COUNTING OBJECTS

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INTRODUCTION

Object counting is an important task in image processing, especially in applications involving real-world images. However, counting food objects such as strawberries and takoyaki is challenging due to color similarity, uneven lighting, and overlapping objects. This assignment explores the use of HSV color space and watershed segmentation to improve object detection and counting accuracy compared to traditional grayscale-based methods.

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PROBLEM CONTEXT

Counting food objects such as strawberries and takoyaki is challenging due to:

- Similar colors between objects and background
- Uneven lighting and shadows
- Objects touching or overlapping each other

Traditional grayscale-based segmentation fails to separate overlapping objects accurately.

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OBJECTIVE

1. To detect and count food objects from images

2. To apply HSV color space for better color-based segmentation

3. To improve counting accuracy for overlapping objects using watershed segmentation

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WHY HSV INSTEAD OF GRAYSCALE

Grayscale limitation:

- Only uses intensity
- Overlapping objects merge into one region

HSV advantages:

- Separates color (Hue) from illumination (Value)
- More robust for color-based object detection
- Suitable for red strawberries and yellow-brown takoyaki

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IMAGE PROCESSING PIPELINE

1. Input RGB image
2. Convert RGB → HSV
3. Color thresholding (mask creation)
4. Morphological operations (noise removal)
5. Distance transform
6. Marker-based watershed segmentation
7. Object counting

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STEP PROCESSING:

1. **Color Segmentation**:
   - HSV threshold is applied to isolate target colors
   - Red mask for strawberries
   - Yellow-brown mask for takoyaki
   - Produces binary mask highlighting object regions

2. **Morphology & Distance Transform:**
   - Morphological opening removes small noise
   - Distance transform identifies object centers
   - Peaks represent individual object markers

   This step is crucial for separating touching objects.

3. **Watershed Segmentation**:
   - Markers are used to guide watershed algorithm
   - Watershed separates overlapping objects
   - Each object receives a unique label

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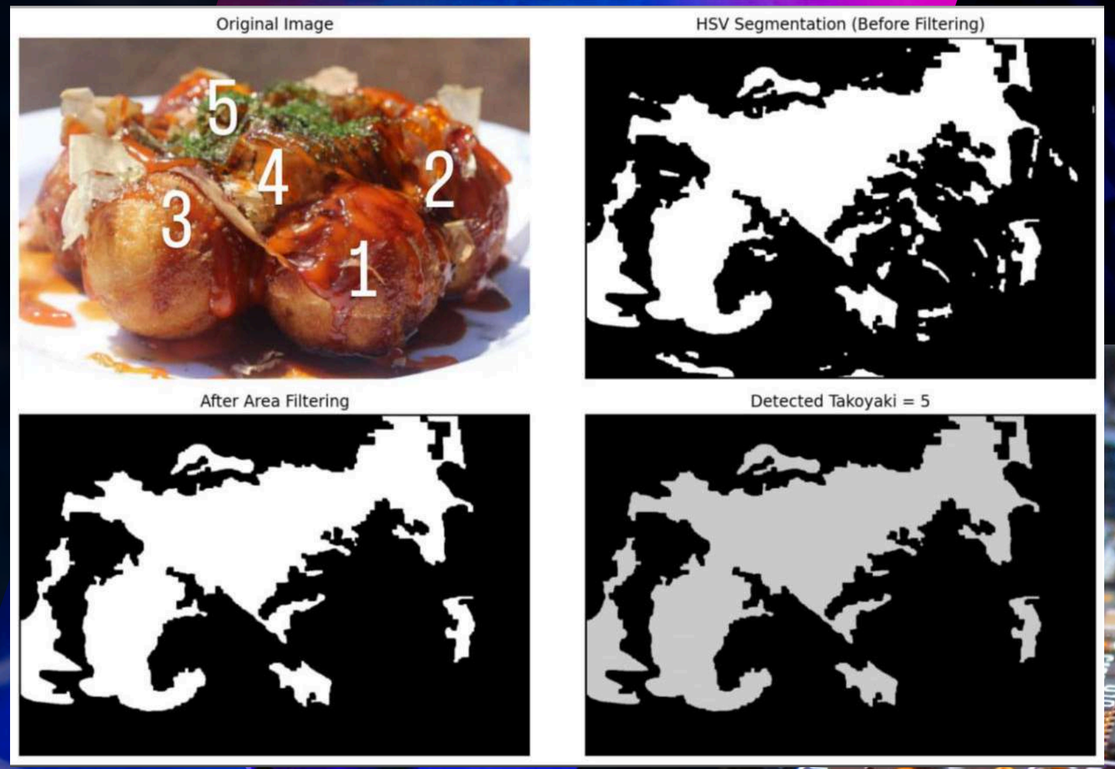
CASE STUDY 1 TAKOYAKI

Results - Takoyaki

Detection

- Takoyaki detected using HSV color segmentation
- Area filtering removes small false detections
- Final count displayed on image



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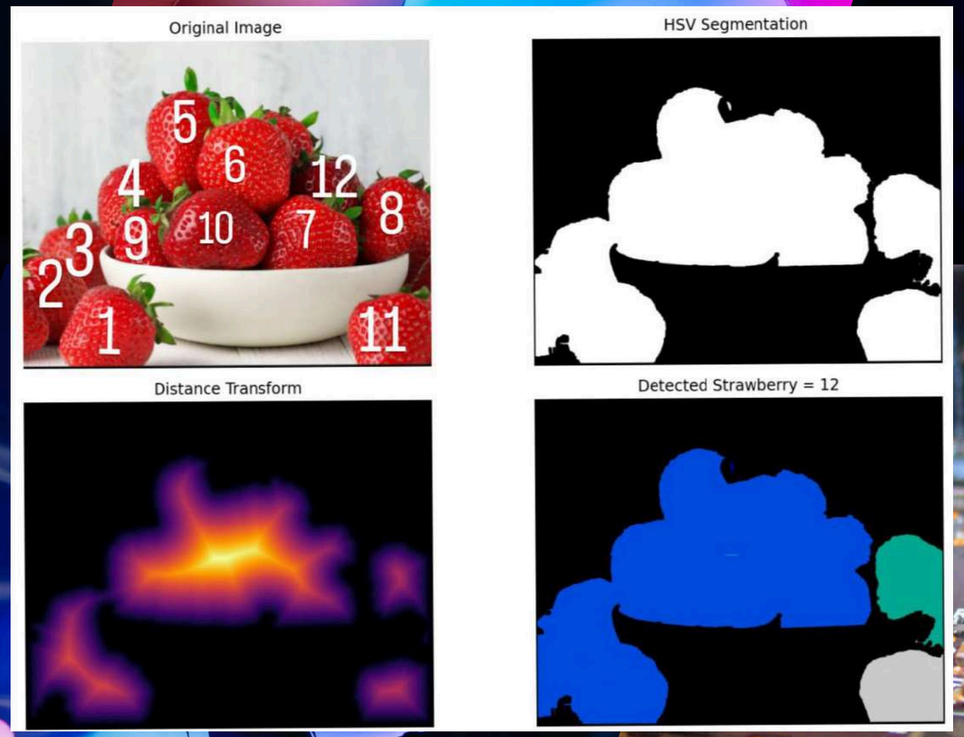
CASE STUDY 2 STRAWBERRY

Results - Strawberry Detection

- Detected strawberries: 12 objects
- Most overlapping strawberries successfully separated
- Boundaries drawn to visualize segmentation results



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CHALLENGES & LIMITATIONS

- Strawberry red color range is narrow and inconsistent
- Strong overlap causes some under-segmentation
  Lighting variation affects HSV
  threshold stability
- These challenges are common in real-world image processing tasks.

CONCLUSION

- HSV-based segmentation improves object detection
- Watershed effectively separates overlapping objects
- The approach significantly outperforms grayscale segmentation

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THANK YOU

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