Innovative Digital Eyes for Objective Color Inspections and Measurements

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Abstract. *An actual problem in research and industry, food processing and health care, traffic and environmental protection, security and administration is the implementation of objective quality inspections and measurements. A new class of smart vision sensors for dimensional and color measurements will be introduced. The advantages of an innovative programming method in natural languages with see & click instructions and solution guarantee will be presented.*

Keywords: Smart Vision Sensors, Color Measurements, Quality Inspection.

1. Introduction

An actual problem in research and industry, food processing and health care, traffic and environmental protection, security and administration is the implementation of objective quality inspection and measurements with digital image processing systems. Innovative color sensitive smart vision sensor systems are new chances especially for small and medium sized enterprises. The new vision sensor systems are characterized by small dimensions, true color sensitivities, integrated cameras and controllable lightings [1]. They are convenient, reliable and affordable. They must not be programmed in higher programming languages. The measurement functions are predefined. Programming (operation) is accomplished windows-like with intuitive icons and/or soft keys in natural language on touch screens. Nevertheless one problem must be mentioned:

Conventional image processing systems for quality inspections and measurements are operated by trained specialists. They have a profound qualification and technical documentations as usual [2]. The fast distribution of innovative vision sensor systems in the hands of lower qualified users strongly demand a new kind of technical documentations and programming software.

As a first step we developed the so called see & click operation instructions (S&COI). They are solution dependent driven by icons and soft keys. The user has only to follow red, yellow and green frames in the innovative operation and programming instructions. Red, yellow and green frames are used in analogy to traffic lights: Red (see), Yellow (wait), Green (click).

A second step to support the fast distribution of smart vision sensor systems was an open access to these see & click instructions. We applied the new possibilities of browser-based software as a service [3] and cloud computing [4].

A third step was the implementation of the see & click programming procedures in a specialized platform as a service for digital color image processing and spectral imaging.

We took the platform www.spectronet.de [5] to provide the intuitive programming instructions online which can be accessed from a web browser, while the software and data are stored on SITEFORUM servers [6].

More than 30 practical examples are given in www.spectronet.de > Akademie (academy) > BV Anwendungen (image processing applications) > Bedienungsanleitungen (operation

instructions) > OMRON Xpectia from optical character recognition over data matrix code and pattern recognition through geometrical and spectral measurements. The practical operation of innovative smart vision sensors with intuitive see & click programming for color measurements will be demonstrated.

2. Subject and Methods

Smart vision sensor systems are a new kind of measuring instruments on the market. The OMRON Xpectia is a smart vision sensor system for visual quality control that includes everything from camera with integrated light sources to image-processing units (Table 1, left). With Omron's newly developed proprietary measurement algorithms, the parameters can be set through only a few steps involving the operation of touch-panel color monitors, colored functional icons and/or full-text functional soft keys in natural language and see & click programming instructions. (Table 1, right).

Table 1. Xpectia smart vision sensor system (left) and see & click programming system (right)

Xpectia vision sensor system
http://www.visquanet.de/servlets/SITEFORUM?i=1122540720771&&e=UTF-8&l=1&t=/contentManager/selectCatalog&intro=1&active=no&ParentID=1222358585640

05		M01. Zeichenerkennung / Character Inspection m01_xpectia_print.pdf m01_xpectia_web.pdf
06		M02. Winkelmessung / Circle Angle m02_xpectia_print.pdf m02_xpectia_web.pdf
07		M03. Musterklassifikation / Classification m03_xpectia_print.pdf m03_xpectia_web.pdf
08		M04. Farbflächenmessung / Gravity and Area m04_xpectia_print.pdf m04_xpectia_web.pdf
09		M05. Farbtonmessung / Color Data m05_xpectia_print.pdf m05_xpectia_web.pdf
10		M06. Farbobjekterkennung / Labeling m06_xpectia_print.pdf m06_xpectia_web.pdf

Xpectia see & click programming system (extract)
http://www.spectronet.de > Akademie >
BV Anwendungen >
Bedienungsanleitungen >
Xpectias

The new smart vision sensor systems and the new intuitive programming methods are milestones in the digitalization of measurements and therefore a breakthrough in measurement science as well as in measurement education and training.

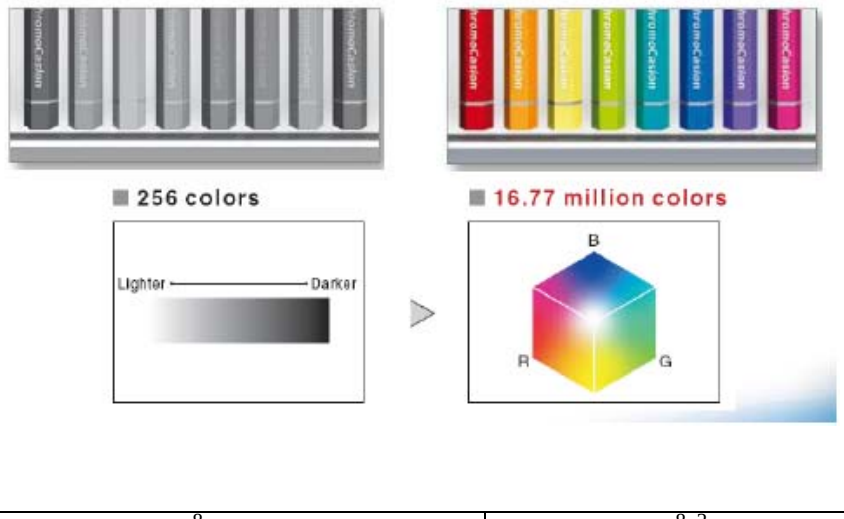
Visual quality inspections are fast, contactless and non-destructive. Most visual quality inspections still provided by human eyes. Visual quality inspections by man have five significant disadvantages:

1. The human inspector decides subjectively
2. The human inspector must be specialized and trained
3. The human inspector is expensive
4. The human inspector becomes tired
5. What human inspect in subjective visual perception is not simply a translation of the image on the retina. Thus people interested in perception have long struggled to explain what visual processing does to create what we actually see. This problem is unsolved till today.

Therefore an increasing interest is observable to use objective vision sensors and image processing software for visual quality measurements [7].

Special interest is focused on visual quality assurance **with color image processing** and spectral imaging. The simple reason is the huge information content of color scales in comparison with gray scales (Tab.2).

Table 2. Information content of different scales



$2^8 = 256$	$(2^8)^3 = 16.777$

Source: http://www.visquanet.de/servlets/SITEFORUM?t=/contentManager/selectCatalog&e=UTF-8&i=1122540720771&l=1&ParentID=1223122702488&active=no

Another reason is the availability of affordable color cameras under the influence of an exploding color camera market for consumer goods. The production of industrial color cameras grew by 13% in 2008 and has topped first in history the monochrome cameras [8]. But design and programming of industrial cameras are different to consumer goods. Therefore the see & click programming instructions has been elaborated for industrial color and other measurements.

3. Results

To understand the philosophy of the new programming method selected instruction steps for color inspections with the smart vision sensor system Xpectia are shown (Table 3).

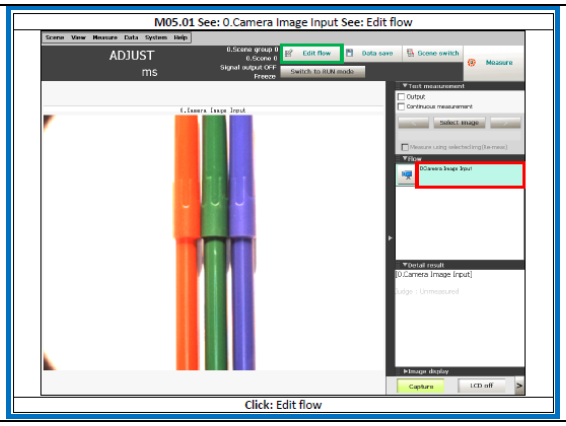
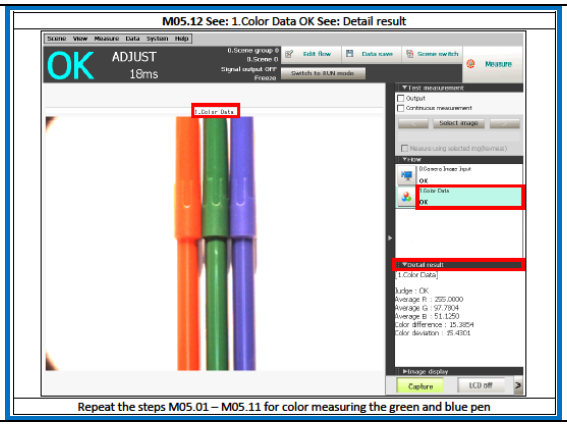
The task is to measure the color of the red pencil.

The results of the measurements are displayed on the graphical user interface in Table 1. The measurement results concerning the red pencil are:

- Average R(ed): 255.0000
- Average G(reen): 97.7804
- Average B(lue): 51.1250.

For measurements of the green and the blue pencils the same procedures have to be run again.

Table 3. Selected instruction steps for see & click instructions in color quality measurements

	
Step 1 of programming the color measurement with Xpectia See: Red frame; See: Camera Image Input & wait; See: Green frame; See:Edit flow & click Edit flow	**Step 12** of programming the color measurement with Xpectia See: Red frame: See Color Data OK & wait, See: Red frame: See Detail result & the END

4. Conclusions

In the paper has been shown that innovative instrumentation and programming facilities are enriching and changing the fundamental methods in measurement science and education.

Smart vision sensor systems and see & click programming instructions making the visual quality control objective, convenient, reliable and affordable. Together with cloud computing and a specialized platform as a service we are at the beginning of a new era for the application of external eyes in research and industry, food processing and healthcare, traffic and environmental protection, security and administration.

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