TRAFFIC SIGN RECOGNITION WITH COLOR IMAGE

Yiming Zhang
SUNY at Buffalo
OVERVIEW

• Traffic sign is very important in navigation and homing

• We are trying to recognize the traffic signs in order to navigate the robot or vehicle
PROBLEM

• With traffic sign, we can get correct information of the action we should take
• Same kind of signs are made in certain color and shape
• Traffic signs are always in complex environment and hard to be recognized
WHY COLOR IMAGE

- Color image can be obtained directly from the camera.
- Gray-scale can also be used for this purpose, but the search is mainly based on shape and can be quite expensive in terms of computational time.
- Color-based segmentation is faster than the one based on shape, although requiring additional filtering.
- RGB is a color space where R means red, G means green and B means blue.
- In most of signal recognition papers, they use the HSV or HSI color space to recognize the signal.
- HSV or HSI space is good, but will need transformation from original image which is in RGB space.
- We can easily implement the color recognition in the image we take with RGB space.
PROCESS

- Color segmentation
- Extract blob
- Smooth the image
- Edge detect
- Shape detect
- Classification
COLOR SEGMENTATION

- In an image, there will not only exist the road signal, but also other objects.
- We need to do something in order to focus on certain color we want, like red.
- In reference [1], the authors mentioned a method called Red Minus Blue which is a kind of weighted sum of the red, green and blue image.
- In my project, to achieve the goal of extracting stop sign from the image, I also minus $0.5 \times \text{Green}$ based on minus operation in order to eliminate the noise remained after RMB operation.
COLOR SEGMENTATION

- And this works good:
SMOOTH THE IMAGE

Original image from
http://www.doobybrain.com/2009/06/02/blue-stop-sign/
EDGE DETECTION

• Using canny edge operation to find the edge of the object in the smooth image
• Using Freeman chain code to detect the shape
CORNER DETECT

• In reference [3], the authors mentioned an operation to detect the corner with Freeman chain code

• Define the code difference $d_i = a_{i+1} + a_i$

• $D_i = |b_i|$ if $|b_i| < 4$

• $D_i = |b_i| - 8$ if $|b_i| > 4$

• $D_i = 4$ if $|b_i| = 4$

• Using curvature to eliminate suspect corner point

\[ \theta_1 = \tan^{-1}\left(\frac{y_{i+2} - y_i}{x_{i+2} - x_i}\right), \quad -\pi \leq \theta_1 \leq \pi \]

\[ \theta_2 = \tan^{-1}\left(\frac{y_{i-1} - y_i}{x_{i-1} - x_i}\right), \quad -\pi \leq \theta_2 \leq \pi \]

\[ \theta_i = |\theta_1 - \theta_2| \]
CLASSIFICATION

• Combine the color feature and shape feature to classify the sign we detected

• Suppose we have two sets, one for colors and the other one contains shape information
FURTHER THINKING
OTHER COLOR SEGMENTATION METHOD

Fig. 1. Algorithm flowchart. (a) Image acquisition; (b) color segmentation; (c) shape detection; (d) bounding box scaling; (e) classification; (f) output.

\[
\begin{pmatrix}
Y \\
U \\
V \\
\end{pmatrix} =
\begin{pmatrix}
0.299 & 0.587 & 0.114 \\
-0.147 & -0.289 & 0.436 \\
0.615 & -0.515 & -0.100 \\
\end{pmatrix}
\begin{pmatrix}
R \\
G \\
B \\
\end{pmatrix}
\] (1)
GOAL OF THIS PROJECT

• In this project, I want to extract road signal signs from images and recognize these signs in order to use them to navigate the robot or vehicle.

• The minimum goal of this project is to recognize traffic signs in certain color and shape.

• The extensive goal of this project is to recognize other useful traffic signs in different shapes and colors, and also implement other efficient method to do comparison and improvement.
• [1]. Matthew A. Turk, David G Morgenthaler, Keith D. Gremban and Martin Marra

• [2]. Alberto Broggi, Pietro Cerri, Paolo Medici, Pier Paolo Porta and Guido Ghisio
“Real Time Road Signs Recognition”, 2007, IEEE Intelligent Vehicles Symposium

• [3]. Wang Jian, Pi You-guo, Liu Ming-you “A Corner Detection Method about Contour of Character Image Based on Freeman Chain Code”, College of Automation Science and Engineering, South China Univ. of Tech, Guangzhou, China