Gesture and Sign Recognition Using OpenCV

Brandon Rodriguez
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Introduction

• Using OpenCV, can we recognize the ASL alphabet?
  • 24 static letters (“J” and “Z” excluded)
• Can we recognize simple motions?
  • Left, Right, Up, Down
• Assumptions
  • Fixed camera
  • Recognize only one hand
  • Trained for one person
  • Depth stays constant
Steps to Success

1. Hand Recognition
   • Color Features
   • Convex Hull / Area ratio

2. Gesture Recognition
   • Centroid Tracking

3. ASL Recognition
   • Template Matching
   • Cosine Similarity
   • Sum of Absolute Differences
   • Shape Matching

Microsoft Research has a robust proof-of-concept using Kinect.

(harder than I thought)
Hand Recognition

• Use background subtraction to isolate the foreground
• Exploit convex hull and contour area to isolate the hand
Hand recognition using centroids and convex hull relationships. [1]

Hand recognition using color tracking and initialization. [2]
Gesture Recognition

• Centroid tracking
• Threshold direction movements
ASL Recognition

Template Matching          Sum of Absolute Differences

Cosine Similarity          Shape Matching

OpenCV has some built in methods to help implement all of these techniques.
Template Matching

Given an image and a template, recognize if the template is present in the image.

Requires you to scan your template pixel by pixel to measure similarity level.
Cosine Similarity

• Given two vectors, measure the angle between them
• Treat images as vectors
• If the images are similar (vectors are almost identical), angle will be small
• Threshold based off of angle value
Sum of Absolute Differences

Easy to pick out the hand in this image frame.

Hard to pick out after absolute difference.
Shape Matching

• Looks for similarities in contours
• Supposedly robust against translation and rotation
ASL Recognition

Template Matching
• My apartment walls are too close to my skin!

Cosine Similarity
• Would require your hand to be in the same space as the training image

Sum of Absolute Differences
• Not suited for the level of detail needed in this application

Shape Matching
• See how similar two contours are (0 = perfect match, 1 = not so much)
Video: Sign Language Recognition

7 correct out of 16

https://www.youtube.com/watch?v=ZNWSyf72bqE
What’s Left?

**Simple Gesture Detection**
- Make direction detection more robust

**Sign Language Recognition**
- Save the training contours to a file
- Work on differentiating similar characters (M, N, T, or A, S)
- Combine gesture + ASL to recognize the letter “Z”? 
References


Many more, but not included in the presentation.
Questions?