Better Polymer Fleece Quality at Low & Bonar

Low & Bonar has achieved better error detection in their polymer fleece manufacturing using real-time image processing with hard- and software from Silicon Software. The solution can detect more errors as with other inspection systems that are available in the market. System conversion to GigE Vision frame grabbers and VisualApplets for the graphical programming of image processing applications, triggering, and peripheral connection proceeded seamlessly, thanks to consulting and implementation from STEMMER IMAGING B.V., Netherlands. The manufacturer is now set to use a tailor-made and yet flexibly modifiable system to deliver better product quality to its worldwide clientele in the process industry.

Source: Silicon Software GmbH

Low & Bonar PLC, headquartered in London UK, is a leading global manufacturer of high-performance materials that are produced in Europe, North America, the Middle East and China. They supply a wide variety of polymer fleece from various polymers they process in their factories into threads, fibers and coated textile items and composite materials. The manufacturing process consists of thermally bonding 350 fibers, each composed of 127 filaments, into fleece. The filaments in the material should open, making a stable product. The task of the image processing system is to find errors such as unopened yarn, dark spots, light spots, and a combination of dark and light spots. The unopened yarn algorithm is very processor intensive and is executed by the Silicon Software frame grabber together with the flat field correction. This could not be done on a PC in real time. The previous proprietary system could not detect unopened yarn errors.

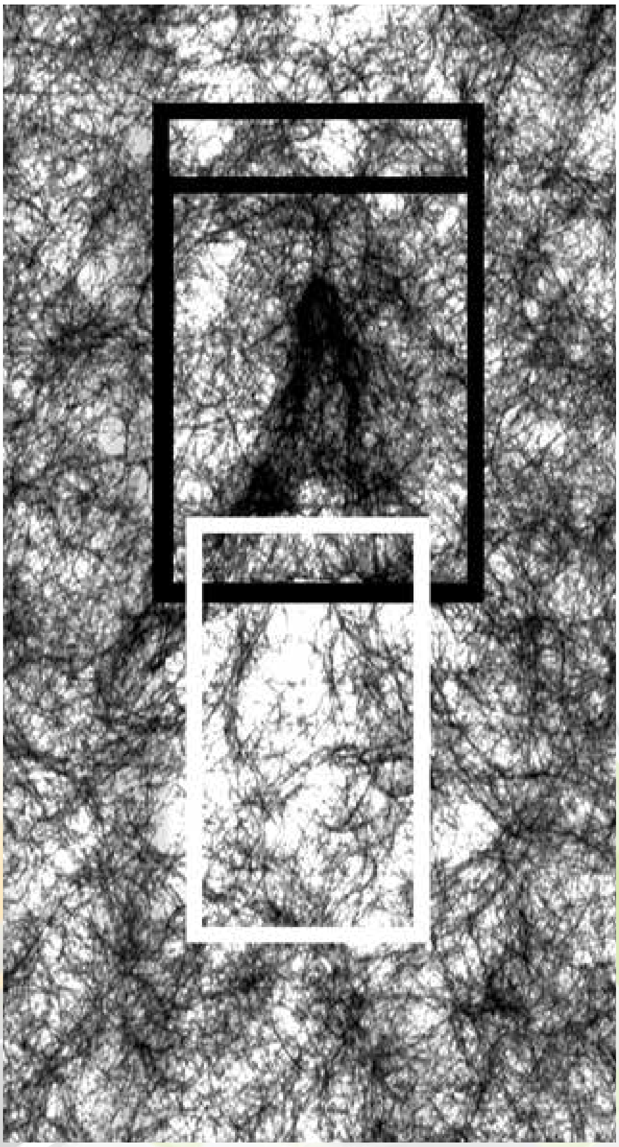
STEMMER IMAGING B.V., Netherlands, was contracted as the consulting, development, and implementation partner to choose appropriate solutions. STEMMER selected four monochrome Teledyne Dalsa Spyder 3 line scan cameras with 4K resolution, 8-bit image depth, and line frequency of up to 68kHz, as well as four programmable microEnable IV VQ4-GE frame grabbers from Silicon Software with GigE Vision camera interfaces. This system offered a good price-to-performance ratio, allowed 100 meter long cables to the host PC, guaranteed short implementation times and satisfied the hard real-time demands on image processing. Silicon Software's GenICam Explorer for the camera configuration and microDisplay for image acquisition control and preview aided rapid system implementation.

The software was developed by Low & Bonar together with STEMMER IMAGING B.V. In a very short time STEMMER IMAGING B.V has done the programming of the microEnable IV VQ4-GE frame grabber using VisualApplets by the specifications of Low &Bonar.

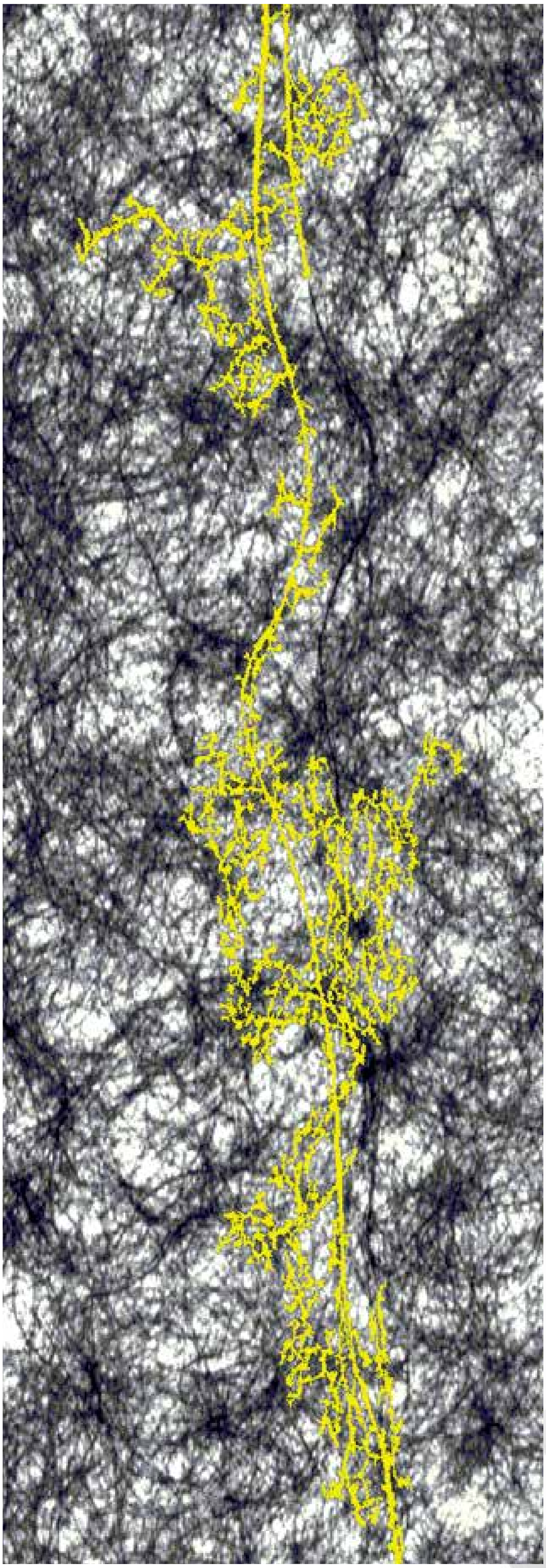
System Programmed and Put into Production in No Time

Using VisualApplets, STEMMER programmed a hardware applet for the FPGA for this special inspection task, along with a software configuration interface to the host PC for the applet. This contains a flat field correction algorithm for line scan cameras and a multiple 9x9 morphological filter for precise, down-to-the-pixel analysis of filaments manifesting defects in their unopened state that compromise the material's tear resistance. Moreover, the applet includes a stitching functionality to combine the individual intermediary result images into a single entire image. STEMMER was able to have the new software available within a week – considerably faster than with conventional hardware programming. "The new hardware, the programmed applets, and the software could be implemented in a very short amount of time. We tested the entire system extensively in advance and had it up and running shortly thereafter", explained Dietmar Serbée, Managing Director of STEMMER IMAGING B.V. Even with the fiber material production line moving at a half meter per second, demands on bandwidth played more of a subordinate role.

In the first 1,000 lines of image acquisition, an original 8-bit monochrome image results, which is used to calculate the shading. The subsequent flat field correction generates yet another image of 1,000 lines. From this, using a multiple 9x9 morphological filter, the filaments' black-and-white transitions are analyzed, where-



Dark light error/ Source: Low & Bonar, PLC



Unopened yarn error/ Source: Low & Bonar, PLC

by once again a further 1,000-line image results. If a filament remains unopened, less light falls on that position and some areas appear darker than others. Using this method, unopened filaments and strands that are not connected are detected from various directions with certainty. Clumps of filaments or holes in the fabric can be identified with certainty as well.

The three images arising during the image recording chain (original image, flat field correction-improved image, and the 9x9 filtered image) are then finally merged via stitching into a single final image. Only four computers evaluate the final image. "We were able to reduce the number of computers particularly by integrating the large multiple 9x9 morphological filter using VisualApplets and without using software", reported Serbée. For the CPU-intensive 9x9 filter matrix calculation as well as the remaining image processing applications, FPGAs were used since real-time behavior could not be guaranteed with calculations on a normal CPU processor.

Tailor-Made and Flexibly Expandable

"With the new image processing system, we are in a position to find more complex errors in the material at the same time. We can alter the system at any time with VisualApplets and modify it for new requirements", underscored Gerrit Verbruggen, Project/Maintenance Engineer at Low & Bonar. "Further investments for this are not needed." When defects in the material are detected, a signal is sent to the machine that then marks the defective spot with a label. The material is usually completely fabricated and the defective spot is excised later. Polymer fleeces manufactured in this manner are tailor-made for different client requirements, and are implemented as stadium roof membranes, truck and sun protection tarpaulins, coverings, and flexible containers as well as for pools and boats, among other uses.

"The selection of appropriate GigE Vision frame grabbers, graphical FPGA programming of algorithms and applications solely with VisualApplets basic building blocks, the short implementation time and flexible system handling made this project a success. We are achieving better quality of our polymer fleece", Verbruggen emphasized. In future, flat field correction will be optimized further using higher dynamic ranges with the goal of inspecting darker polymer fleece error-free as well.

microEnable IV VQ4-GE: PCIe image processing device that allows the full bandwidth connection of four GigE Vision cameras

- Lowest CPU load even in multi-device mode
- Industrial and stable multi-camera support
- Ease-of-use configuration software
- Professional Machine Vision SDK support
- DMA900 / up to 900 MB/s PCIe Data bandwidth (PCIe x4)
- Professional GigE Vision solution
- Broad support of Third-party software interfaces
- Versatile application and industry usage
- Easy programmable Vision processor for individual realtime funtionality
- Up to 100m cable length

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