▸ ShapeFinder

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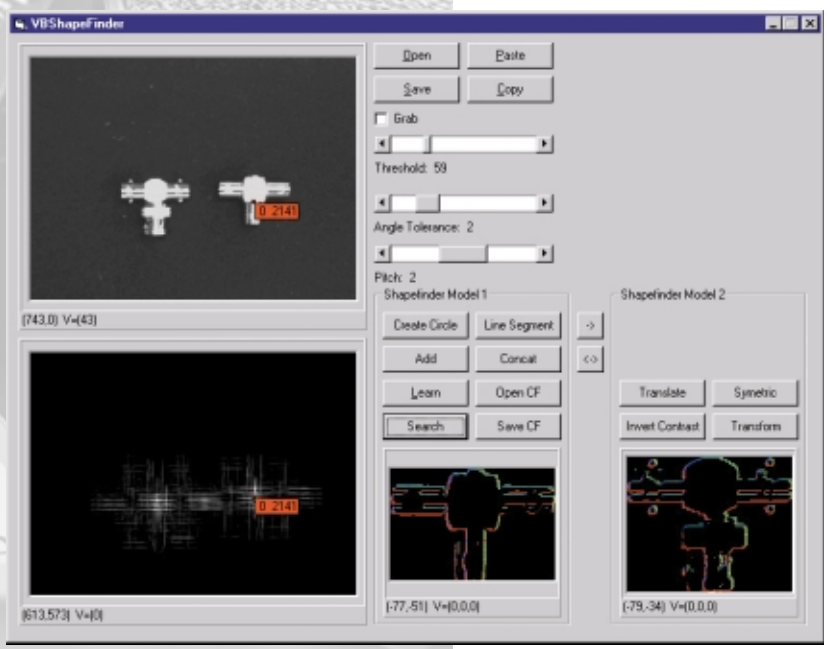


Software tool for pattern recognition

STEMMER® IMAGING

▸ ShapeFinder

ShapeFinder is a search tool for recognizing the position of objects irrespective of orientation and size on the basis of the inner and outer contour properties of the objects. One particular feature of the software is its tolerance to interference when recognizing test objects and materials which are partially covered, noisy or susceptible to reflections. By adjusting various parameters, the user has the option of choosing between an extremely fast setting which is somewhat more susceptible to interference and a rather slower setting which is, however, more reliable. In this way, it is possible to find the best compromise for a particular application.

▸ The algorithm

The tool uses a generalized form of the Hough transform. The patterns to be found are identified solely on the basis of the local contrast between the grayscale values of an image. Contrast regions correspond to pixels in the vicinity of which the grayscale values vary considerably. The algorithm on the other hand ignores regions in which the grayscale values vary only slightly. Users of the ShapeFinder tool can define an appropriate threshold value for the contrast and thus control the computation effort and the quality of the results.
A further interesting feature of ShapeFinder is the option of searching for more than one pattern. In this case, the search window is not investigated iteratively n times for n patterns, but only once. In contrast to the case when searching for a single pattern, an accumulator is calculated for each pattern type. Evaluation of the resulting multidimensional quality value image allows different pattern classes to be identified and their position to be located. For this reason, ShapeFinder has also been tested in respect of its suitability for OCR applications. This function requires, of course, a large number of accumulators and has correspondingly high memory requirements. Nevertheless, when required to identify the digits 0 through 9, ShapeFinder delivered very good results.
Another important aspect of the multi-accumulator technology is orientation-independent recognition, which is of key importance for many industrial applications. This is achieved by simply distributing the corresponding orientation space over several accumulators in an appropriate manner.
ShapeFinder achieves impressive search speeds. Typical times for locating a 30 x 30 pixel pattern in a 768 x 572 image are around 15 ms, depending, of course, on the processing power available.

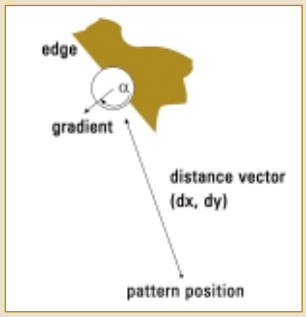
▸ Features of ShapeFinder

- The tool is extremely tolerant of interference, for instance with noisy patterns or patterns which overlap.
- It is possible to teach several pattern classes.
- The tool provides support for orientation- and size-independent recognition.
- ShapeFinder can be parametrized by the user and can thus be adapted to meet the requirements of the given application with respect to speed and precision.
- The tool is simple to use. The mere 27 functions in the ShapeFinder library (DLL) allow simple solution of even difficult tasks.

The principle of pattern recognition

The analytical tool used to describe the local contrast is the grayscale value, measured at a specified position in the image. The resulting gradient has two properties, the direction and the magnitude. The direction indicates the direction in which the grayscale values rise most sharply. The magnitude describes the increase in the grayscale value in this direction over a distance of one pixel, i.e. the maximum increase in grayscale value in the vicinity of the pixel as a measure of the contrast value found.

When teaching a pattern, the user first specifies a position for the pattern and a feature space in which the algorithm is to find the relevant characteristics of the pattern. The function searches in this space for pixels for which the magnitude of the gradient at least equals the threshold value previously defined. One characteristic is then stored for each of these pixels. This is a record which in principle includes the relative position of the pixel to the pattern position in the form of a two-dimensional distance vector (dx and dy) and the direction a of the gradient. The set of the identified characteristics provides the basis for pattern recognition by the ShapeFinder tool.



When searching the specified search window for a pattern, ShapeFinder uses the characteristic list (which can be imagined as a template in which each characteristic is entered at the position defined by dx and dy) in order to calculate a numeric similarity or quality for each pixel in the search window. By repeating the calculation for the various positions, a »quality value image« (the so-called accumulator A) is built up, whose dimensions correspond to those of the search window. The probability is high that the target pattern is at that point at which the correspondence stored in the accumulator is greatest.

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