Multispectral CIELAB camera for the evaluation of automobile coatings (Poster)

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Abstract

ISO/IEC JTC1/SC28 “Office Systems” has studied in ISO/IEC DTR 24705:2004 the input and output data of ISO/IEC-test charts defined for example in the device coordinates *cmyk*.*CIELAB cameras produce the device independent coordinates *LAB** for a whole scene. The multi spectral camera consists of a high resolution monochrome camera and a liquid crystal tunable filter. This device measures the spectral reflectance of ISO/IEC-test charts and the automotive paints at 31 wavelength in the visible range between 400 nm and 720 nm. The CIELAB data are calculated for any pixel of the image. For the visualization of these *LAB** data different methods are possible. Although not necessary for the evaluation of automobile coatings, a transfer from the *LAB** coordinates to the *cmyk** device coordinates allows a visualisation on any device making it possible to present quality data of coatings in different media.

Purpose and Overview

The proposed system is designed for the online color measurement of color coated car bodies and their attachment parts. For this goal a color measurement with a spatial resolution based on the acquisition of the spectral reflectance is needed.

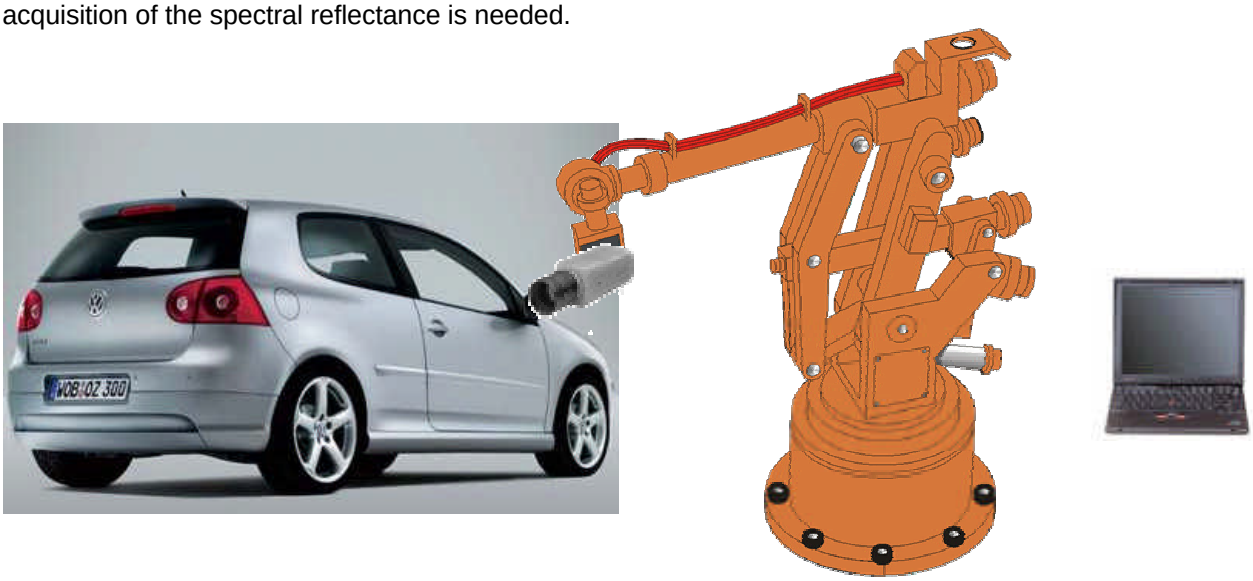

Figure 1: System Overview

In comparison with the measurement of plane color test charts two main problems arise. First, due to the geometry of the samples measured, i.e. the surface of a car, the lighting will always be distributed inhomogeneously. Second, many effect colors used in the automobile industry are heavily illumination/observer angle dependent.

Workflow of Color Measurement

A custom made software coordinates the image acquisition and assembles the so called multi-channel image cubes. Then this software estimates the reflectance values from these image cubes for each point of the scene taken. Before the measurement a model for this estimation must be specified.

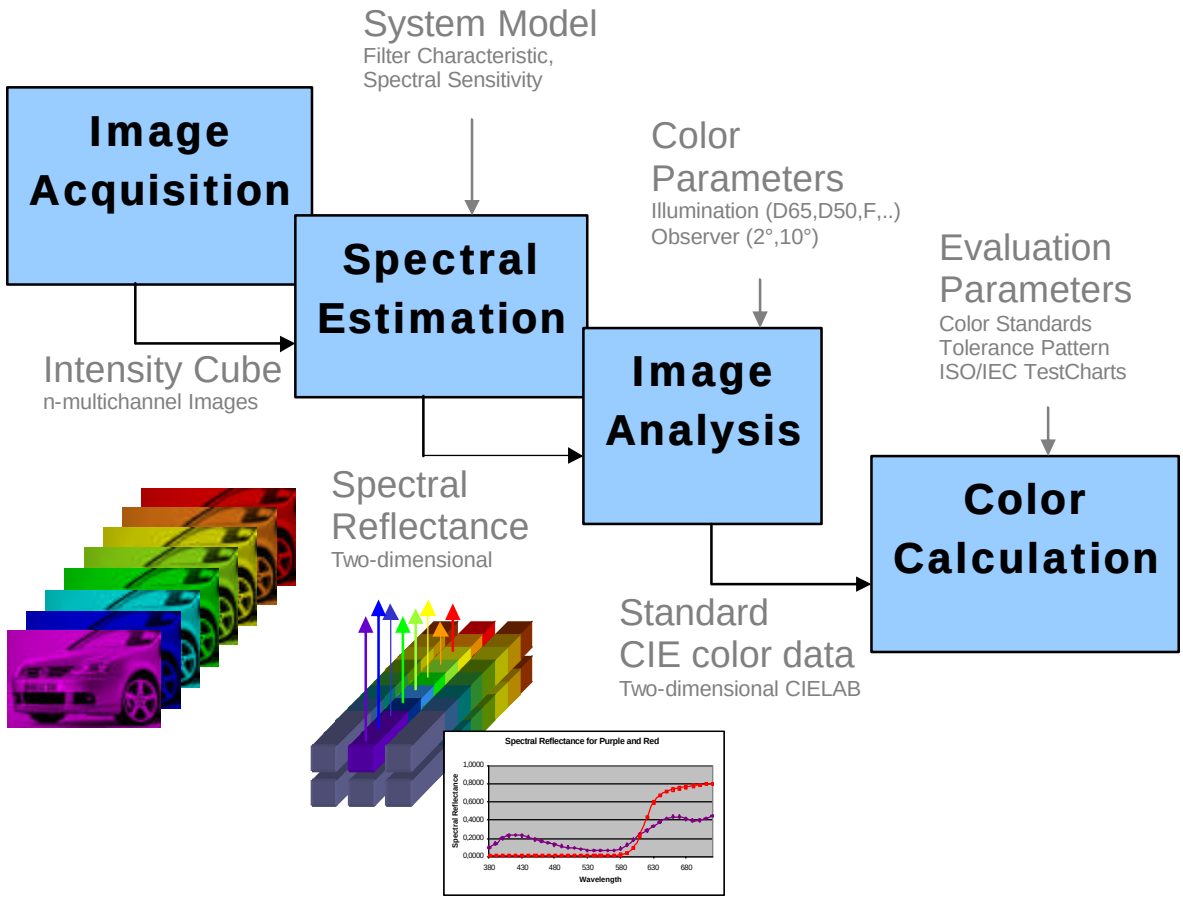

Figure 2: Process of Color Measurement by Spectral Camera

Configuration and Setup

Basically the measuring device of the system consists of a two dimensional luminance detector (1), a chromatic corrected lens (2) and an electronically tunable spectral filter (3).

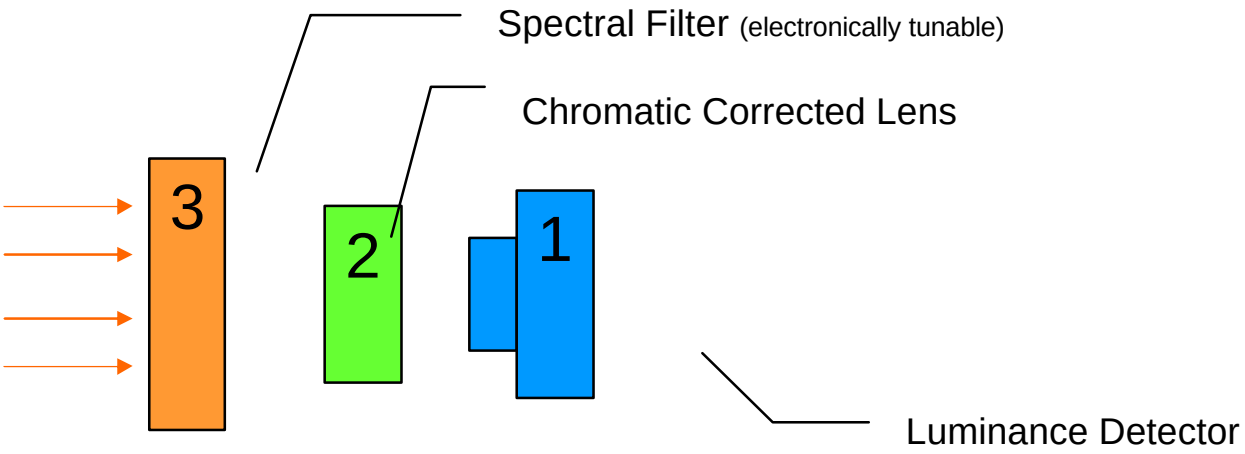

Figure 3: Measuring Device Setup

The used detector is an off-the-shelf IEEE1394 monochrome-camera with a spacial resolution of 1240x1024 and a dynamic range up to 10 Bit.
The most crucial part of the system is the electronic tunable filter. This is a narrow band spectral filter with a bandwidth of 10nm. In contrast to the commonly used filter wheel for spectral applications this so called liquid crystal tunable filter (LCTF) can be tuned to any wavelength over a spectral range between 400nm to 720 nm with a tuning delay of about 50ms.

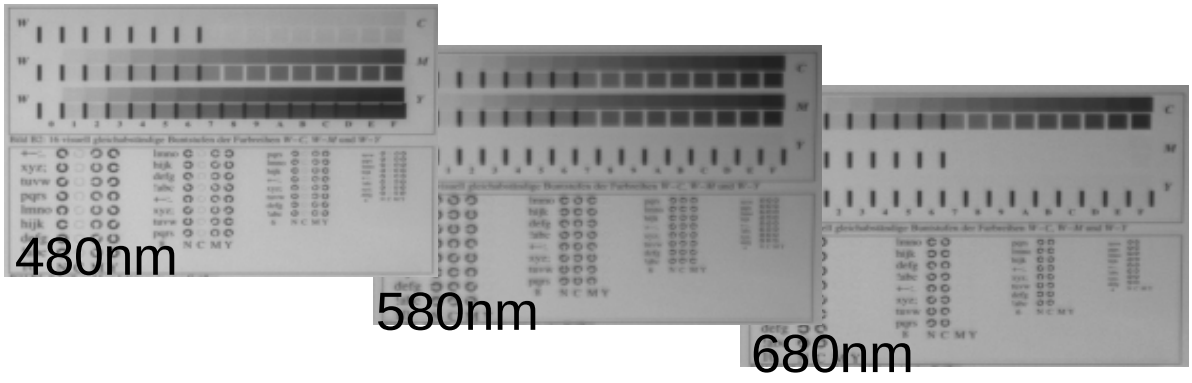

Figure 4: Multi-channel Image at three Wavelengths

The transmittance characteristic of the used *VariSpec*® Filter mainly depends on the wavelength it is tuned to. The correct operation of the filter requires a stable temperature and a relatively small viewing angle. In addition the short wavelengths IR transmittance is an issue. The main source for non linear behavior of the system is the CCD camera used. Apart form fixed pattern noise and saturation effects for values near the detection limit, the camera transfers the true scene illumination to a measured luminance. This procedure is a non-linear transformation and needs to be compensated.

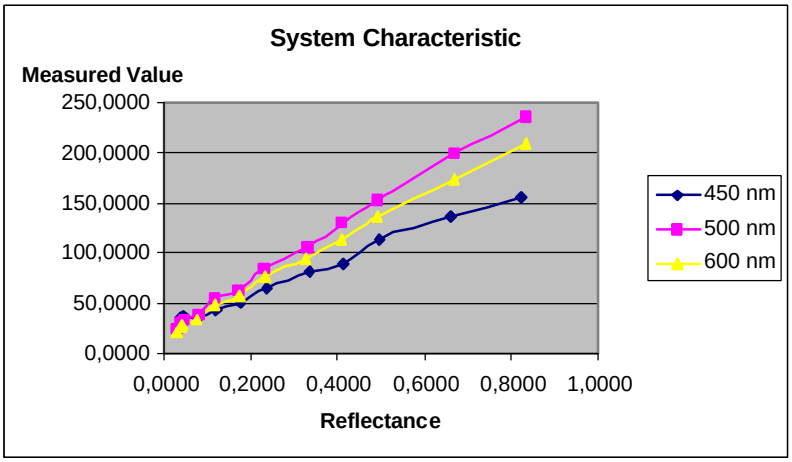

Figure 5: Measured System Characteristic

The measured values are characteristic for the selected exposure of the camera at a certain wavelength.

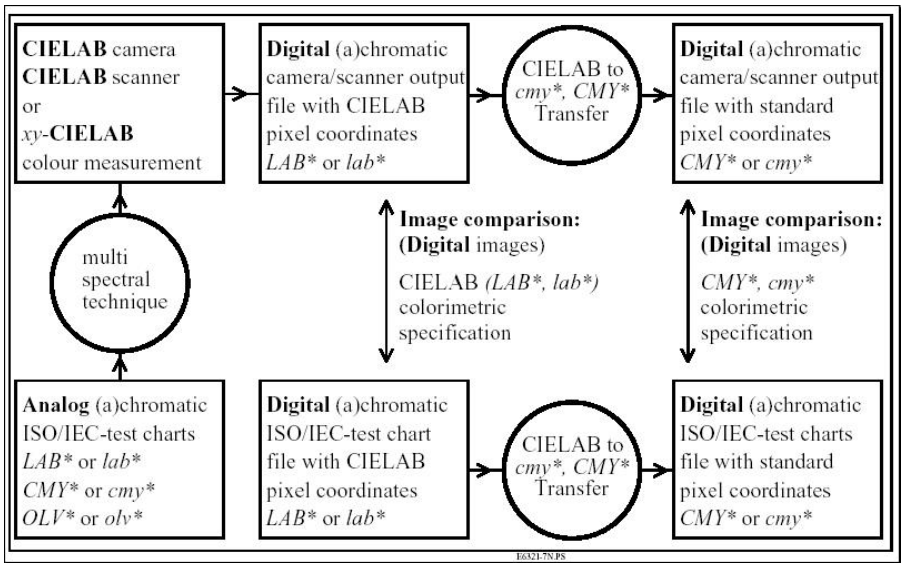

Figure 6: Multi-Spectral Camera in a Testchart related Workflow