Inventory Management Using Color Segmentation

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Course:
Deep Learning For Perception

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Objective

The objective of this project is to develop a color segmentation-based inventory management system for efficient tracking and monitoring of items in a warehouse or store environment.

Problem Statement

Traditional inventory management systems often rely on manual processes for item counting and tracking, leading to inefficiencies, errors, and time-consuming operations. By leveraging color segmentation techniques, we aim to automate the inventory management process and improve accuracy and speed in item detection and counting.

Methodology

1. Data Acquisition and Preprocessing

1. **Data Collection:**
    - Acquire images or videos of the inventory environment using cameras or sensors.
2. **Image Preprocessing:**
    - Load the captured images using OpenCV library.
    - Resize the images to a standard size for consistency in processing.
    - Convert the images from BGR to HSV color space for color segmentation.

2. Color Segmentation and Object Detection

1. **Color Definition:**
    - Define the lower and upper HSV color ranges for each item category to be segmented.
2. **Color Segmentation:**
    - Create a dictionary of color ranges and corresponding color names.
    - Iterate through the color ranges dictionary to segment colors in the image.
    - Apply thresholding and contour detection to identify objects based on color segmentation.
3. **Object Counting:**
    - Initialize counters for each color category to track the quantity of items.
4. **Bounding Boxes and Labels:**

- Draw bounding boxes around segmented objects using OpenCV's rectangle function.
- Add labels with color names to the bounding boxes for visual identification.

3. User Interaction and Feedback

1. **Trackbar Interface:**
   - Create a graphical trackbar interface using OpenCV to adjust color ranges interactively.
   - Display the live camera feed and the segmented results side by side for real-time feedback.
2. **Quantity Display:**
   - Show the quantities of each color category on the screen using OpenCV's text rendering capabilities.

4. System Integration and Testing

1. **Integration:**
   - Integrate the color segmentation and object counting algorithms into the inventory management system.
   - Ensure compatibility with the existing inventory database or management software.
2. **Testing and Validation:**
   - Test the system with sample images or live camera feeds in a controlled environment.
   - Validate the accuracy of color segmentation and quantity counting against ground truth data.

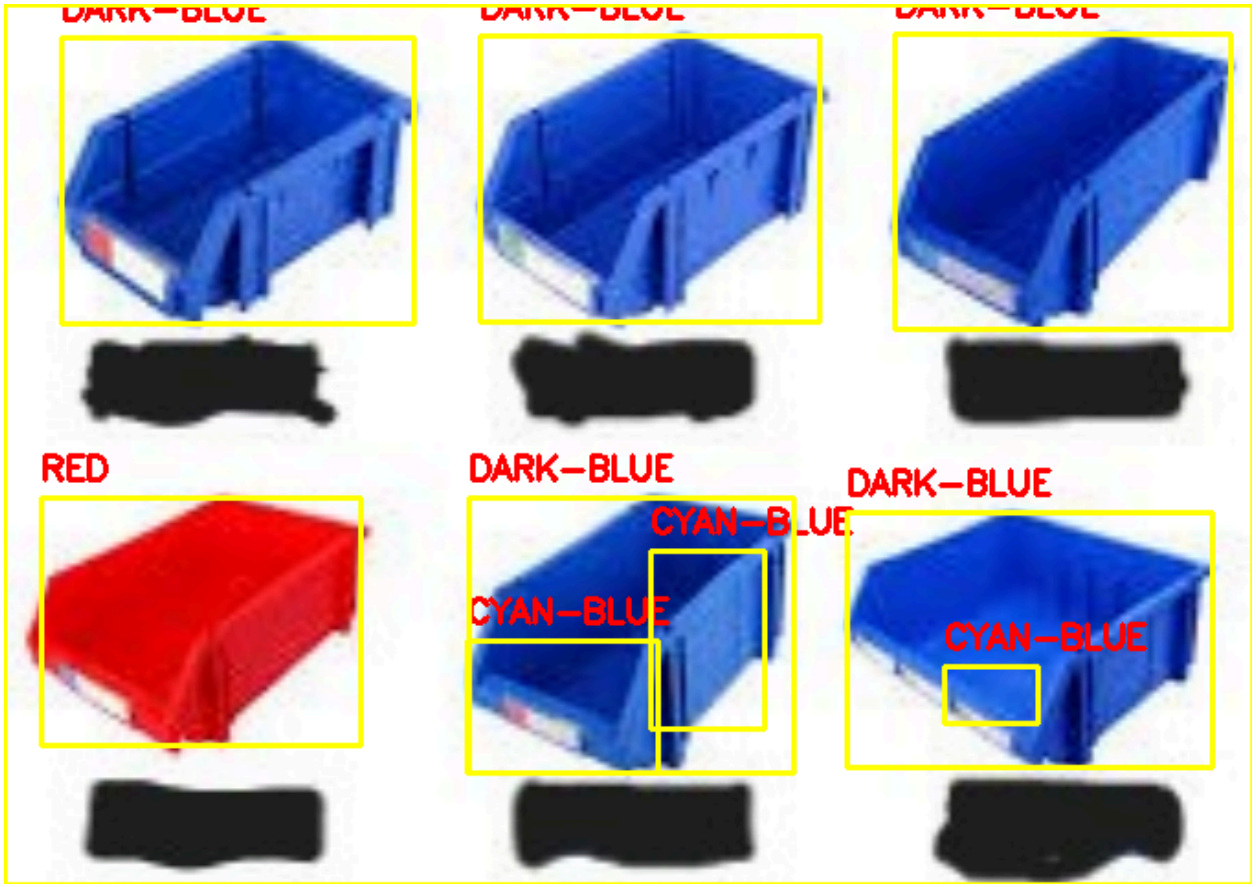
Results

1. **Results Evaluation:**
   - Evaluate the system's performance based on accuracy, speed, and user experience.
   - Identify any areas of improvement or optimization.
2. **Optimization:**

- Fine-tune color ranges and segmentation parameters for improved accuracy and robustness.
- Implement optimization strategies such as noise reduction and adaptive thresholding.

3. **Result Demonstration:**

- Quantity of CYAN-BLUE: 2
- Quantity of DARK-BLUE: 4
- Quantity of RED: 0
- Quantity of YELLOW: 0
- Quantity of WHITE: 7
- Quantity of PINK: 1



- Quantity of CYAN-BLUE: 3
- Quantity of DARK-BLUE: 5
- Quantity of RED: 1
- Quantity of YELLOW: 0
- Quantity of WHITE: 1
- Quantity of PINK: 0

- Quantity of DARK-BLUE: 6
- Quantity of RED: 6
- Quantity of YELLOW: 6
- Quantity of WHITE: 9
- Quantity of CYAN-BLUE: 3

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GitHub Repository:

https://github.com/shayanpirani/color-segementation-for-inventory-managment