Comparing Apples and Oranges

**Self-service scale with USB cameras
identifies fruits and vegetables**

From apples to oranges, from avocado to zucchini — the fruit and vegetable departments of large supermarkets offer an overwhelming choice of fresh products. Consumers benefit from a broad selection, as most fruits are now available all year round. Another advantage of self-service supermarkets is that consumers can check and choose the fruit and vegetables themselves. Difficulties start when reaching the self-service scale: how to find the right button among dozens of different types of produce. The vast choice can quickly turn into an ordeal when it takes ages to locate the Papaya or Peppers button. To make shopping easier, METTLER TOLEDO, an international market leader in weight measurement technology, is offering an innovative solution: A compact, integrated uEye USB camera aids the self-service scales to automatically recognize the individual products.

METTLER TOLEDO has been developing and producing weighing systems for food retailers since 1975. The German company's PC-based UC3 scale series with touch screen is very successful in this market. The series features 20 different models, of which several tens of thousands are in use throughout Europe. The UC3-GTT-P is a very special version: This self-service scale is available with an optional integrated USB camera from the German machine vision specialist IDS Imaging Development Systems. With a size of only 3.5 cm, the board-level version of the USB uEye LE camera is concealed inside a curved metal arm that is mounted to the scale's screen. This way the camera points directly at the weighing plate on which the products are placed, but is barely noticeable to shoppers. The machine vision system has been developed for the shoppers' convenience and makes the self-service scales exceedingly easy to use.

The analysis process starts automatically as soon as a weight is placed on the scale. The scale's operating panel displays: "Recognition in progress". First, the scale checks whether the image captured by the camera changes, for example because the user's hand was in the field of view. As soon as the image remains still, the system starts analyzing. This takes about a second. Then four possible matches are presented for selection in large colored fields.
The consumer can now choose the desired type, and the scale prints the label. Due to various disturbance factors a fully automatic system cannot be implemented, as highly fluctuating light conditions or covered areas in the image affect the analysis. If conditions are good, however, the camera system achieves a high accuracy even if the weighed products are in plastic bags.

How does the image analysis work? Color is one of the key criteria. The colors detected in the product on the scale are compared with a stored list of colors that are assigned to the individual types of fruit and vegetable. The system analyzes not just single colors, but also color combinations. This way, for example, a specific combination of red, green and yellow could be recognized as "mixed peppers," if the retailer provides for such a choice. The combined analysis also helps distinguishing products of similar color, such as lemons and bananas. Characteristics like shape and texture are additionally evaluated. However, the use of plastic bags often complicates analyzing them. METTLER TOLEDO developed the algorithms in cooperation with the Fraunhofer Institute for Information and Data Processing. "The greatest challenge in developing the system was the actual definition and weighting of the product characteristics," says product manager Klaus Weber.

When selecting the camera, the size, the USB 2.0 connection and the color quality were at the top of the requirements list. Walter Grom, the engineer in charge of the project, explains: "An important factor in our decision was of course an excellent image quality, which the uEye provides."

The USB uEye LE camera series offers high-performance CMOS sensors in a compact design

The engineers from METTLER TOLEDO opted for the UI-1226LE-C, a model from the USB uEye LE camera series from IDS. The light-sensitive CMOS color sensor of the board-level camera captures up to 87 frames per second at the full 752 x 480 pixel resolution. Another major aspect is that the uEye's automatic white balance works reliably even against the blue background of the scale.

The second essential factor was the camera's software integration. Depending on the customer's specifications, METTLER TOLEDO installs either a Linux-based or a Windows-based operating system on the scale's integrated PC. "Another reason for choosing IDS was that they also offer a Linux driver that comes right with the camera," adds Walter Grom. The fact that the machine vision specialist IDS is located near to METTLER TOLEDO was a further advantage: During the development stage, the engineer visited IDS a couple of times to inspect the quality of production on site and discuss various customizations of the camera hardware. The scale manufacturer attaches great importance not only to a perfect product quality, but also to great flexibility regarding customized developments, and that is something that METTLER TOLEDO also expects of their business partners: "It was important to us to be confident of the quality and reliability of the camera supplier – and we have been very satisfied with IDS," explains product manager Klaus Weber

In Germany, the successful combination of precision scale and industrial camera is already in use in over 300 stores of a major food retailing chain. Other retailers in Germany and Europe have also started using the system and are planning to expand usage company-wide, as well.
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The compact USB camera auto-detects the products on the scale

The USB uEye LE series is a family of highly compact and cost-effective USB 2.0 cameras with CMOS sensors and resolutions from WVGA to 5 MP. Besides board-level versions with M12 or M14 threaded lenses, IDS also provides a housing version for the USB uEye LE.
The uEye camera range additionally features CMOS and CCD models with a rugged metal housing and USB 2.0 or GigE interface. The extensive uEye Software Development Kit (SDK) for Windows and Linux is available for free and is compatible with all uEye camera drivers. The uEye SDK also includes over 20 demo applications for camera integration and image acquisition as well as the source code in C++, C# and VB. The software bundle further provides an ActiveX component, interfaces for DirectShow/WDM, TWAIN and 3rd party drivers for most popular machine vision software. The cameras of the uEye LE series – like all camera models from IDS – support the new GenICam software standard.