

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

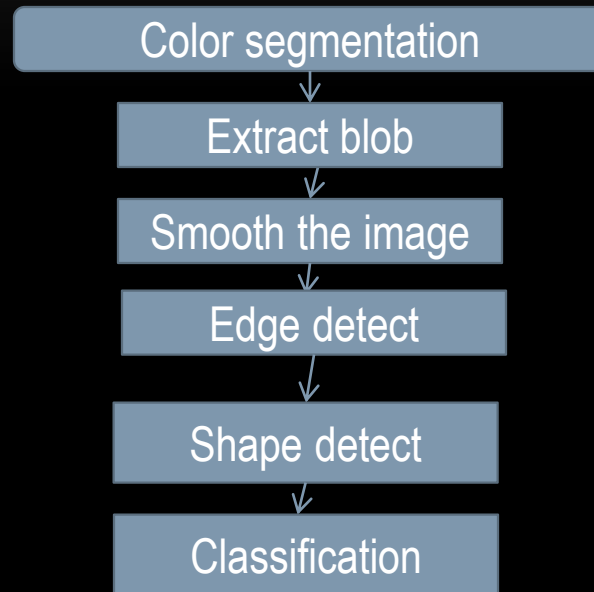
PROBLEM

- 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

- 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 an 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 extract stop sign from the image, I also minus $0.5 * \text{Green}$ based on minus operation in order to eliminate the noise remained after RMB operation

COLOR SEGMENTATION

- And this works good:



SMOOTH THE IMAGE

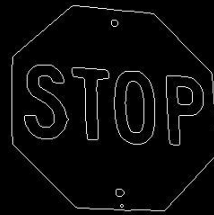


Original image from

<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

$$\theta_1 = \tan^{-1} \left(\frac{y_{i+s} - y_i}{x_{i+s} - x_i} \right) \quad -\pi \leq \theta_1 \leq \pi$$

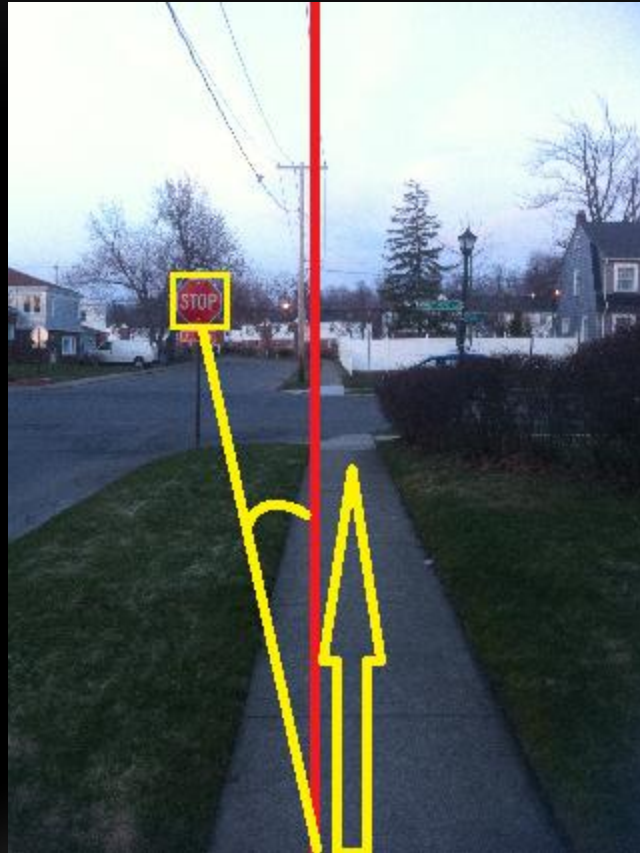
$$\theta_2 = \tan^{-1} \left(\frac{y_i - y_{i-s}}{x_i - x_{i-s}} \right) \quad -\pi \leq \theta_2 \leq \pi$$

$$\theta_i = |\theta_1 - \theta_2|$$

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

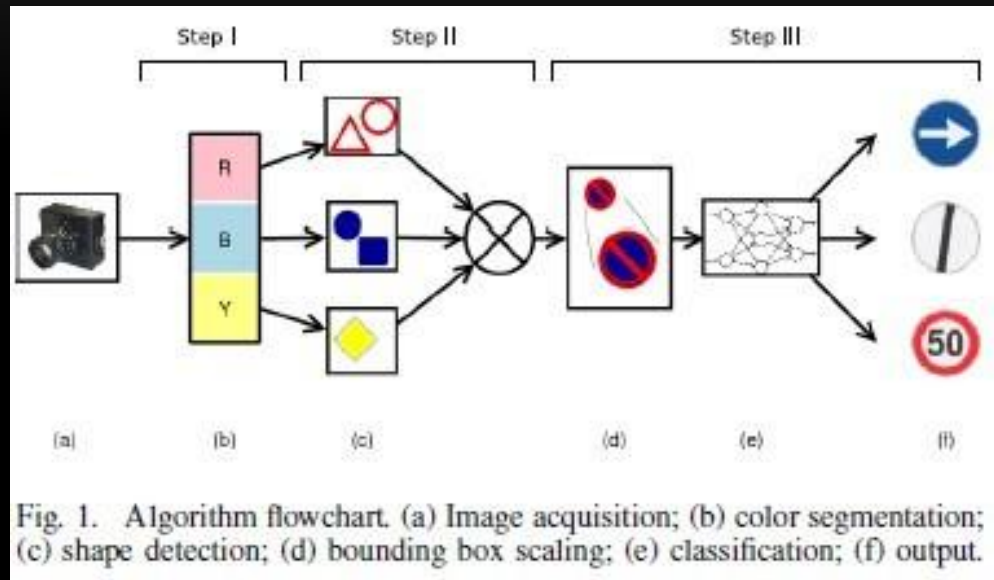


Fig. 1. Algorithm flowchart. (a) Image acquisition; (b) color segmentation; (c) shape detection; (d) bounding box scaling; (e) classification; (f) output.

$$\begin{pmatrix} Y \\ U \\ V \end{pmatrix} = \begin{pmatrix} 0.299 & 0.587 & 0.114 \\ -0.147 & -0.289 & 0.436 \\ 0.615 & -0.515 & -0.100 \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix} \quad (1)$$

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
-

REFERENCE

- [1]. Matthew A. Turk, David G Morgenthaler, Keith D.Gremban and Martin Marra “VITS-A Vision System for Autonomous Land Vehicle Navigation”(IEEE, 1988)
- [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