

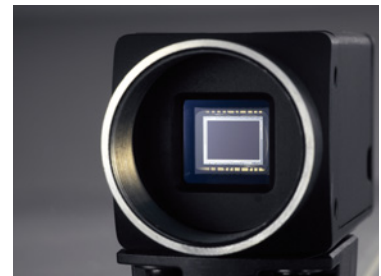
Image Processing

Color Extraction

This technical document introduces the idea of image processing from the basics. The topic covered in this document is color extraction, which reduces the amount of data that must be processed. To achieve both high performance and speed, it is important to select the right method of extracting color information for the specific target.

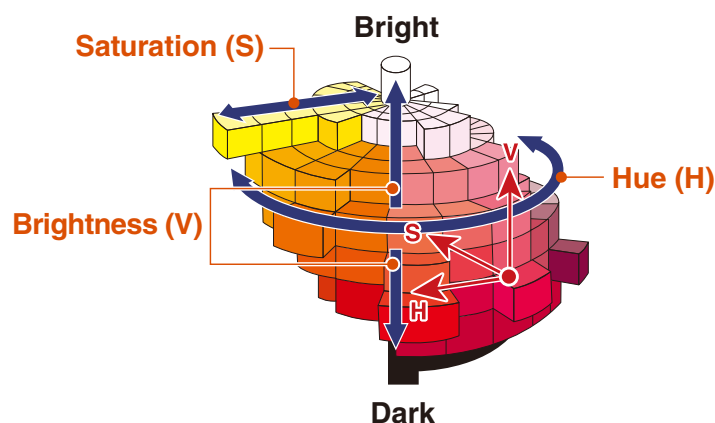
1. Color camera

The image sensor used in a machine vision camera is generally a single-chip CCD. Since color images need RGB (red-green-blue) data, a color filter called the Bayer filter converts each pixel on the CCD to a red, green, or a blue pixel. By using a level from 0 to 255 on each of these colored pixel, an image can be constructed in the vision controller using this color data.



[Color system]

The system for expressing color numerically is called a color system which is usually expressed as three-dimensional space with three axes. Of several color systems, the HSV color system using the three components of Hue, Saturation and Brightness is the closest to human eyes and is most suitable for image processing.



Brightness (V): Vertical axis, higher is brighter.

Saturation (S): Horizontal axis, farthest outside is brightest.

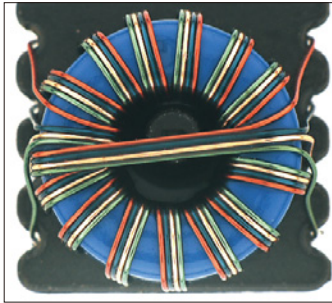
Hue (H): Hue represents the actual color and changes as you change position on the circle

2. Color to binary conversion

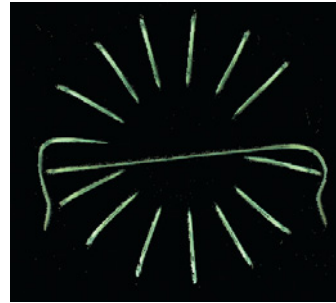
While each pixel of a monochrome camera contains 256 levels, a color camera has 256 levels in each red, green, and blue values. This results in a total of 16,777,216 possible levels. Since this data is 80,000 times larger than a monochrome camera, it allows detection of objects that cannot be detected based on 256 grayscale levels. The function of extracting the specified color range from approximately 16 million levels is referred to as color-to-binary conversion.

[Application example of color to binary conversion]

Detection of green wire winding



Extract only the green wire for inspection by using color to binary conversion

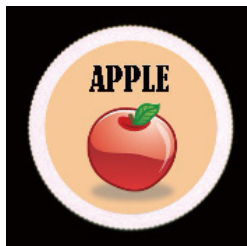


By extracting out just the green color, it makes it easy to check for any breaks specifically in the green wire

3. Grayscale vs. RGB grayscale

Color cameras receive data that is 80,000 times larger than monochrome cameras. This is advantageous for more detailed image processing, but takes a much longer time to process compared to monochrome images. Grayscale and RGB Grayscale processing is useful for keeping details, while making inspections fast, something binary or color processing cannot do.

Color image



Grayscale

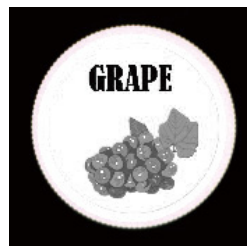


RGB Grayscale



[Grayscale]

Converts the image into a grayscale image by taking the maximum R, G or B level and using that as the grayscale pixel level. This will create a generally bright grayscale image and bright spots, like the orange or purple areas in the images to the left, are converted to white.



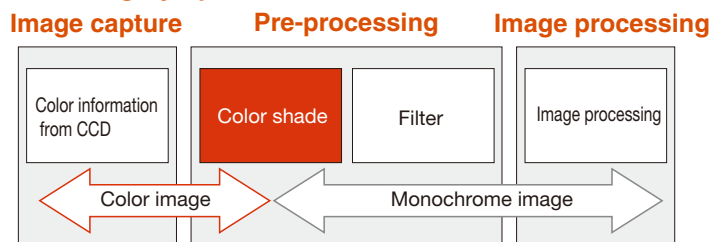
[RGB grayscale]

Converts the image into a grayscale image by taking the average of the R, G and B level and using that as the grayscale pixel level. This will create a grayscale image close of that captured with a monochrome camera.

4. Color to gray processing

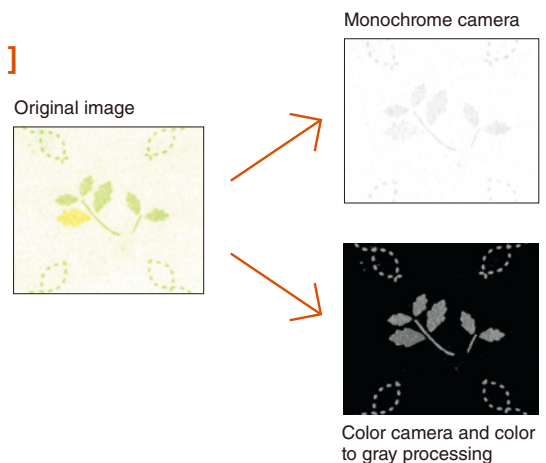
Color to gray processing converts a color image into a grayscale image by using a chosen range of colors as the maximum brightness. The rest of the colors get converted to a range of grayscale values based on the selected colors. Since both brightness and color information is used, distinction between similar colors like gold and silver is easily distinguished as a grayscale image.

Color to gray operation



[Application example of color to gray processing]

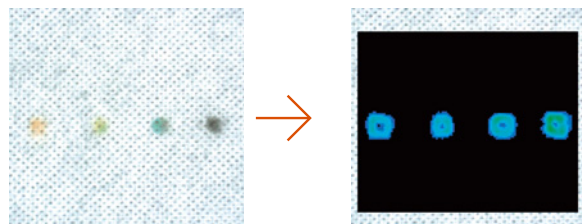
Detection of faint patterns on a white background is very difficult using conventional grayscale processing. By using color to gray processing, the colors on the pattern can be converted to a bright grayscale level and the rest will be a darker shade of gray.



5. Fine Color processing

Using Fine Color processing, the raw color data is used for inspection. This allows very accurate distinction in color and is useful to distinguish between similar colors and to ignoring uneven shading.

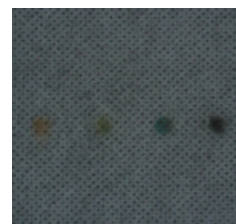
Detection of foreign matters on a non-woven cloth



Raw image (bright)

Contrast view

Stable detection of all flaws



Raw image (dark)

Same image, darker exposure



Contrast view

Stable flaw detection is possible even when brightness changes

[Shading Correction Filter]

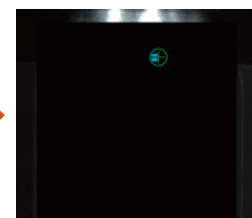
The Shading Correction filter is a unique image filter by KEYENCE that can eliminate uneven lighting caused by hot spots, which is a common issue with metallic parts. By using Shading Correction, the uneven lighting can be ignored and defects can be found.

Detection of spots on a beverage can



Raw image

The raw image shows highly varying shading caused by the metallic surface



Contrast view

After applying Shading Correction, the uneven lighting is ignored and the flaw is found

■ An introduction to lineup of image processing

XG-8000 / XG-7000 Series

Best solution meeting every need

All of lineup of cameras including line scan cameras, high speed using distributed processing on multicore DSP, a wide variety of flexible inspection tools, interface that allows users to create on their own make a precise response to customers' needs.



CV-X100 Series

Offering tools having the same ability to judge as the judgment of human. Anyone can use it easily.

The "Auto-teach inspection tool" which recognizes those items that are different from conforming items as non-conforming items is incorporated into the series. This tool allows human-like inspection. This series can be globally deployed and used by anyone by setting and operating by just selecting and clicking.



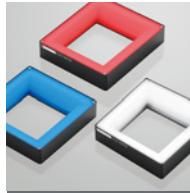
■ Lineup of lights that support a wide range of inspections



Direct ring light



Multi-angle round light



Multi-angle square light



Bar light



Dome light



Backlight



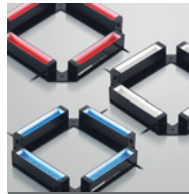
Coaxial light



Spot light



Low angle light



Square bar light



Line light



Controller for LED light

■ Lineup of lenses that can be selected based on the camera types and accuracy requirements



Super high resolution/low distortion lenses



High resolution/low distortion lenses



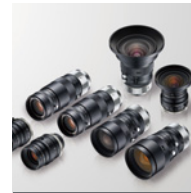
CCTV lenses



Macro lens



Compact camera lenses



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