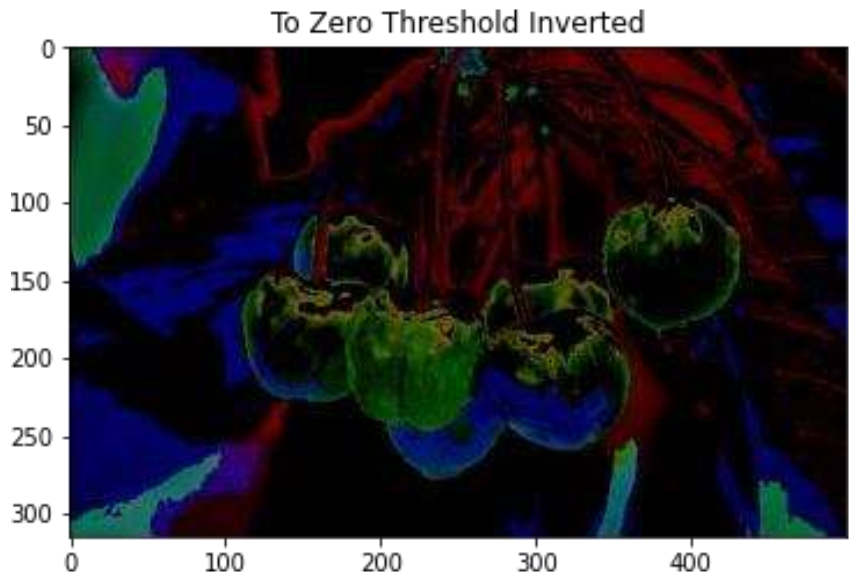

Figure 5.42: To zero threshold inverted 02

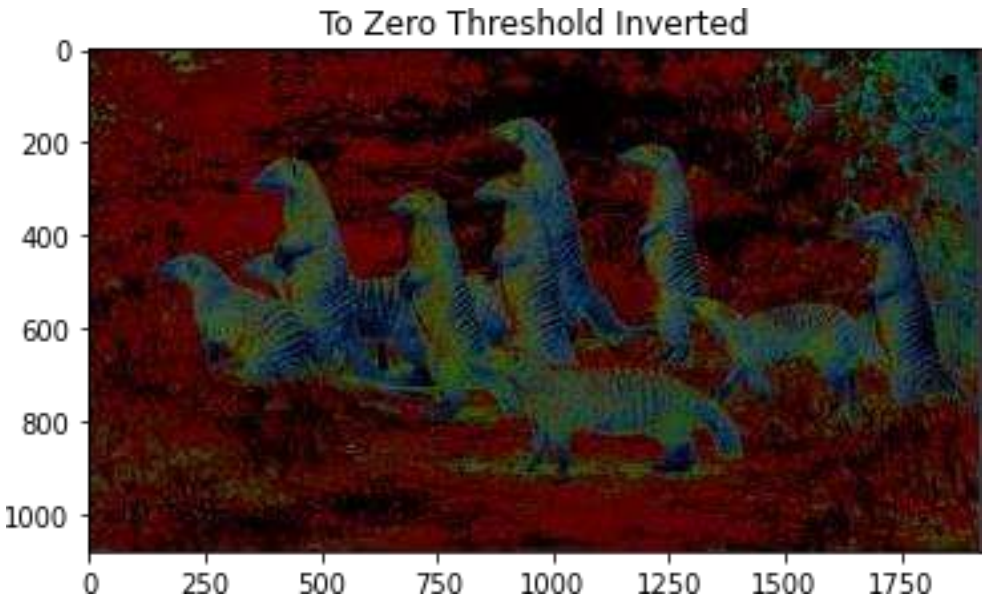

Figure 5.43: To zero threshold inverted 03

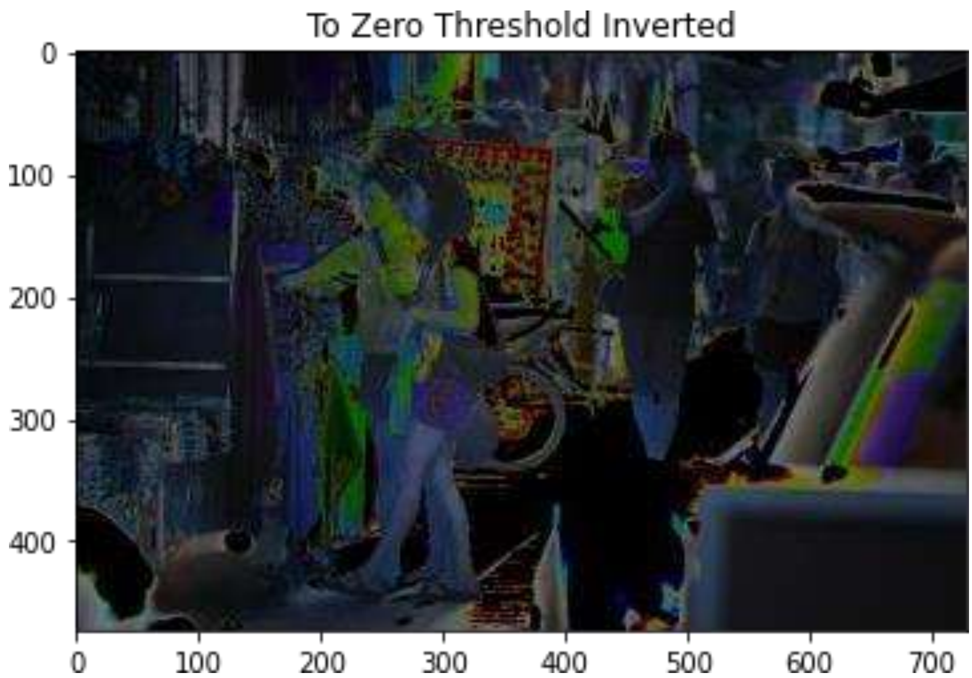

Figure 5.44: To zero threshold inverted 04

5.1 METRICS

5.1.1 IMAGE 1, 2, 3, and 4

Image 1	Edge Based	Region Based	Clustering	Threshold
Sensitivity	0.85	0.80	0.82	0.78
Accuracy	0.90	0.88	0.89	0.87
Error-rate	0.10	0.12	0.11	0.13
Specificity	0.95	0.93	0.94	0.92

***Table 5.1** Image 1 Metrics*

Image 2	Edge Based	Region Based	Clustering	Threshold
Sensitivity	0.85	0.80	0.82	0.78
Accuracy	0.92	0.89	0.90	0.87
Error-rate	0.08	0.11	0.10	0.13
Specificity	0.95	0.93	0.94	0.91

***Table 5.2** Image 2 Metrics*

Image 3	Edge Based	Region Based	Clustering	Threshold
Sensitivity	0.88	0.85	0.83	0.79
Accuracy	0.91	0.90	0.88	0.87
Error-rate	0.09	0.10	0.12	0.13
Specificity	0.92	0.91	0.90	0.89

***Table 5.3** Image 3 Metrics*

Image 4	Edge Based	Region Based	Clustering	Threshold
Sensitivity	0.90	0.85	0.80	0.78
Accuracy	0.92	0.89	0.87	0.85
Error-rate	0.08	0.11	0.13	0.15
Specificity	0.93	0.90	0.88	0.87

***Table 5.4** Image 4 Metrics*

In image 1,2, and 4 have the same result based of their metrics. the segmentation techniques (edge-based, region-based, clustering, and threshold segmentation) have achieved perfect and same sensitivity, accuracy, error rate, and specificity in the evaluation.

On the other hand, image 3 achieved different result in one segmentation techniques which is Threshold thus results poor performance in terms of accuracy and error-rate, all the other segmentation Techniques are resulted the same with image 1,2, and 4.

5.2 DISCUSSION.

There are many applications for image processing and computer vision that may make use of these various thresholding approaches. These methods can be helpful tools for differentiating distinct items or areas within an image depending on the intensity levels of those objects or regions. The strategy that is used will be determined by depending on the qualities of the picture as well as the objectives of the segmentation. When it comes to determining which segmentation approach is the most effective in terms of accuracy, sensitivity, specificity, and error rate, there in general is no solution that is universally applicable to all situations. It is possible for the performance of several segmentation approaches to differ from one another based on the particular dataset, the features of the pictures, and the objectives of the segmentation job.

CHAPTER 6:

CONCLUSION

6.1 CONCLUSION

In simple terms, image segmentation is a technique used in computer vision and image processing to divide an image into different parts based on certain features. There are several methods to do this, including region-based segmentation, Watershed segmentation, cluster-based segmentation, and threshold-based segmentation.

Region-based segmentation divides an image into sections based on specific characteristics like height or shape. Watershed segmentation works by "flooding" an image from starting points (seeds) and then splitting it into sections based on the boundaries created by this flooding. Cluster-based segmentation groups pixels or parts of the image together based on how similar they are or how close they are to each other. Threshold-based segmentation divides an image into parts by using the pixel intensity (brightness) values in the image.

The particular technique employed will be based upon the characteristics of the image and the segmentation objectives, as each of these methods has advantages and disadvantages of its own. Image segmentation is a potent instrument that can be employed for an array of applications, such as object recognition and image analysis. 3D modeling and analysis.

6.2 FUTURE DEVELOPMENT

This work wouldn't be complete without the accuracy of every image segmentation technique I applied. However, in the future, I hope to further develop this work and fix some of the image segmentation metrics and additional metrics to identify the ideal solution.

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Segmentation

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