

Resistor Detection and Classification Using Support Vector Machines

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Overview

- 1 Introduction
- 2 Detection
- 3 Classification
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- 5 Conclusion

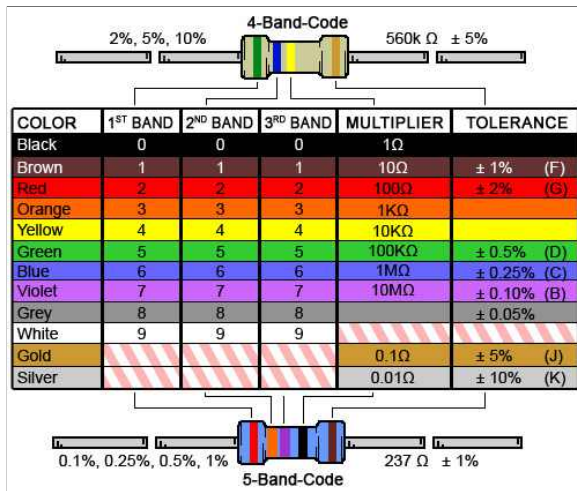
Objective

Successfully be able to detect and classify resistors in an image.

- Detection– Determining the location of the resistors in the image
- Classification– Determining the resistor value based on color codes

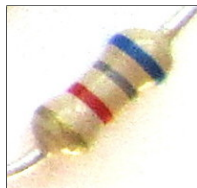


Resistor Color Codes



Assumptions

- Resistors are all of a standard type
- Resistors are of a similar size in images
- Images are all of the same resolution
- Images have a similar white balance
- Images have been taken on a white background
- Images have been taken with a consistent camera angle
- Images only include resistors

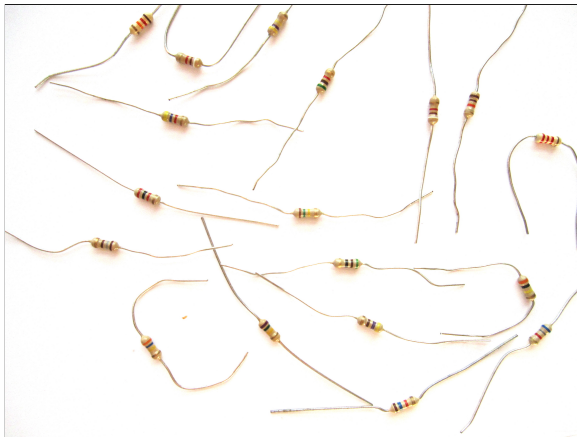


Detection

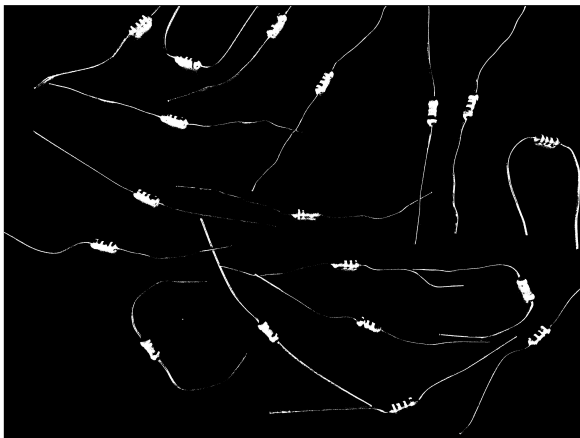
Basic Approach

- Convert image to black and white (binary image)
- Convolve the binary image with a binary mask of a resistor
- Rotate the binary mask and convolve again, repeat at 10° intervals
- Find local maximum in the convolved space

Initial Image



Binary Image

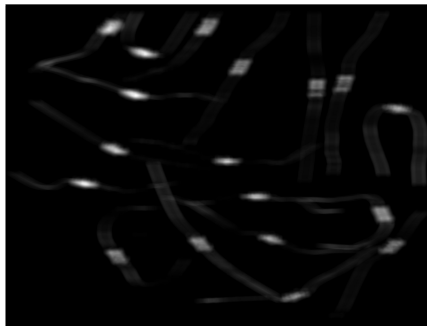


Resistor Mask

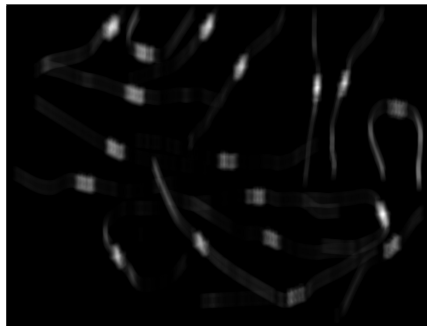


Convolved Images

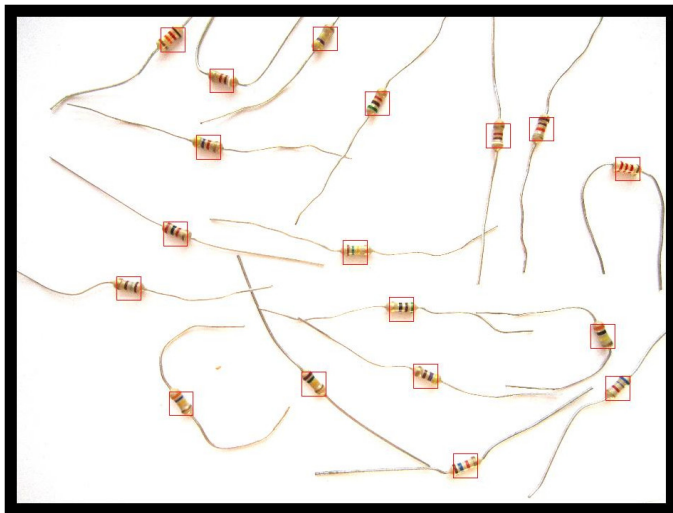
Mask at 0°



Mask at 90°



Resistor Bounding Boxes



Resistor Bounding Box



Classification

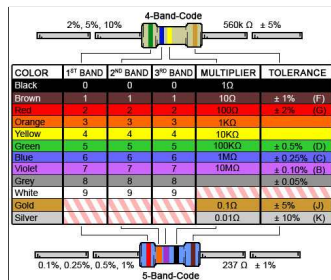
Basic Approach

- Collect 3x3 mean RGB data from each color band and base resistor color
- Train support vector machine (SVM) classifier
- Apply prediction to each pixel in resistor
- Use statistical results of classification to determine resistor value

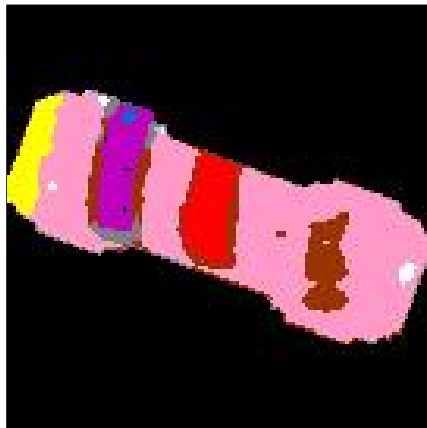
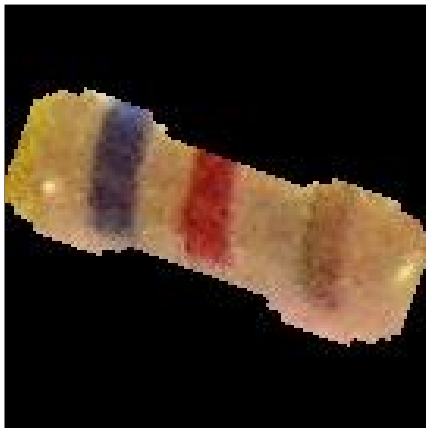
Train Classifier

- 11 class problem
- 880 training points
- 220 verification points
- Used radial basis kernel function

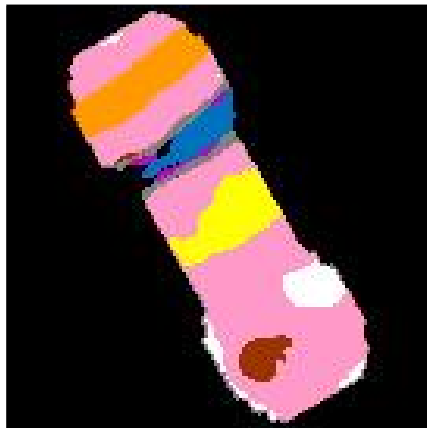
$$K(x, x') = \exp(\gamma ||x - x'||)$$
- 5 fold cross validation
- Grid search for cost function (C) and γ
- Cross Validation Accuracy = 95.4649%
- Verification Accuracy = 94.5701%



Apply Classifier



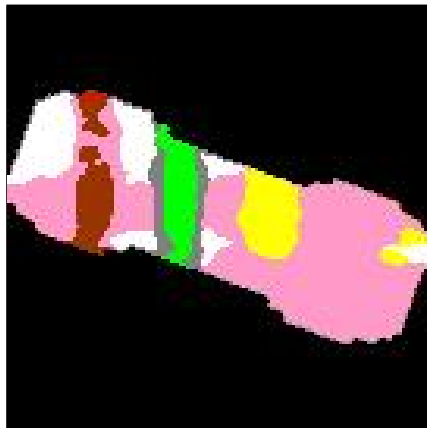
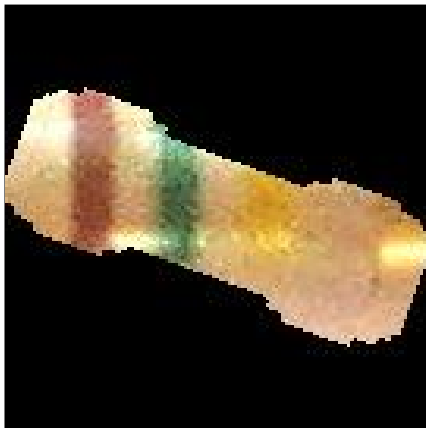
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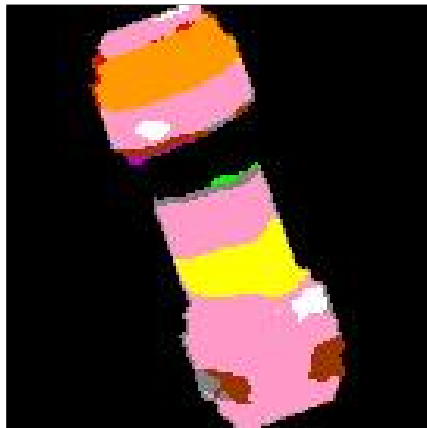
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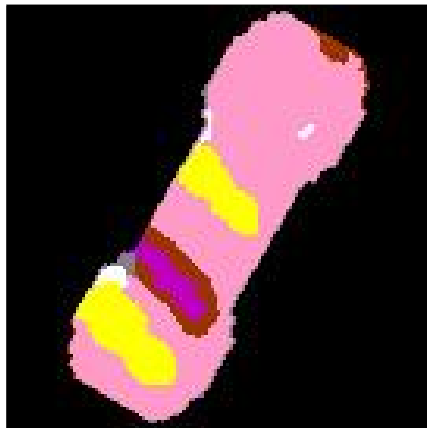
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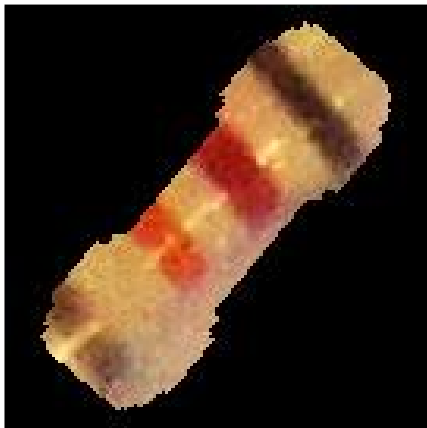
Apply Classifier



Apply Classifier



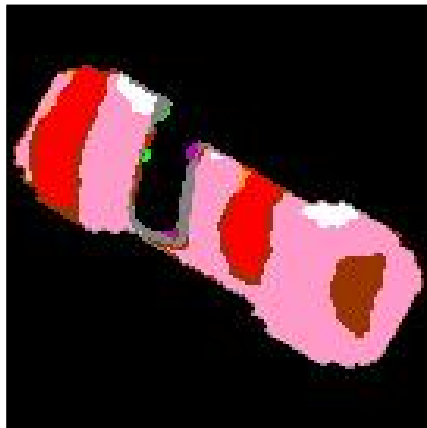
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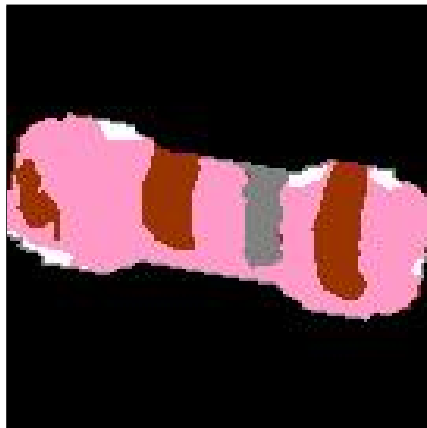
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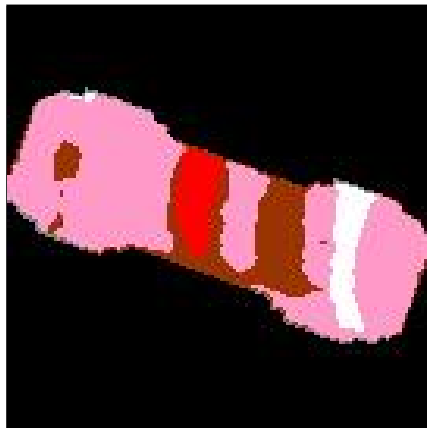
Apply Classifier



Apply Classifier



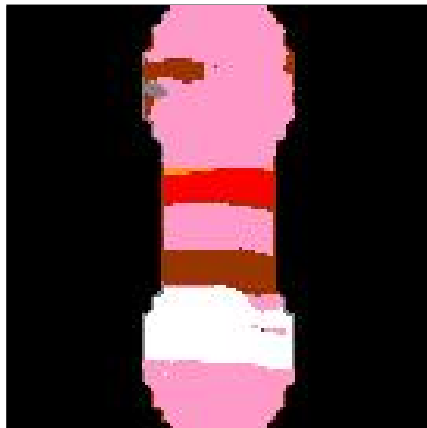
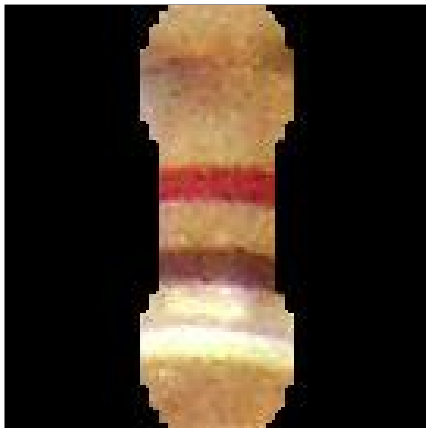
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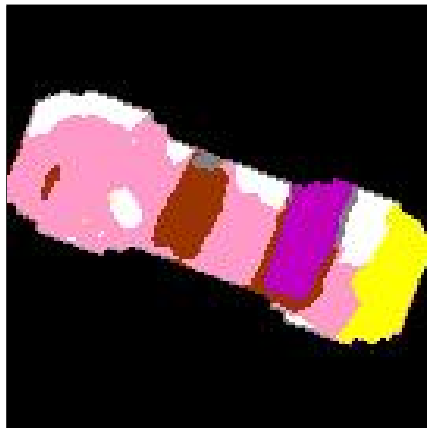
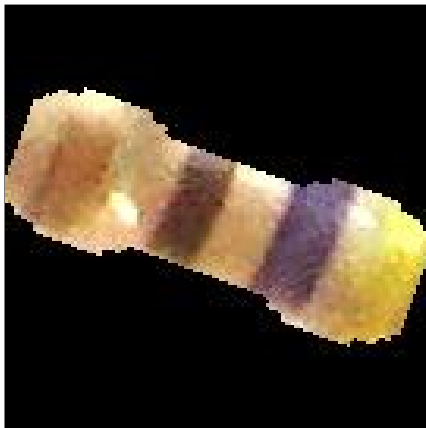
Apply Classifier



Apply Classifier



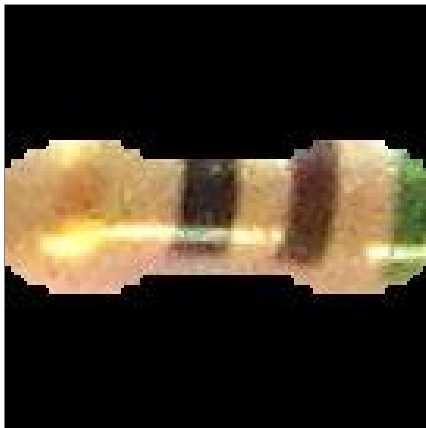
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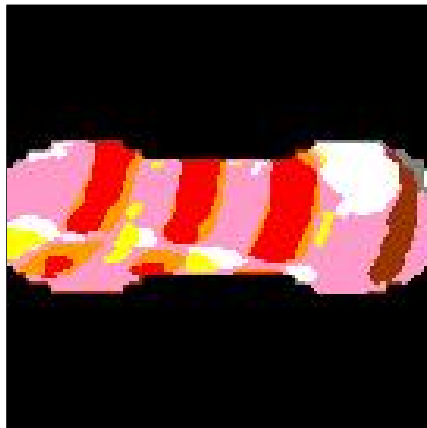
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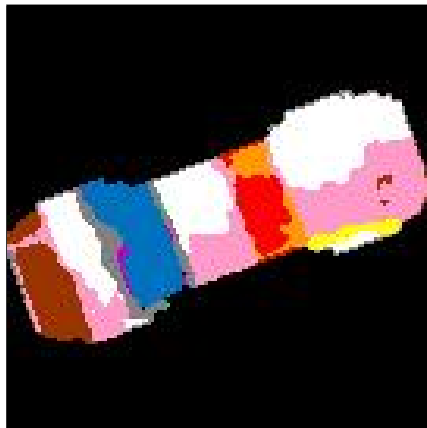
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Apply Classifier



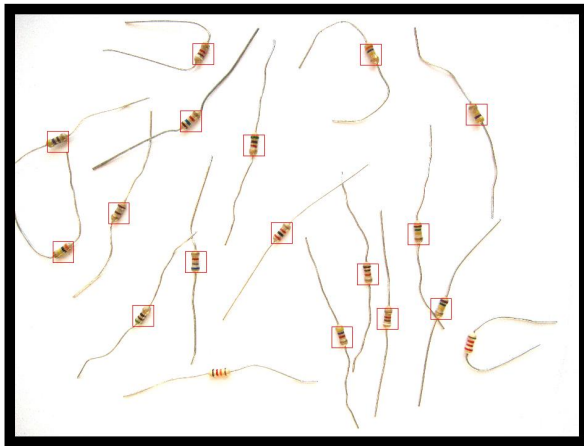
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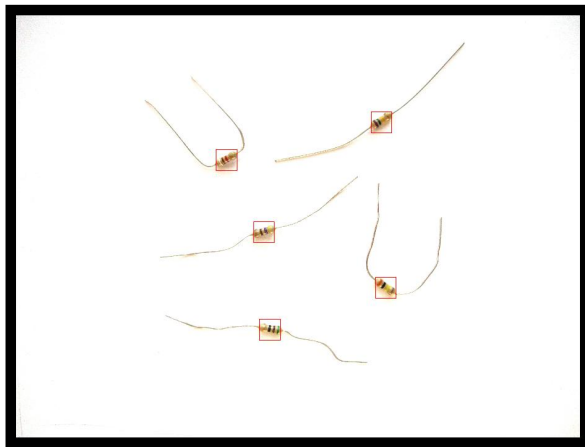
Resistor Bounding Boxes



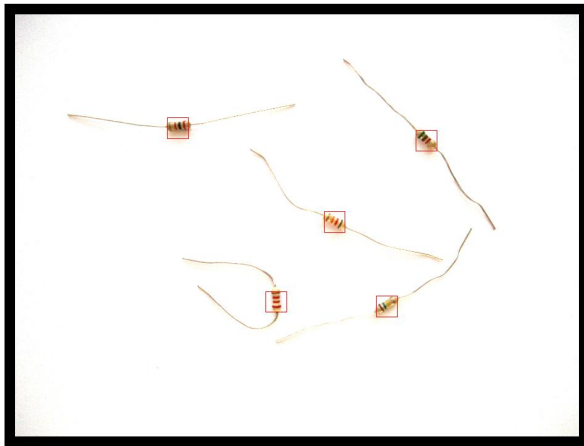
Resistor Bounding Boxes



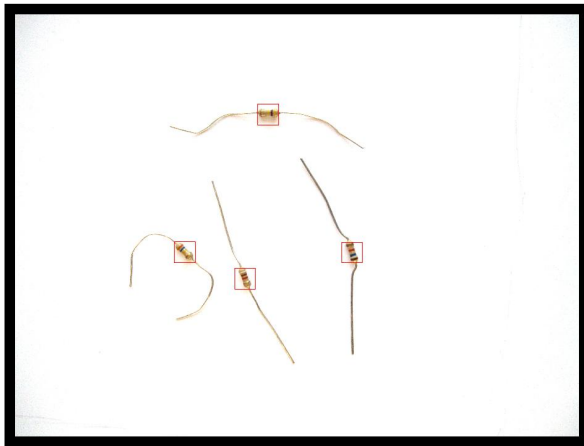
Resistor Bounding Boxes



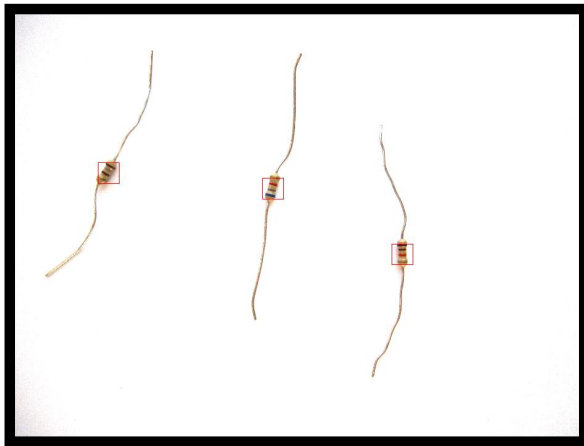
Resistor Bounding Boxes



Resistor Bounding Boxes



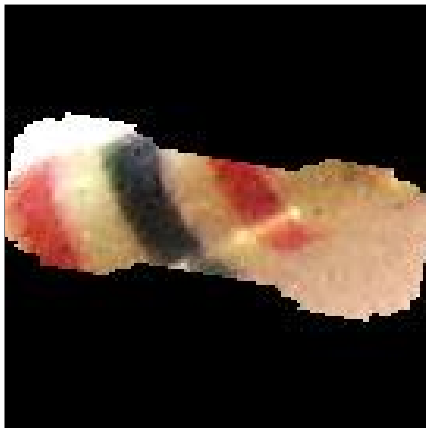
Resistor Bounding Boxes



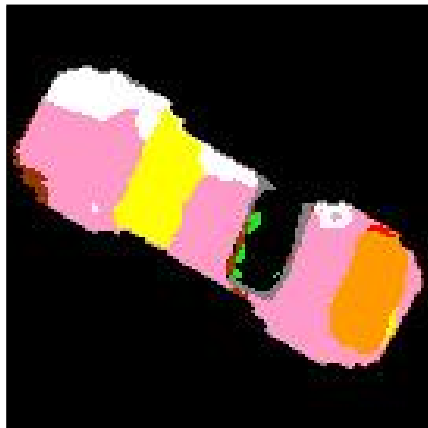
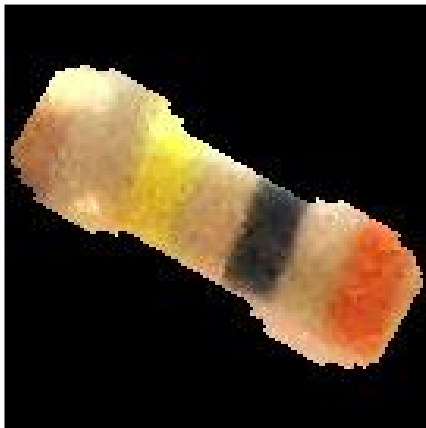
Resistor Bounding Boxes



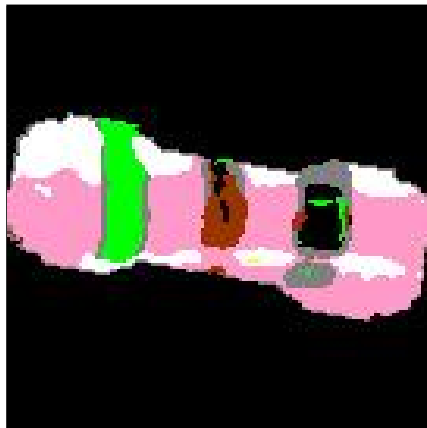
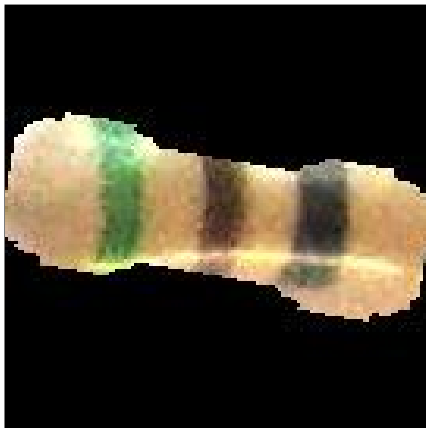
Apply Classifier



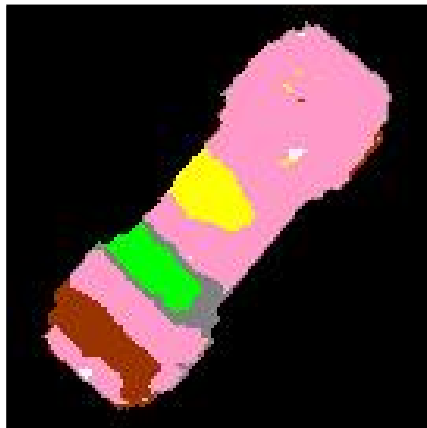
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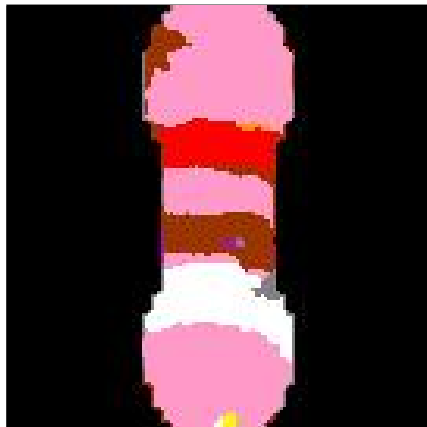
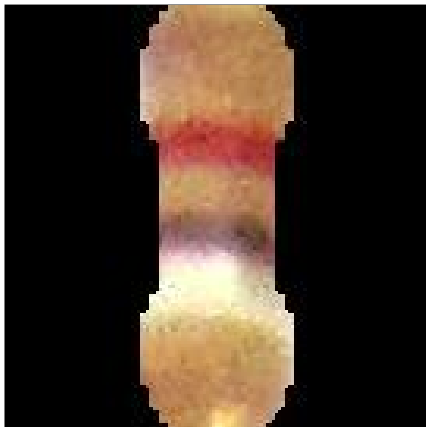
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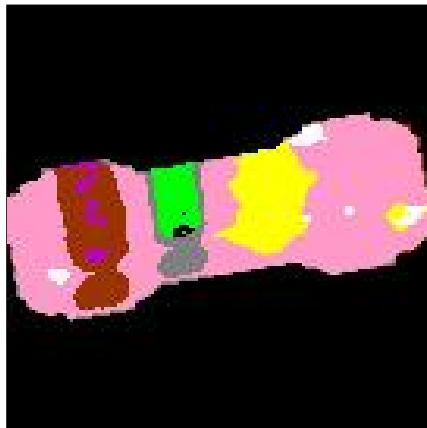
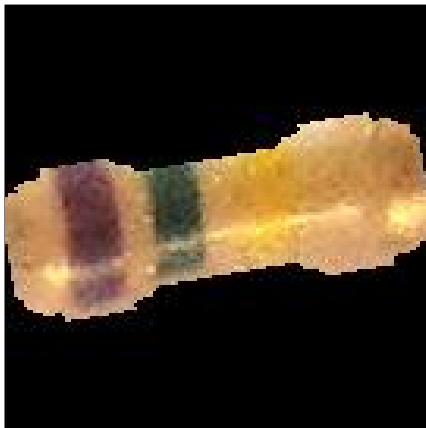
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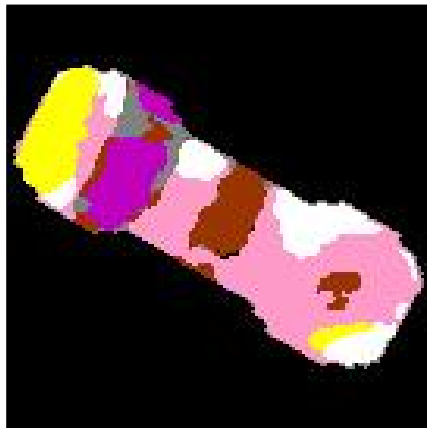
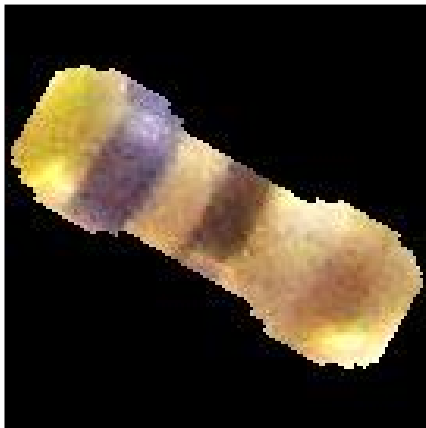
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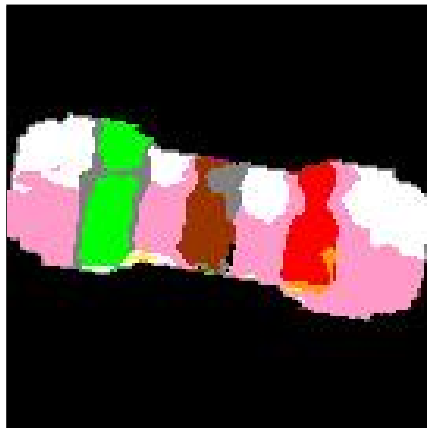
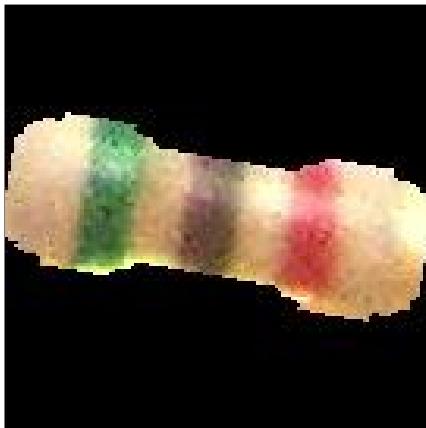
Apply Classifier



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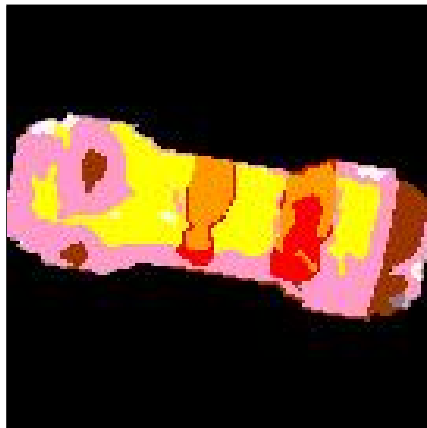
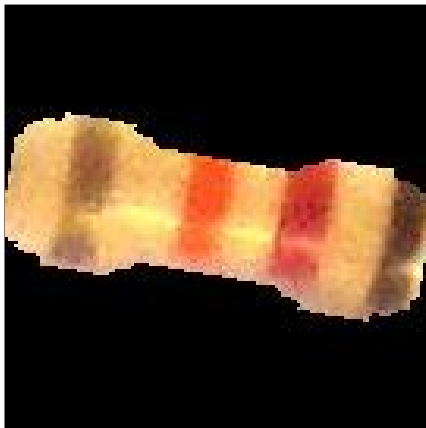
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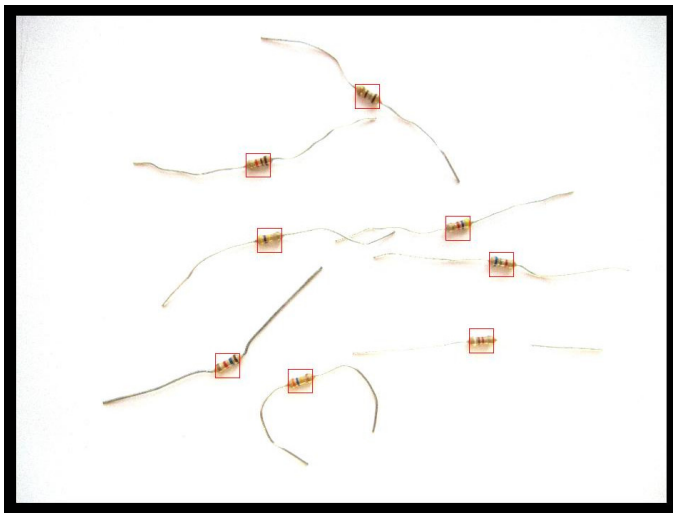
Apply Classifier



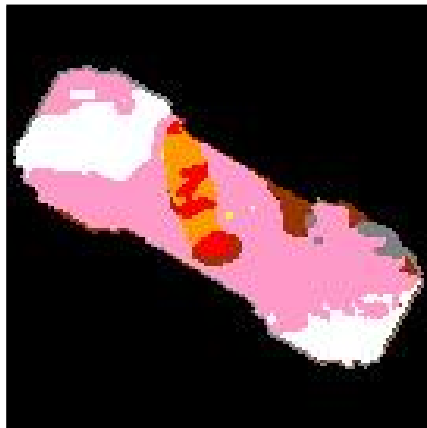
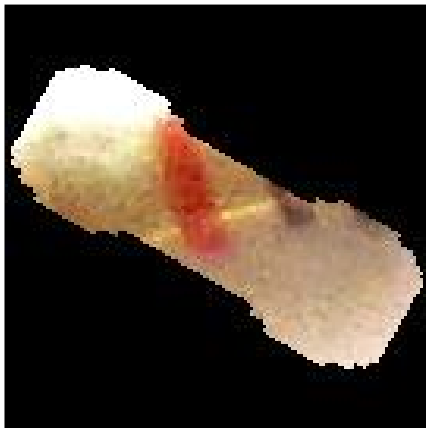
Apply Classifier



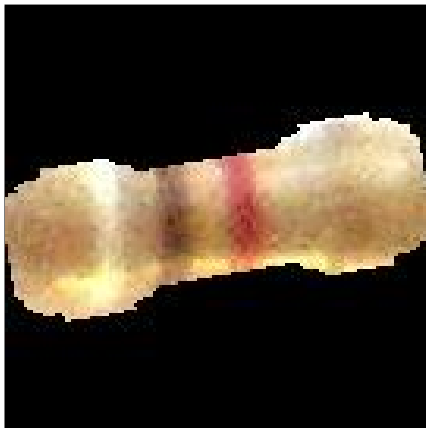
Resistor Bounding Boxes



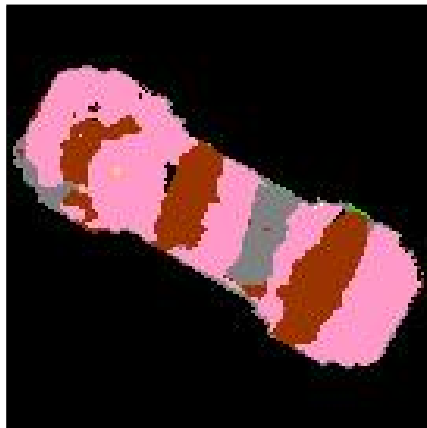
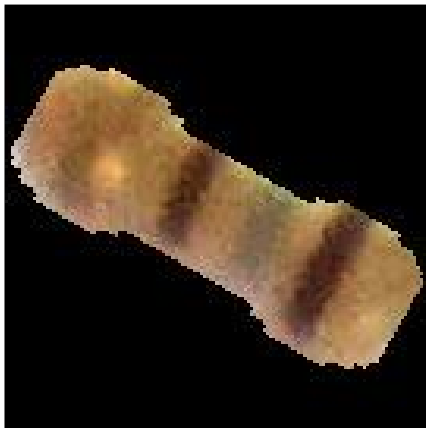
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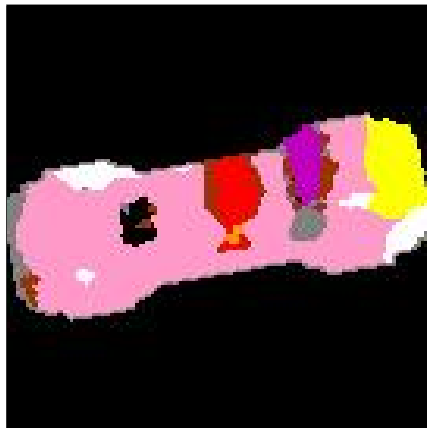
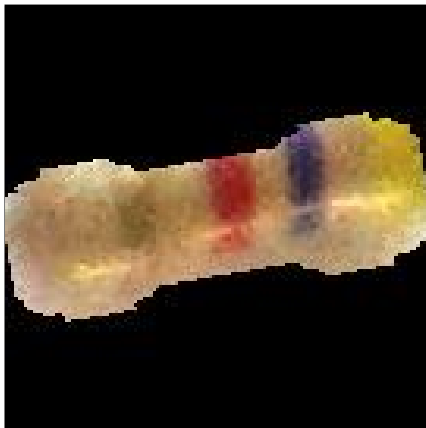
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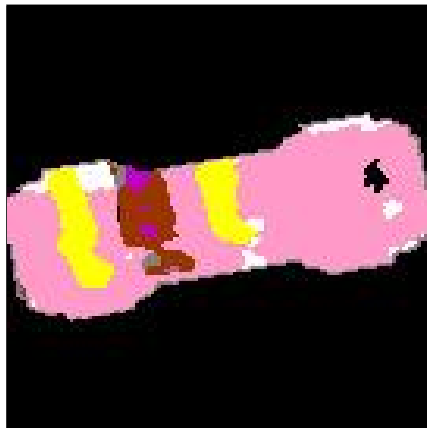
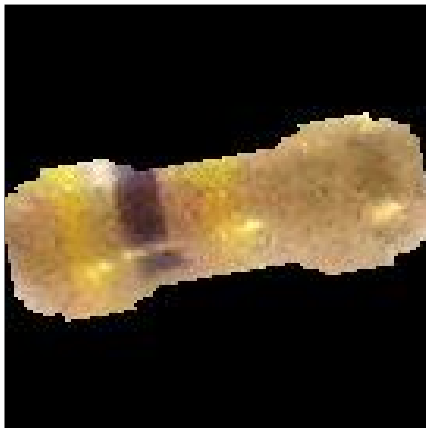
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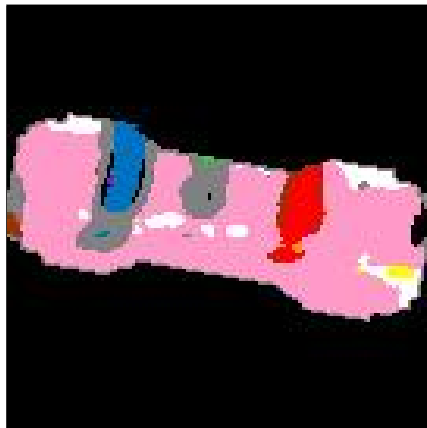
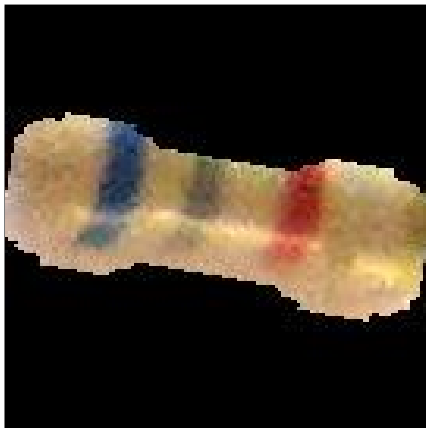
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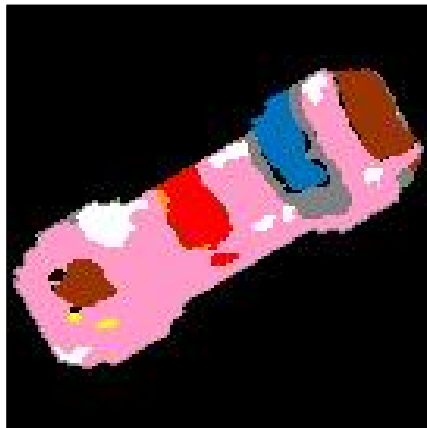
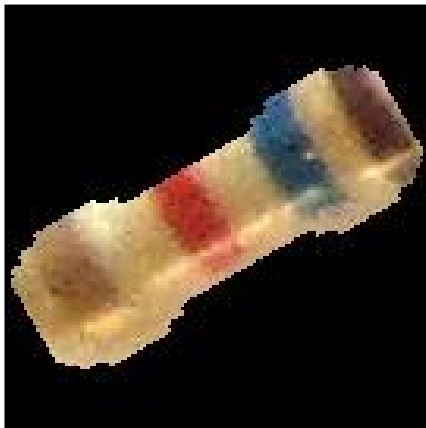
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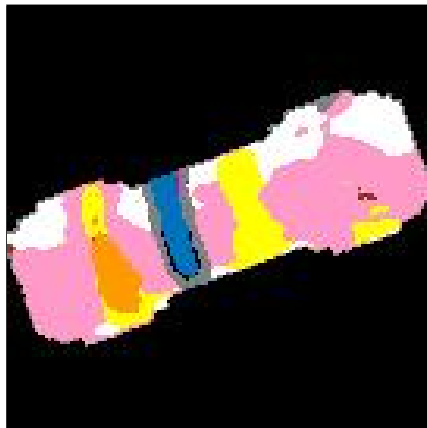
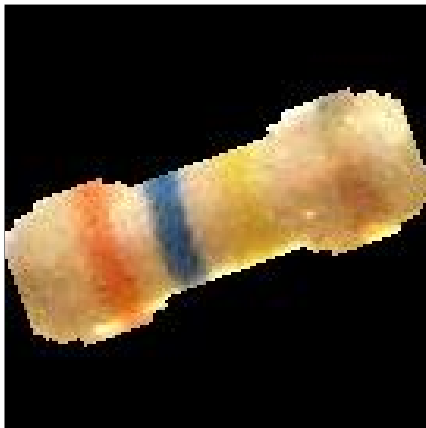
Apply Classifier



Apply Classifier



Apply Classifier



Future Work

- Use classification data to determine color code
- Use line walking method and standard resistor values to improve accuracy
- Create augmented reality mobile app

Questions?