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COUNTING OBJECTS

Presentation

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INTRODUCTION

This project focuses on building an automated object counting system. The main challenge is Overlapping Objects, where individual items (Takoyaki and Strawberries) touch each other and look like one single group. We use HSV Color Segmentation and basic image cleaning to separate these objects and get an accurate count.

Objectives

Objective 01

Effective Segmentation: To use HSV Thresholding to clearly pick out the food items while ignoring shadows and bright reflections.

Objective 02

Noise Removal: To use Area Filtering to delete small, unwanted dots and keep only the main objects.

Objective 03

Result Analysis: To compare simple counting versus advanced separation to see which method gives the most accurate number.

Objective 04

Object Separation: To test how well the Distance Transform can "break" a large group into individual pieces for better counting.

CONTEXT OF THE **PROBLEM**

The core difficulty in Object Counting is not just background removal, but Overlapping Instance Segmentation.

- Complex Textures (Takoyaki): Irregular surfaces (sauce, shavings) cause uneven color thresholding and fragmented masks.
- The "Blob" Problem (Strawberry): Uniformly colored objects packed tightly together appear as a single large mass (blob) to standard algorithms.
- Goal: To move beyond simple detection and achieve precise individual entity separation for accurate counting.

STEP PROCESSING **PIPELINE**

1. Color Space Conversion: RGB to HSV (Hue, Saturation, Value) to achieve lighting invariance.

2. Binary Segmentation: Masking specific color ranges (Reds/Browns) to create a foreground-background map.

3. Noise Refinement: Utilizing Area Filtering and Morphological operations to remove artifacts.

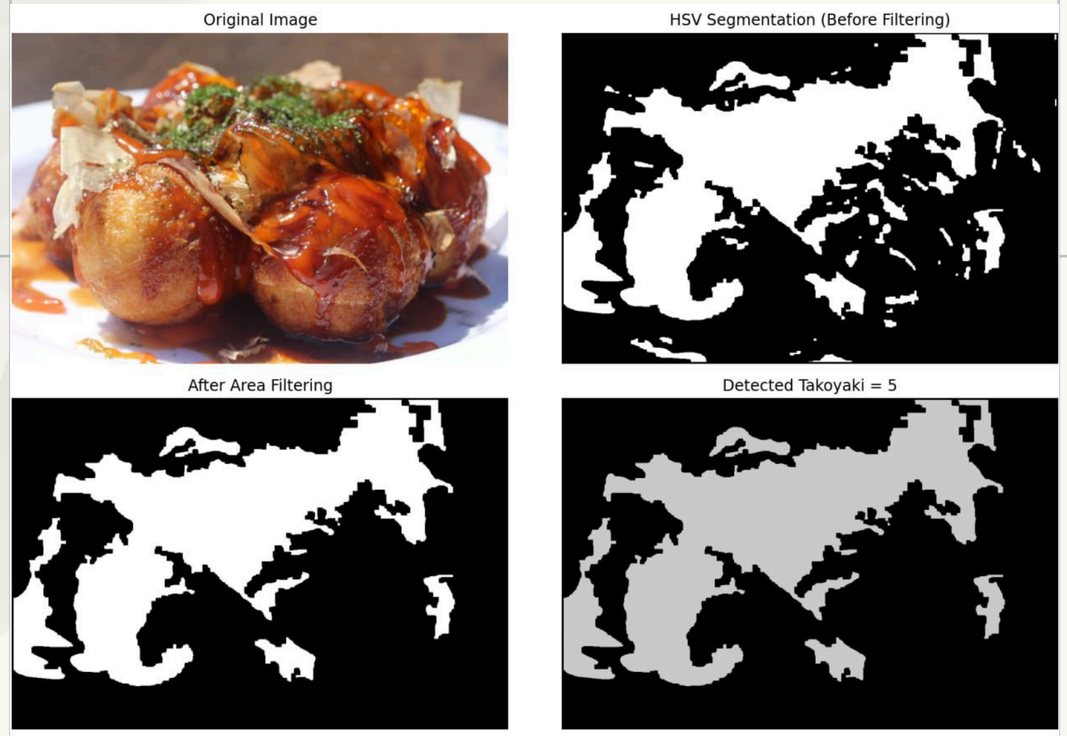
4. Spatial Separation: Applying algorithms like Distance Transform to identify object centers.

5. Labeling: Assigning unique IDs to connected components to determine final counts.

CASE STUDY

1- TAKOYAKI(Area Filtering)

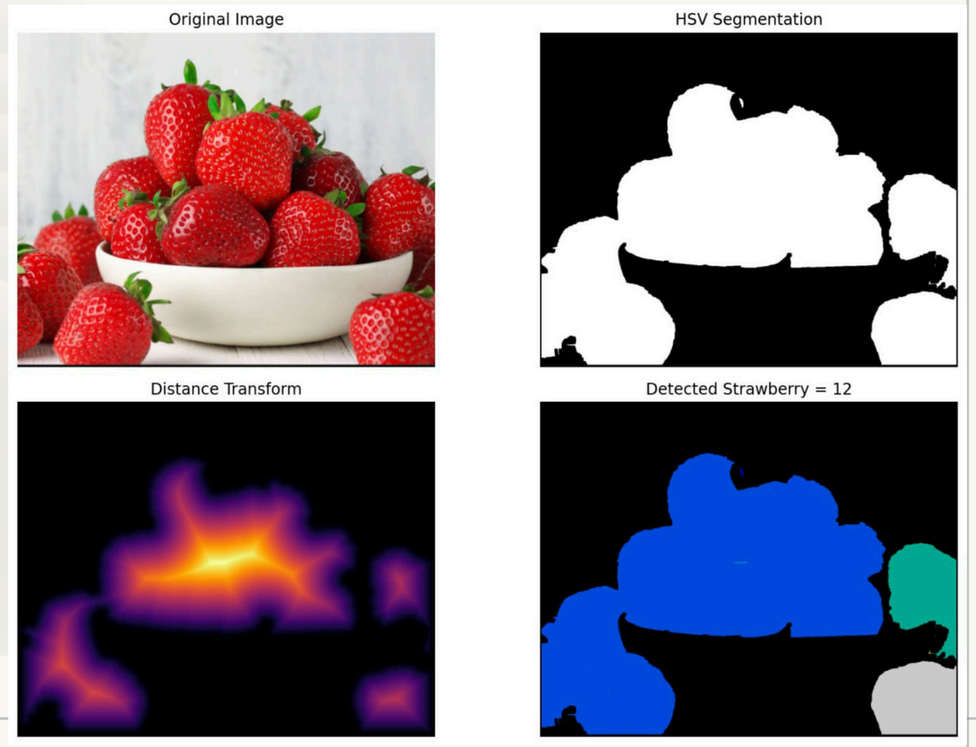
- Technique: After HSV segmentation, many small noise particles (specular reflections) remain. We applied an Area Threshold to keep only significant blobs.
- Observation: The system detected 5 components.
- Limitation: Because the Takoyaki are physically touching, the algorithm lacks a "bridge-breaking" mechanism. It treats clustered balls as a single connected component, leading to under-counting.



CASE STUDY

2- STRAWBERRY(Distance Transform)

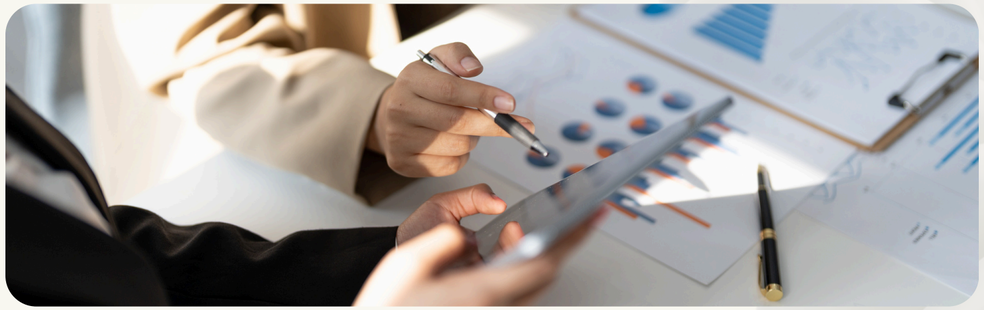
- Technique: To solve the clustering problem, we used Distance Transform. This calculates the distance of every foreground pixel to the nearest background pixel.
- The Logic: The "peaks" (brightest points) of the transform represent the center of each strawberry.
- Observation: The multicolored labels in the output show the algorithm attempting to isolate individual berries.
- Result: While improved, the dense center still poses a challenge for traditional watershed boundaries.



PERFORMANCE **EVALUATION**

How well did the system handle the problem?

Segmentation Accuracy: High. The HSV masks successfully isolated the food items from the white plates and backgrounds with minimal leakage.



Counting Accuracy:

- Takoyaki: Low. Area filtering is too primitive for "sticky" objects.
- Strawberry: Moderate. Distance Transform provides a better mathematical foundation for separation, but suffers when the "valleys" between objects are too narrow to detect.
- Overall: The pipeline is robust for isolated objects but requires more advanced geometry-based separation for clusters.

CONCLUSION

In conclusion, HSV Segmentation is a great way to separate objects from the background.
However, the Takoyaki example shows that simple methods fail to count objects that are touching. The Strawberry example proves that Distance Transform is much better at finding individual centers within a group. To get the best results, we must use specific tools to separate objects that touch, rather than just relying on color alone.

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