ISG LightWise IEEE-1394 cameras sort rice and beans.

In the processing of beans and rice, incoming beans or rice are washed and dried, and, sorted for type and quality. The beans or rice must be sorted before they are sold to grocery stores or to manufacturers to be made into new products, such as soups and frozen dinners. The beans or rice are delivered by the ton by trucks straight from the farm to agricultural distribution centers. After unloading, many thousands of beans or rice per minute must be sorted using high-speed automated systems. This article will describe two systems, one to sort beans and the other rice.

To accomplish this inspection, one or more line scan or area cameras build an image of every bean or grain of rice as it travels off the end of a the conveyor belt. After inspection, machine-vision algorithms determine which parts are acceptable and which must be ejected. Either the Smart Camera itself or a PC-based system will trigger air-jets at specific points to blast out the unwanted beans or rice, broken beans or rice, or extraneous items such as rocks or bugs.

Since rice or beans are a consumable product quality sorting is very important. Accuracy is paramount as no one wants to bite into a rock or consume any bugs. Speed is very important also since large volumes of product must be sorted efficiently.

In the inspection of beans and rice, ISG uses it's smart line scan and area cameras coupled to an external compressor and air-jet system. Designed for a high-speed sorting-machine vendor, the system inspects up to four tons of beans or rice per hour.

Implementing complex algorithms in a PC is an everyday task for many machine-vision companies. Software from major vendors, such as National Instruments, are easy to use and powerful. A bean sorting application is described below that utilized the National Instruments IMAQ Vision product. However, some customers require high performance and low cost where custom image-processing algorithms must be embedded inside the camera. The rice sorting application will describe this second implementation.

BEANS:
ISG has recently developed a bean sorting system using its LightWise LW-1.3-S-1394-C Color Smart Camera, a 1280 × 1024-pixel area camera that incorporates small processor and a FPGA (Field Programmable Gate Array). After the beans are loaded onto a conveyor, they are illuminated and then imaged. After the camera detects the beans, the National Instruments IMAQ Vision software running on a National Instruments Compact Vision System (CVS) processes the captured images. For high-speed image capture the region of interest used in this system was 1280 columns by just 48 rows of pixels. Cutting the number of rows to 48 enabled the area camera to operate at 174 frames per second. This is more than fast enough to capture the beans in free fall after leaving the conveyor belt. The NI IMAQ vision software will determine the color and size of the beans and determine if they pass or fail. After this determination has been made, the failed items will be sorted out by having the NI CVS box trigger air jets to blow the failed beans into a separate bin.

This system is very flexible and the application can be developed very quickly using the NI IMAQ Vision and the CVS box. Making changes to the system is done quickly and efficiently.

RICE:
ISG developed such a Rice Sorting system using its LightWise LW-SLIS-1024a-1394 Smart Line Scan Camera, a 2048 × 1 pixel Line Scan camera that incorporates a small processor and a FPGA (Field Programmable Gate Array). After the grains of rice are loaded onto a conveyor, they are illuminated and then imaged. After the line scan camera detects the grains of rice, the captured images are processed on-board by the Smart Camera. Typically, image-processing algorithms determine the gray-scale level of objects within an image, and then threshold algorithms are used to set the limits of what is sorted. As the rice are being scanned, the gray-scale data will be compared to

a preset threshold limit value. In a 8-bit system, each pixel will represent pure white at 0 and 255 is pure black. Sorting will simply assign a pass or fail based upon the pixel value and the preset threshold limit. After the sorting algorithms determine which grains of rice are passed or failed the camera triggers a number of air-jets. The air-jets push each rejected grain of rice into a separate bin.

With such designs, our customers pay a nonrecurring engineering charge for the algorithm's customization and implementation in hardware inside the camera. When it is completed, the need for the PC is eliminated and the algorithm's performance is optimized. This lowers the system cost and enables OEM customers to offer sorting machines at lower prices to their customers. Since the machines are optimized, they can sort more material faster, and the end customer's throughput is increased.

These two implementations describe similar sorting applications with each system having different goals and outcomes. Due to the size differences between grains of rice and beans, rice sorters typically use many cameras in a single machine while bean sorters just a few. The bean sorting application has been designed for flexibility and ease of design and development. The National Instruments IMAQ Vision Software and the NI Compact Vision System is very powerful and easy to use. The cost of this system is very reasonable for the sorting of beans. The other rice application was designed for very low implementation cost and speed of sorting. Designing a custom algorithm into the Smart Camera requires Verilog HDL programming and the associated NRE charges. However, this system doesn't need a PC or vision processor to implement the algorithms so that the need for a PC or host vision processor is eliminated lowering the overall system cost significantly. Due to the size differences between grains of rice and beans, rice sorters typically use many cameras in a single machine while bean sorters just a few.

Written by:
Kerry Van Iseghem,
Imaging Solutions Group (ISG),
1387 Fairport Road, Suite 890,
Fairport, NY 14450
Phone: 585-388-5220
Fax: 585-388-5223,
Email: Kerry@isgchips.com
Website: http://www.isgchips.com