High-Speed Vision Technology Automates Mail Handling

Akatech SA, a Swiss company that specializes in algorithm design for high-speed image processing, has used Datacube equipment to develop a vision system for the Swiss PTT (Post Office and Telecom). The system recognizes the many types of postal "currency" (stamps, meter imprints, and bar codes) used in Switzerland, and calculates each piece's face value or "franking value" for proper sorting. Akatech turned to Datacube and the MaxVideo 200 for its advanced vision technology, fast processing speeds, and the ability to integrate the finished vision system with the PTT's existing mail sorting system.

The Swiss PTT uses flourescent-based equipment provided by NEC to automate the process of culling (sorting), facing (orienting), and canceling the large volume of standard-sized pieces of flat mail they handle every day. Called a "CFC" system, the equipment first sorts out, or "culls," from the many pieces of mail fed into the system those that can fit through the rest of the system. The culler weeds out any pieces over an acceptable size or thickness, and tests the flexibility of the remaining pieces to make sure they will pass through the twists and turns that lie ahead. Those that don't pass the tests are redirected for hand canceling.

Second, the CFC orients the pieces to align their edges. A bright light is shone onto each piece to locate the stamp,

Mail is guided through the Swiss PTT's postage recognition system

bar code, or meter imprint which, in Switzerland, is most often printed with a fluorescent ink. The area with the greatest reflective properties is assumed to include the stamp, bar code, or meter imprint, and is then fed into the system in the same general orientation each time. Those without any apparent fluorescent markings are also rejected by the system and redirected for hand canceling.

The pieces that make it this far are next fed through the innovative, non-flourescent recognition system developed by Akatech. This Datacube-based vision system uses two separate cameras and lighting systems — one to capture images of stamps and bar codes, and another specially configured to capture images of the harder-to-read meter imprints. Both cameras are connected to MaxVideo 200s that carry out complex metrology and recognition algorithms to isolate and identify each piece's postage value.

Next, captured images of stamps are compared to a large library of templates stored in the MaxVideo 200's memory. The system is capable of recognizing stamps in any of four

What: **Postal Currency Recognition and Calculation**

Who: **Akatech SA for the Swiss PTT**

How: **Dual MaxVideo 200s with 8x8 Convolvers**

Technical Summary: *The Swiss PTT uses an automated system to sort, orient, and cancel a large portion of their daily mail. Akatech SA developed a vision system based on Datacube technology that could be integrated into the existing process to recognize the many types of postal "currency" that appear on these pieces of mail and calculate their face values.*

orientations — "right-side up" or 0°, 90°, 180°, or 270°, all ±10°. Once a match has been made between the captured image and a stamp template, the system looks up the franking value assigned to that template and passes the information on to the host CPU. Adding to the complexity of the recognition and calculation tasks, stamps may be used alone or in a variety of combinations. Akatech's system recognizes up to four stamps per piece of mail at a rate of 10 to 15 letters per second. The host CPU adds up the values of these individual stamps to determine the total amount of postage per piece.

When the captured image is a bar code, the MaxVideo 200 calculates the length and width of the bars and the host CPU uses the results to determine the code's franking value. In the case of a meter imprint, the MaxVideo 200 isolates the specific area of the imprint in which the value is printed. This image data is passed on to the host CPU where it undergoes optical character recognition to determine the value.

In all cases, the postal value is passed back to the NEC CFC system. The CFC uses that information to determine how a piece of mail should be canceled and handled. There are two classes of mail in Switzerland — priority, or "preferred," and normal class — each with a separate rate. The total value of postage calculated for each piece of mail dictates which class of service it receives. If any given piece is determined to have insufficient postage for the lowest class of service (normal class), the item is rejected and returned to the sender.

This integrated system, including the NEC CFC equipment and the Datacube-based recognition system from Akatech SA, significantly reduces the amount of hand canceling required by the Swiss PTT, which reduces daily operating costs. The Swiss PTT has installed the system in all major postal centers and has contracted with Akatech to design additional vision-based applications to further automate their operations.

System Overview

The recognition system developed by Akatech SA consists primarily of two separate MaxVideo 200 image processing boards, each with its own video input. The two image processing boards are housed in a VME chassis and connected to an MVME167 which handles all non-vision specific processing.

D A T A C U B E

The vision system includes an interface to the CFC equipment and a PC interface. A PC is used to adjust parameters such as the values assigned to a given stamp and to perform routine maintenance of the system. For example, when stamps are first issued, the system must be trained to recognize them. One of the options on the operator console places the system in "learn" mode, during which the system creates a new template from the acquired image of a newly-issued stamp.

Image Acquisition

The input into the first MaxVideo 200 is a line scan camera in an enclosure with a white light source. This part of the system is responsible for capturing images of stamps and bar codes. The second MaxVideo 200 is connected to a line scan camera in an enclosure with a cyan light source. The cyan light (a mixture of blue and green light) enables
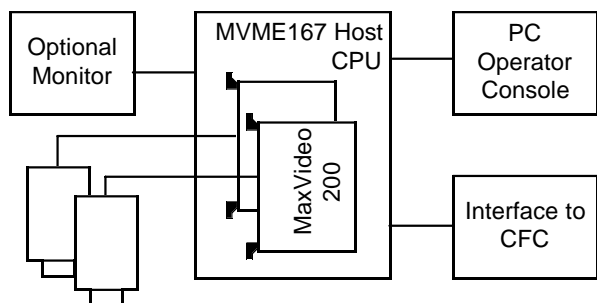

the system to more easily recognize meter imprints that are printed with red ink.

As mail is passed through the system, each camera captures an area 110 mm wide and 50 mm high from the upper right-hand corner of each piece to create an image 440 pixels by 200 pixels (4 pixels per millimeter).

Recognition Algorithms

The first step in recognition uses an X-sum filter to find the relative vertical (Y) position of the stamp(s), bar code, or meter imprint within the captured image. If the results show evidence of frequent changes from light to dark, characteristic of a bar code,

image data is handed off to the CPU for interpretation. If, on the other hand, the filter locates one or more apparently separate rectangular shapes (stamps) within the image area, the next step is to locate the center of each stamp and isolate a region around its center for comparison to the system's stored templates.
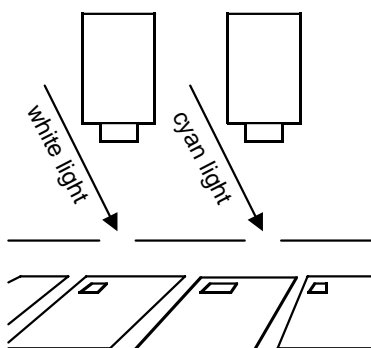
The system focuses on a 16x16 mm area around the center of each stamp, creating a region of interest 64 pixels wide and high. Using an 8x8 convolver, the image is converted into an image 8 pixels wide and high to be compared to the many templates held in memory. The system can store up to 128 templates, and any 32 of those tem-

plates can be chosen by the operator to use at any given time.

If the X-sum filter results in sharp spikes that don't fit the parameters of either a bar code or a known stamp, the

ROI = 16x16 mm (64x64 pixels)
Reduced to an 8x8 pixel image
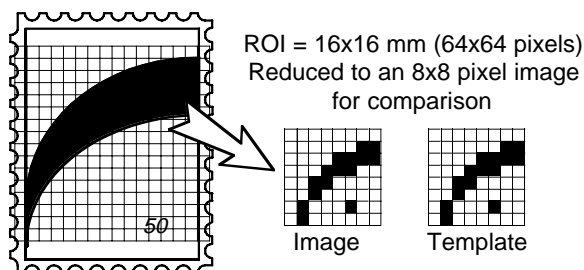for comparison

Image   Template

image undergoes processing for meter imprints. (The two camera/two MaxVideo 200 configuration allows this to occur in parallel with the processing of stamp and/or bar code images.) The Y position of the image has already been found using an X-sum filter. Using a Y-sum filter, the horizontal (X) position of the image is also isolated, allowing the system to focus on just that portion of the image where the value of the imprint is located. This image data is then handed off to the CPU for optical character recognition.

Project Status

The Swiss PTT is highly satisfied with Akatech's recognition system and has installed it in every PTT office equipped with the NEC CFC equipment. Recognition and calculation success rates are typically around 97% for stamped mail passed through the system, significantly reducing the amount of hand sorting and canceling required at Switzerland's postal centers. The success rate for meter imprinted mail is slightly lower (80-90%) due to imperfections in the imprint which make OCR difficult.

Akatech's current project for the Swiss PTT is the development of a new, non-flourescent vision-based system for facing. The Swiss PTT's current method for facing pieces of mail is being phased out because the printing of stamps, bar codes, and meter imprints using fluorescent ink is very expensive and environmentally unsound. Akatech has developed a prototype of a facing system based on the MaxVideo 200 and plans to use the MaxPCI platform from Datacube for the final product.

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