Firstsight Vision - Technical Tip

Using Illumination to Reduce 'Colour Pollution' in Monochrome Images

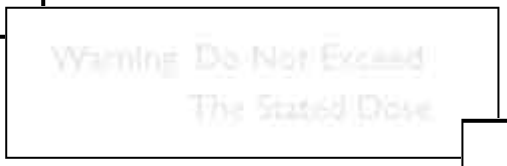
It is often assumed that the colour of machine vision illumination is irrelevant if the system is designed to produce a monochrome output. This is not the case, as we will see.

If the object of interest is coloured, or contains different colours, then the images that are obtained will depend, in large part, on the colour of the light that falls on them. Take the following example:

An inspection system is performing OCR on printed text on labels.
The target is a warning label which has important text in RED on a WHITE background.
This RED text needs to be OCR'd in order to be verified by the software
Illumination: Standard RED LED ringlight.

Problem:	The contrast between the RED text and the WHITE background is very poor causing too many read errors from the OCR system.
Cause of problem:	Both the RED text and the WHITE background are reflecting RED wavelengths of light back into the camera sensor, giving very low contrast.
Solution:	Use either a GREEN or BLUE light to obtain better contrast between the RED text and the WHITE background.
Explanation:	A RED object is seen as RED because it is absorbing the other colours, BLUE and GREEN and only reflecting the RED component of the light. The WHITE background is reflecting all colours, including RED. Therefore the camera is seeing a RED reflected light against a RED background. If either GREEN or BLUE light is used, then these colours will be absorbed by the RED text, with very little light being reflected into the sensor.

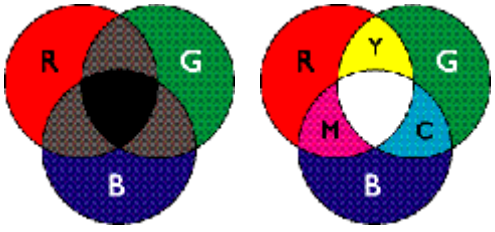
Text as seen by the human eye



Text under RED illumination
(monochrome camera)

Text under GREEN illumination
(monochrome camera)

Colour Theory



Subtractive (pigment) Additive (light)

There are two different colour systems to bear in mind when considering lighting solutions: 'Additive' and 'Subtractive'. Coloured pigments, (as in printed inks) are termed 'Subtractive' and when all 3 colours (RGB) are combined together they make a dark messy colour close to black. Illumination on the other hand is an 'Additive' system and when the same three colours *of light* are mixed, white is produced. It must be remembered that an object is seen to have a particular colour because it absorbs all other colours, so for instance, a red object absorbs green and blue light. This should help when choosing the best colour to illuminate the target in order to achieve the best results.

When trying to maximise contrast in a monochrome image it helps to remember the following:

Green absorbs blue and red
Red absorbs blue and green
Blue absorbs green and red

Colour Reflection Chart

This chart shows what kind of image a monochrome camera would produce when illuminating different coloured objects or features, with Red, Green and Blue light. The chart should be used as a rough guide only, as in real life situations, external factors may alter the results somewhat.

Object/Feature Colour	Red	Green	Blue
Red	Pale	Dark	Dark
Orange	Pale	Grey	Dark
Yellow	Pale	Pale	Dark
Green	Dark	Pale	Dark
Cyan	Dark	Pale	Pale
Blue	Dark	Dark	Pale
Magenta	Pale	Dark	Pale

Standard illumination is normaly available only in Red, Green and Blue. It is however possible to produce exact colours (colour temperature) and the CCS, HLV 'Tri-Colour' light source would be one example of how to achieve this. However, the cost of solutions like this would need to be weighed against the benefits to your application and any possible application changes that could be made to simplify the lighting requirements.

For more information on colour in illumination or any other aspect of machine vision contact us on:

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