The Advantages of Inline Recognition

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1. Introduction

In data entry applications, it is often the case that certain fields of incoming forms must be scanned and their contents recognized. For example, a customer's name, address, and customer number may have to be read from the form and turned into a bar code that gets printed on the form. This recognition can be done while the form is on the scanner's transport ("inline" recognition) or it can be at some later time ("offline" recognition).

Until recently, inline recognition was clearly superior to offline recognition. Inline algorithms used grayscale data from the scanner's cameras to do template matching (i.e., matching a canonical template of a letter to the image of a letter). Inline recognition also featured neural net algorithms for handprint recognition. The accuracy of both techniques was superior to offline techniques, in part because the data offered to the inline algorithms was greater than could be offered to the offline algorithms. Ten years ago, the amount of data required to achieve the accuracy of inline recognition was too great to be transported and stored to do offline recognition. Offline recognition had to make do with a bitonal image of lower resolution. These limitations did not exist within the scanner itself.

Subsequently, however, the costs of storage and bandwidth have plummeted, while faster CPUs have radically increased compression speeds. Consequently, the constraints on offline recognition have fallen away, and the accuracy of offline recognition has caught up with inline recognition. In terms of recognition accuracy, it is hard to beat the newer offline recognition applications that use multiple tuned engines accompanied by a voting algorithm (e.g., in products like the eFLOW Unified Content Platform from Top Image Systems). However, there are still business requirements that cannot be met with offline recognition. This paper will discuss the advantages of inline recognition, give some examples of business situations where inline recognition is essential, and summarize the main points.

2. The advantages of inline recognition

The one inescapable advantage inline recognition has over offline is that by reading and analyzing a document while it is still on the transport, inline recognition can intelligently direct the labeling, stacking, and operator processing of the document.

For example:

Inline recognition can cause a downstream inkjet printer to print a label on each document, where that label can be created under program control. The program can apply business rules to the contents of any combination of the document's fields, or it can use parameters external to the document being imaged (e.g., reset the value of this label field at the start of a new processing day).

Offline recognition is much more limited in the intelligence it can bring to bear on the labeling. Some scanners can effectively read bar code and/or patch codes. If the read head is ahead of the print head, the printed text can be incremented based upon the bar/patch code (e.g., the batch number can be incremented).

Similarly, based on the content of the document, different physical annotations can be written on the document using inline recognition. This would not be possible with offline recognition.

Batches consisting of intermixed documents (i.e., documents of different types and sizes) can be recognized as consisting of a set of different document types. Using inline recognition, each document can be recognized as belonging to a given type. Different recognition templates can be applied to each type, and each type can be physically dispatched to a different stacker. For example, a series of batches, each consisting of tax forms and a check, can be processed so that all the checks end up in the same stacker. In an offline recognition situation, the checks would have to be separated out by hand after scanning. Another example would be outsorting documents that were not recognized (e.g., because highlighter was obscuring some key text).

Note that the ability to "waterfall" (outsort different documents into different stackers) allows the operator to continuously feed the scanner, which increases throughput.

Inline recognition is capable of distinguishing batches (and individual transactions within the batch) on the fly, without the need for special transaction or batch separator sheets. This has several advantages.

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First, the scanner can group all of the documents into a single multi-page transaction. For example, in a tax processing situation, the scanner can recognize the lead form (e.g., a 1040EZ) as the start of the transaction, and then every document following it will be part of the transaction until a new lead sheet (1040EZ or other form) is encountered. Avoiding the use of separator sheets decreases the document preparation time and the amount of paper passing through the scanner. Also, on some scanners, the operator must take a physical action (e.g., press a button, hit a foot switch) to signal the start/stop of a transaction. Besides being error-prone, this means the operator is not free to do document preparation or feed the scanner.

Second, it is possible to distinguish when one batch or transaction succeeds another *without* some required separator (the 1040EZ form, in the above example), and to do this immediately at the point at which the implied transition to the second batch is detected. This enables the scanning application to stop the transport and tell the operator that something is wrong and needs correcting.

For example, in a sequence of documents consisting of A's 1040 form, A's supplementary tax forms, A's check, B's supplementary tax forms, and B's 1040 form, inline recognition can detect a malformed batch as soon as it recognizes the first of B's forms not preceded by B's 1040 form. B's forms can be directed to a separate stacker, and inline recognition can continue running the transport and directing documents to this "error" stacker until it finds some defined batch boundary, such as B's 1040 form or (more likely) C's 1040 form (assuming it is not preceded by any of C's documents). The erroneously ordered forms of B can be reordered by the scanner operator and reprocessed.

Note that special sheets can explicitly separate batches, or they can be implicitly separated by transitions detected by business rules. A business rule might look for a barcode identifying, say, a customer invoice, and this must precede any other documents from that customer. Or, as in the tax example, the features of the form itself denote its type, and the business rule may specify that a document of a certain type for a given customer must precede other document types for that customer.

The last example illustrates another advantage of inline over offline recognition. Errors in the document stream can be detected at the point of scanning and can be corrected by the scanner operator. These personnel are typically paid less than downstream people who would otherwise have to detect and correct these kinds of errors. Thus the cost to detect and correct errors is less when using inline recognition than when using offline recognition.

3. Examples of inline recognition applications:

We will analyze two applications which demonstrate when inline recognition is the only answer to the business requirements.

A large tax processing Outsourcer pays property tax bills for mortgage companies, which receive tax bills from between 2500 – 3000 taxing authorities. The process works as follows:

The Outsourcer receives the tax bills and scans them.

Using inline recognition, each tax bill is assigned a document control number that reflects the mortgage company, the taxing authority, and the sorting information required by the taxing authority. This latter item might be the tax bill number, the property address, the property owner's name, etc. In any case, it is the item on which that taxing authority wants its bills sorted when they are returned to it. The document control number is then printed on the tax bill as a bar code.

The Outsourcer organizes the scanned information as an electronic record. The records are batched by the mainframe and sent to the mortgage companies.

Each mortgage company sends back a file of results. For each tax bill, there will be some disposition instructions to pay the bill or not pay it (in cases where the property has been sold, the mortgage company no longer services that mortgage, etc.).

The Outsourcer rescans the tax bills. Inline recognition reads the bar code from step 2, checks the disposition of the bill based on the mortgage company's instructions, outsorts all invalid bills into a special stacker, and outsorts the "to be paid" bills into other stackers. There will be several passes through the "to be paid" bills, because what must happen is that the physical bills must be stacked by taxing authority, and within that, by mortgage company, and within that, by the tax authority's required sort order.

At the end of the multi-pass sorting, the operator can pick out the set of bills to go to each taxing authority, attach a check for the taxing authority to the front of the batch, and send it to the taxing authority.

As can be seen in this example, inline recognition is required in order to label the physical tax bills in a single pass and direct them to specific stackers under application control (e.g., the mortgage companies' dispositions files).

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A second example of inline recognition comes from a company that processes orders for music CDs and DVDs. In this application, customers send in cards indicating one of the following choices:

- I want to buy this month's featured selection only.
- I want to buy this month's featured selection and some other items as well.
- I don't want this month's featured selection, but I do want some other item(s).
- I don't want anything this month.

Inline recognition allows the items to be sorted into those groups, plus "error" groups (e.g., unable to distinguish whether a box is checked or not, unable to read an item number). As noted in section 2, inline recognition enables a less-expensive scanner operator to perform many of the necessary corrections.

Assuming that an item can be scanned correctly, why save the paper? The fact is that saving the paper is a customer-specific requirement, in which case, inline recognition must be used.

4. Summary

Inline recognition is indispensable in situations where the business requirements include any or all of the following conditions:

A logical transaction consisting of two or more documents that may or may not be explicitly demarcated from the preceding or following transaction. The documents within the transaction must be noted as belonging to that transaction, for example, because they need to be physically labeled with an identifier that is derived by applying business rules to the document's fields, the transaction's characteristics, or other parameters external to the transaction (date, time, number of transactions processed that day, etc.).

A batch consisting of intermixed documents that must be physically separated into different stackers for processing (e.g., outsorting checks to be deposited, or items requiring operator attention).

Documents (whether batched or not) that must be annotated on-the-fly, for example, using a barcode containing information derived from the information on the document. (The barcode will be used in later steps in the business process.)

Errors that must be detected and fixed as early in the business process as possible.

In applications with any of these requirements, inline recognition gives intelligent control over the physical sorting process and allows errors to be detected and corrected sooner in the data entry process, which in turn lead to improved data accuracy rates, greater operator productivity and lower data entry costs.

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