Ahmet Emre Usta
2200765036

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AIN432 Project Report:
K-Means Clustering for Image Segmentation

Overview

In this project, we applied K-Means clustering to perform image segmentation using pixel-level and superpixel-level features. The goal was to explore the effectiveness of k-means clustering in partitioning images into distinct segments, based on different feature representations.

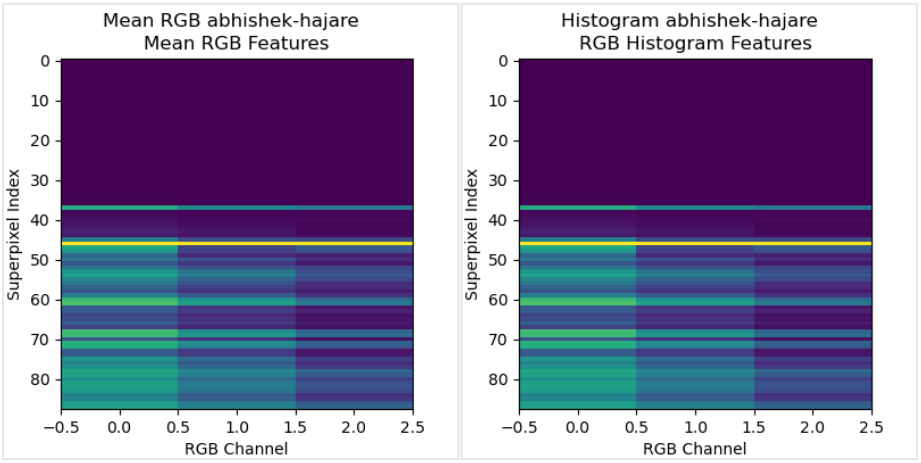
Approach

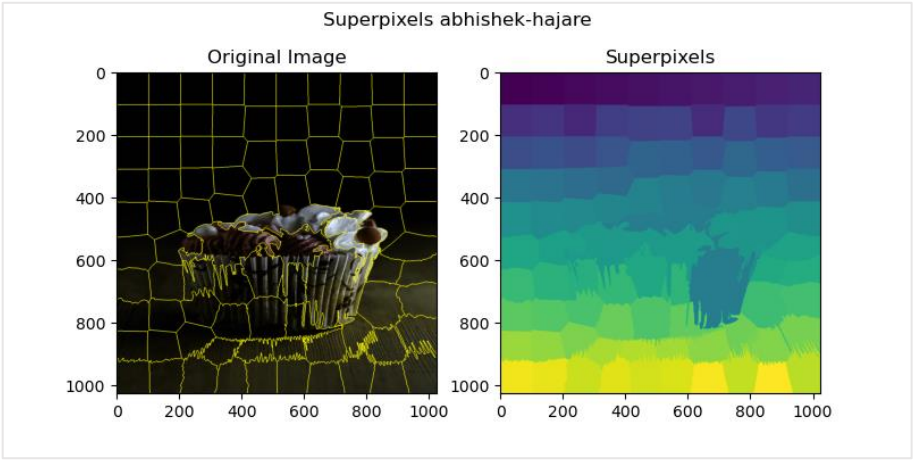
1. Data Preprocessing:

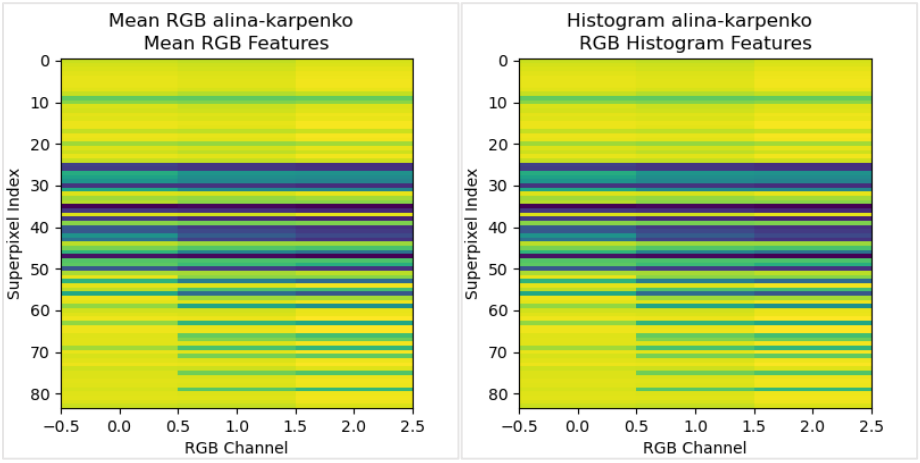
The raw images were resized to a standard size (1024x1024) to ensure consistency. Pixel-level and superpixel-level features were extracted from the resized images.

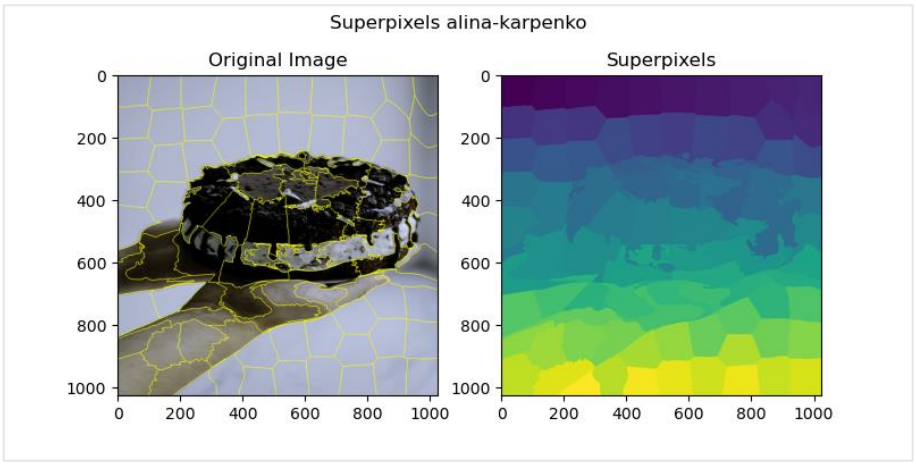
2. Feature Extraction:

For pixel-level features, the RGB color and spatial location features were extracted. Superpixel-level features included the mean RGB color values, RGB color histograms, and mean Gabor filter responses.









Others can be found in GitHub and Google Drive

3. K-Means Clustering:

A custom k-means clustering algorithm is implemented to cluster the extracted features. The elbow method was used to determine the optimal number of clusters.

4. Visualization:

Clusters were visualized on the original images, providing insights into the effectiveness of segmentation.

Results

1. Elbow Method Analysis:

The elbow method was used to determine the optimal number of clusters for both pixel- and superpixel-level features.

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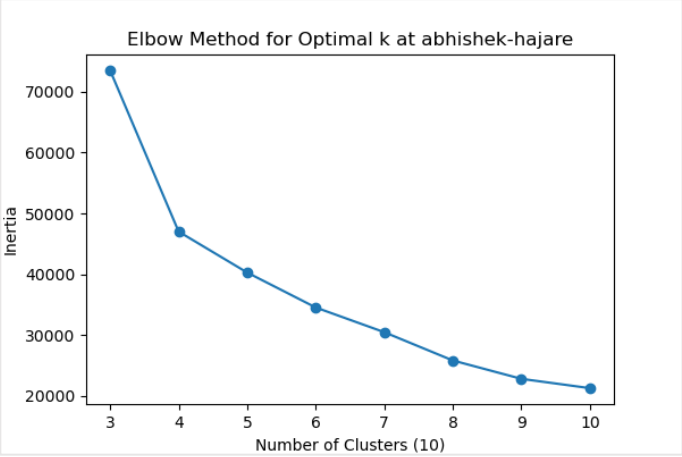

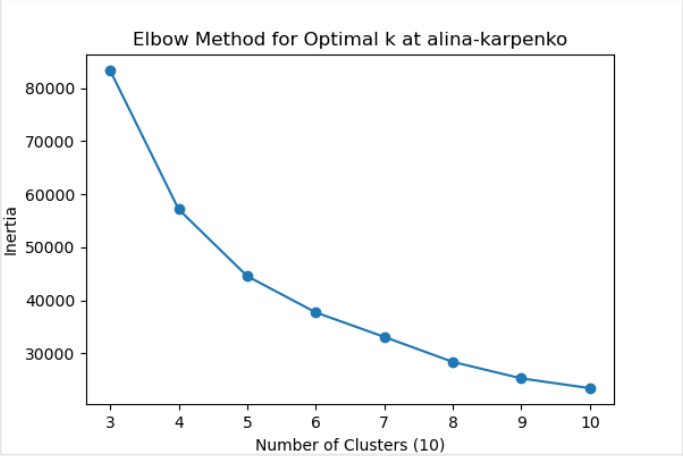

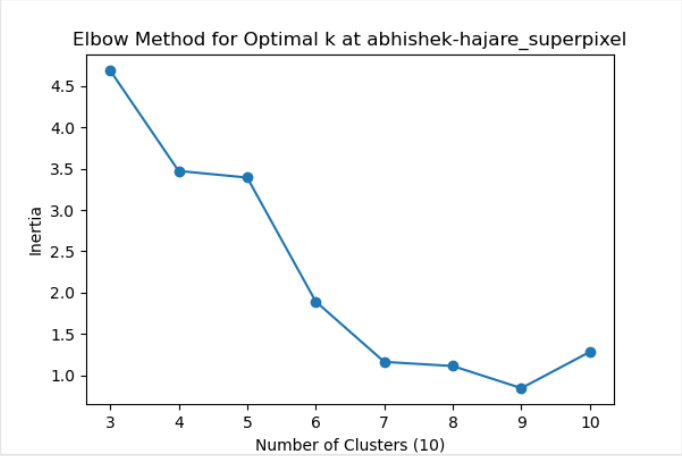

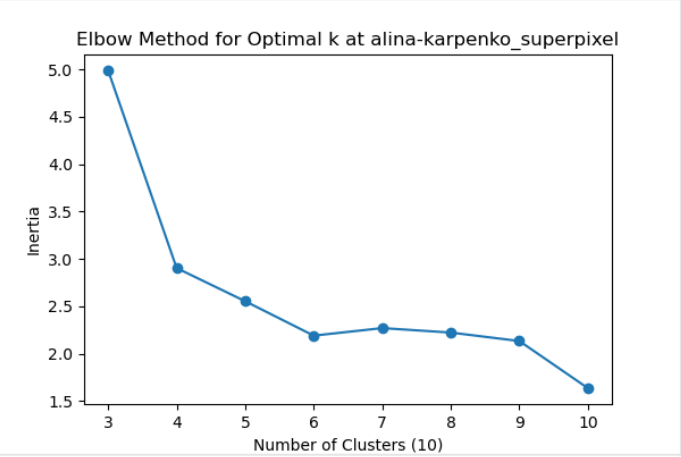

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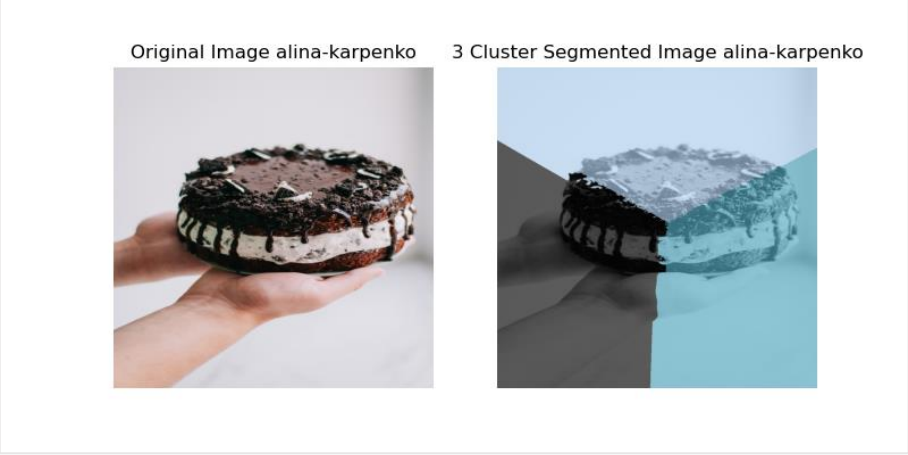
2. Pixel-Level Clustering:

Pixel-level features were clustered using a custom k-means algorithm. The results were visualized for different cluster numbers, and the impact of the number of clusters on segmentation quality was analyzed.



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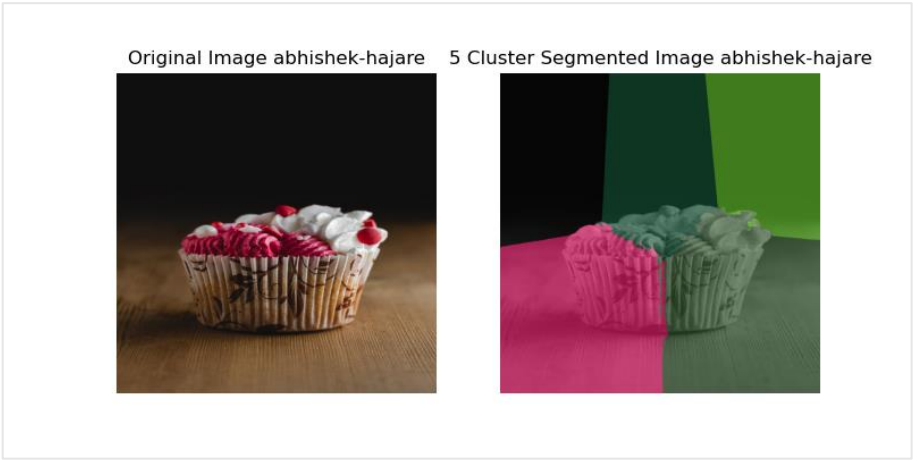
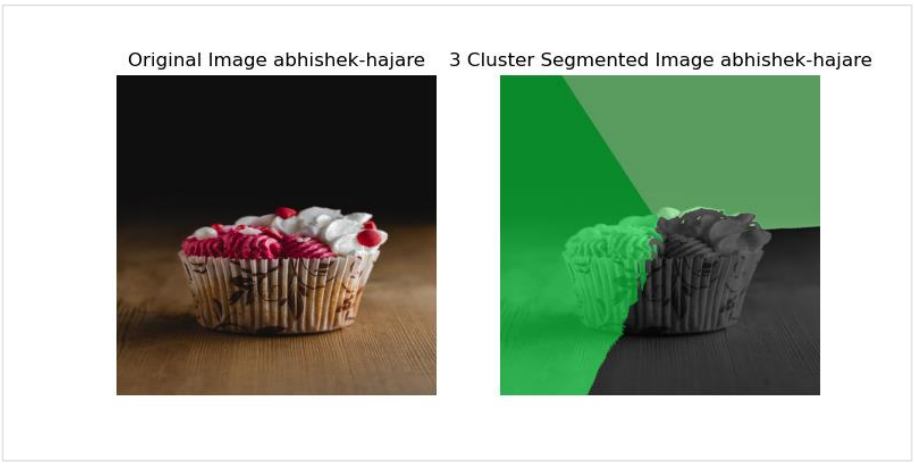
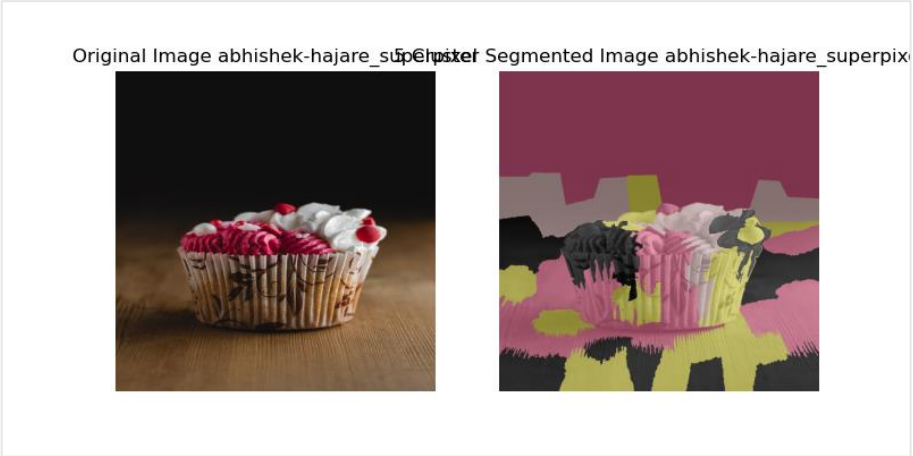


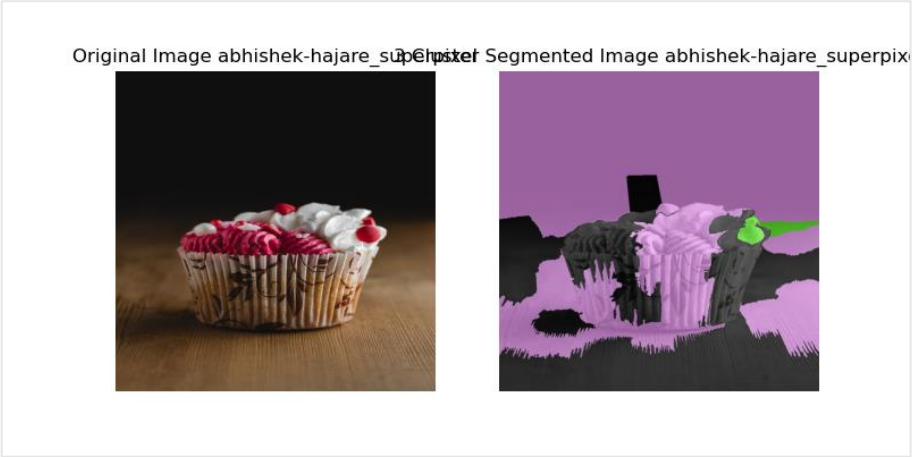


Others can be found in GitHub and Google Drive

3. Superpixel-Level Clustering:

Superpixel-level features were clustered using a custom K-means algorithm. Visualizations show the segmentation results for varying cluster numbers.





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Conclusion

In conclusion, the application of k-means clustering to image segmentation demonstrated promising results. The project provided insights into the impact of different feature representations and cluster numbers on segmentation quality. The custom K-means implementation, coupled with visualization techniques, offered a comprehensive understanding of the segmentation outcomes.