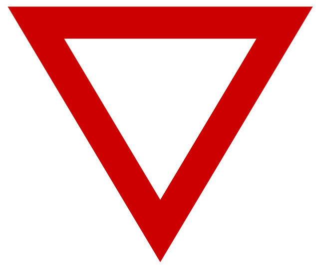

Yield Sign Detection

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Contents

Chapter 1

Introduction

This document describes the implementation of a system to detect yield signs from images.

1. *Notation definitions*
2. *Image test set*
3. *Requirements*
   (a) *Changing light (night, day, dawn, dusk)*
   (b) *Performance*

1.1 Filter pipeline overview

...

1. Binarization
   (a) Red Amplification
   (b) Binarization

1.2 Binarization

The first step of the whole pipeline consists of extracting the red color from the coloured input image *source*. Thus a mapping for each pixel from three dimensions to one dimension is needed. Simply returning the red color component does not suffice, as with larger values of the green and blue components the source color either shifts towards yellow, magenta or white. A very simple method that is used in this application takes the red component, optionally amplifies it by some factor and substracts the green and blue components values.

Let $\Gamma = \{0, 1, ..., 255\}$ be all possible pixel values, $\delta \in \Gamma$ the threshold and $\alpha \in \mathbb{R}, \alpha \geq 1$ the factor for red amplification, then the pixel written to the binarized image *target* is:

$$
\begin{aligned}
f : \Gamma \times \Gamma \times \Gamma &\rightarrow \mathbb{Z} \\
f(r, g, b) &= \alpha r - (g + b) \\
target(y, x) &= \begin{cases} 255 & \text{if } f(source(y, x)) > \delta \\ 0 & \text{else} \end{cases}
\end{aligned}
\tag{1.1}
$$

This method has one drawback however. There is no distinction between less saturated or darker shades of red and orange or magenta. This is a result of not taking the distance between green and blue into account. An example is depicted in Table 1.1. More elaborate variations of this calculation were tested (considering the ratio of red to all colors or weighting by green-blue distance) but did not increase the overall quality of red detection. Actually, without constantly white balancing the camera used for capturing, narrowing the range of red would perform worse as the ambient light differs greatly over the course of a day.

1.2.1

Color	Red	Green	Blue	*f(r, g, b)*	*target(y, x)*
	0	0	0	0	0
	255	255	255	-51	0
	0	255	0	-255	0
	0	0	255	-255	0
	255	0	0	459	255
	255	125	125	209	255
	255	125	0	334	255
	255	0	126	334	255

Table 1.1: Example results of function *f* in 1.1 with $\alpha = 1.8, \delta = 200$. Note that the result is equivalent for light red, orange and magenta.