DETERMINATION OF OPTIMAL CENTERS FOR SCANNING OF REGULAR FIGURES' IMAGES WHEN RECOGNITHIZING THEM

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Abstract

There has been proposed method for recognition of images of flat regular figures using their resolution from the internal spot of scanning. new forms of images representation are considered. An algorithm on search of optimal scanning center has been proponed. A structure of images recognition device has been developed.

Key words: *image, center of scanning, angle of discredit, contour.*

1. Introduction

On creating modern intellectual systems, a use of effective work methods for treatment and recognition of images is of big importance [1-10], which are widely used in different spheres of science and techniques (robotics, space, communication, telecommunication, medicine, transportation and others).

Currently, there are plenty of developed methods of image treatment and recognition based upon various scientific approaches, which have certain advantages and imperfections [11-21].

The work considers a method of image recognition for flat figures based on its evolvement and subsequent treatment.

By way of images on entry which are objects for recognition there have been used secluded salient figures which are scanned into internal region with the center of scanning established in advance.

The task determination of optimal center on scanning of images and geometrical shape of a figure is based upon findings.

2. Method and realization algorithms of determination of optimal centers for scanning of regular figures' images when recognizing them.

The method is based upon image scanning of secluded figure on the inside of a contour, and the forming shape of evolvement, which is exposed to the subsequent treatment.

The crux of the method is underlined in the following:

Within an image projected on receiving carrier, a spot is chosen. The distances between it and contour spots are calculated. All the distances are calculated on the straight lines passing through the spot chosen and oriented between each other in series under the certain angle in it (fig. 1).

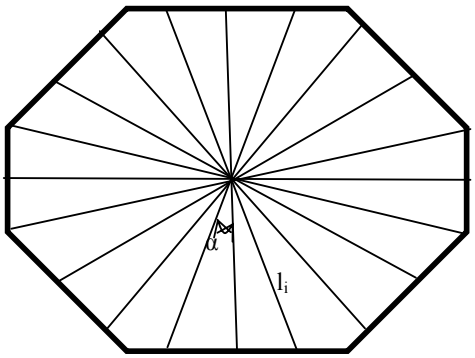

Fig. 1. An example of scanning and figure image at the spot O.

Each scanning step is realized by the given angle α. Of the calculated lengths l_i there are formed angles of discrimination α and by vertical - l_i (fig. 2).

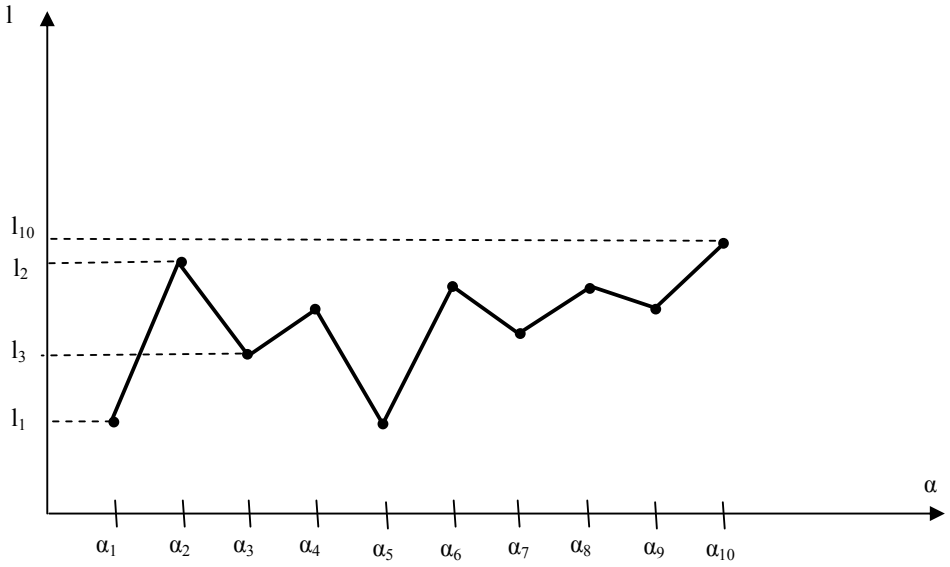

Fig. 2. An example of unfolded image by the method of internal scanning $\alpha_i = i*\alpha$ = the common angle of scanning.

At the same time the diagram shapes can change. All depends on initial choice of scanning direction. For checking up the identity of two images there are fulfilled cyclic shift with congruence tact by tact. An example of the shift to the right at one discrete value α of (fig 2) image is shown in the fig. 3.

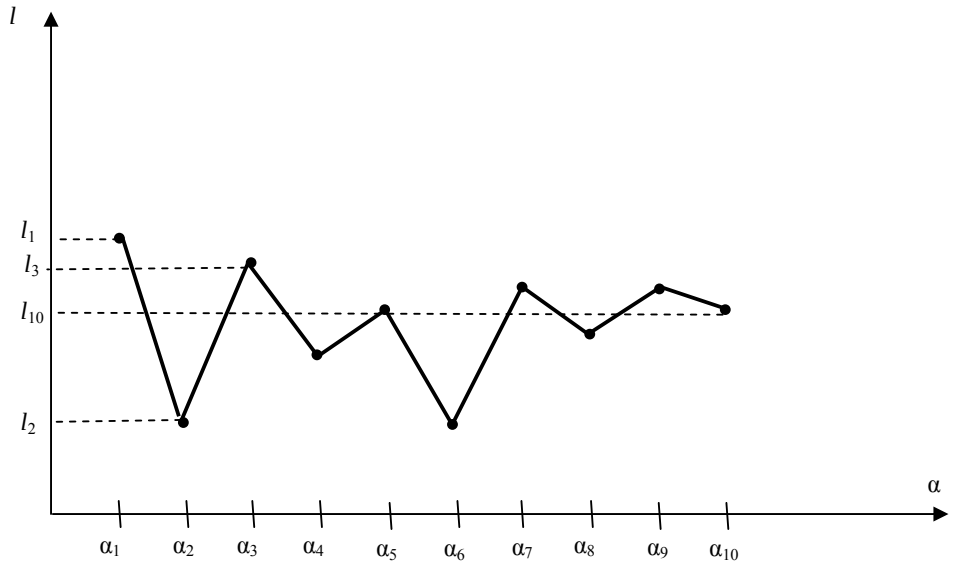

Fig. 3. An example of a graphic shift of unfolded image at one position to the right.

Examples of graphic presentation of the standard figures are introduced in the fig.4.

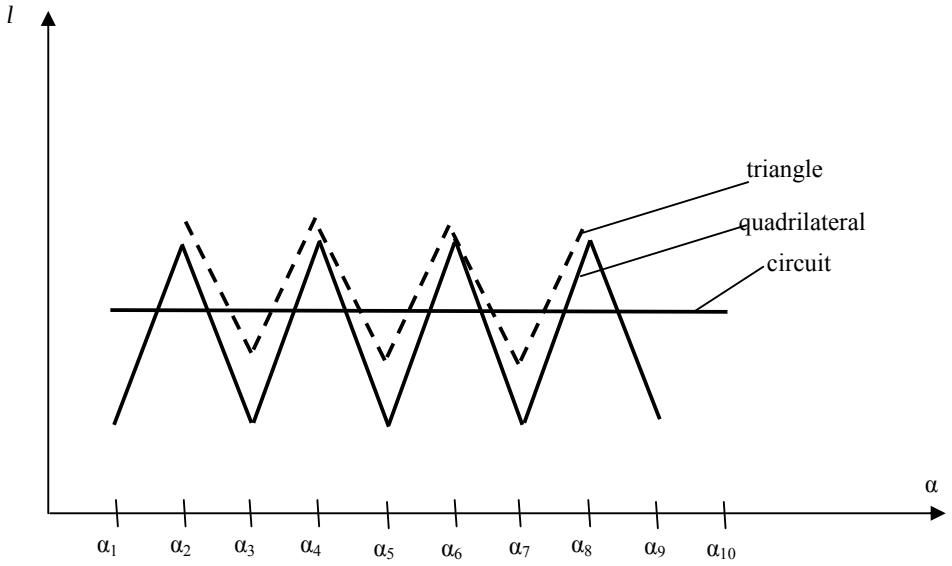

Fig. 4. Examples of graphic presentation of the standard figures.

It is not always possible to exactly define a scanning spot. Therefore series of additional operations are carried out which include calculations of the sum total of the lengths l_i. Also there are some additional spots of scanning and length 1_{md} mean value is calculated.

Sum total is calculated as

$$L = \sum_{i=1}^{k} l_i$$

Where $k = \frac{360}{\alpha}$ – numbers of scanning tact's.

The procedure for calculation 1_{md} is little bit complicated. Several scanning spots are used and sums total L^j are calculated for each. Accordingly, there must be fulfilled condition for one image which is concluded in equality of all the sums total

$$L^1 = L^2 = \ldots = L^j$$

Examples of triangle images unfolded with different spots of scanning are presented in the figure 5.

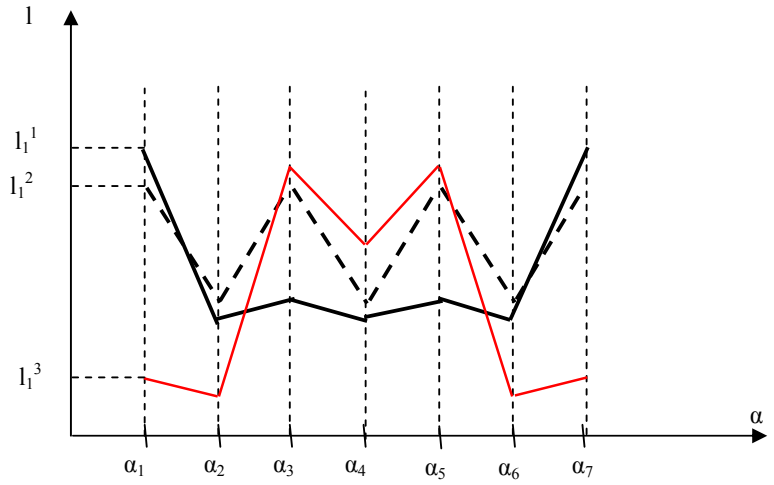

Fig. 5. Examples of triangle images unfolded for three spots of scanning.

The mean length $l_{i,\,md,}$ is calculated by every discrete value α_i which determines the mean scanning spot. From the total set of scanning spots, some will be excluded, which sums total are not equal to the majority of sums total of the rest spots.

If scanning spot is located on the contour then the diagram of unfolded figure crosses α axis.

For imaging of complex figures, with irregular shapes, there are great numbers used for scanning spots. Spots which describe the figure totally are chosen. Choice of such spots is fulfilled by the special algorithms.

Location of spots out of an image does not provide strong assurance during recognition inasmuch as scanning line can coincide with one of the figure side.

For recognition of figures on the entry of the system there is created standards base. speaking of which, each image is presented with great number of lengths $I = \{l_i\}$ disposed in hard established consecution.

Recognition algorithm is concluded in the following.

1. Figure's image is projected to an operational carrier
2. Scanning spot is chosen.
3. Vector of lengths $<l_i>$ is formed by the results of scanning.
4. The vector received is compared with a vector from standards base. If the standard is found – the transition should be undertaken to the spot 5, if the standard is not found - the transition should be undertaken to spot 6.

5. Identification of the figure's image (Completion of algorithm).
6. Shift of the vector received to one discrete value on the (α) axis to the right (left).
7. Determination of the total shift. If the total shift happened – there should be transition to spot 8. If the total shift did not happen – there should be transition to spot 4.
8. The scanning spot is chosen.
9. The condition on spots limitation is checked, if spots number is more than established one – then there should be done transition to point 10, and if less than or equal to – then transition to point 11.
10. Figure has not been recognized. (Completion of algorithm).
11. The mean value of vector is calculated and the transition to point 4 is made.

Operating speed of algorithm depends on established scanning spots number and on their occurrence. Such presentation of image in the figure of unfolded diagram is easier for treatment.

3. Structural realization

For technical realization of the proposed recognition method – it is of highest efficacy to use parallel matrix structures which allows realizing turn and shift of image to all its spots parallel. For lengths *l* calculation a reading ruler is used which has special position. Scheme of design recognition is presented in the fig. 6.

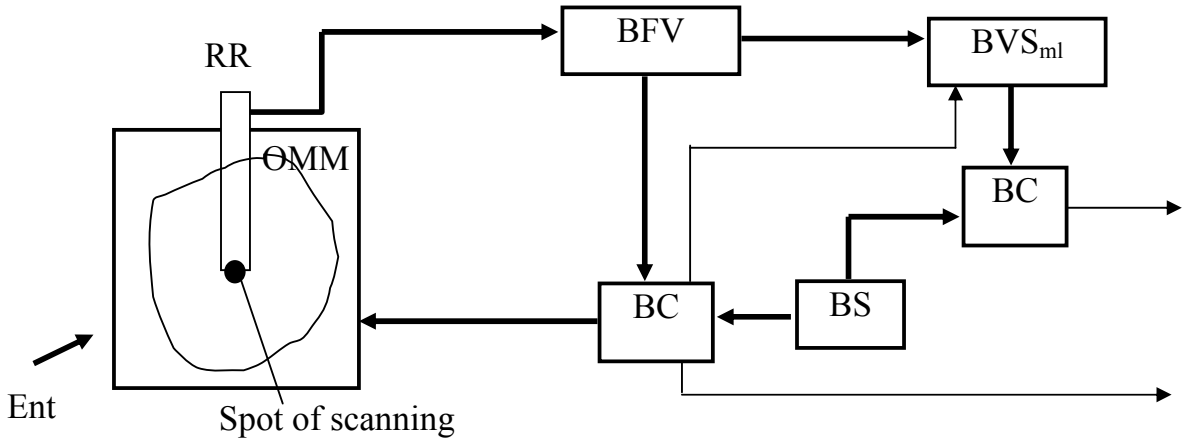

Fig. 6. Structure of flat figures' images recognition.

Input image is projected on operational matrix medium (OMM), which directs it relatively toward the spot of scanning located on the edge of reading ruler (RR). The spot of scanning is the center of the image turn and on its outlet there is a code formed which enters to the block of vector's forming (BFV). Code of the vector from BFV outlet is compared with the code of the block of standards (BS) into the block of comparison (BC).

If a code into BC is not found – then a calculation of l_{md} takes place into BVl_{md} and again a comparison takes place.

Realization of the method on computer results takes too much time. The use of OMM and RR permits realizing series of designs on the treatment of contour images accounting informational parameters of a contour.

4. Summary

The proposed method allows exactly to identify two-dimensional salient figure due to its convenient presentation. Incidentally, the precision of recognition rises under decreasing value α and then when $\alpha \to 0$ the sum total tends to the largest value and is equal to the square of the image. It permits calculating the square of two - dimensional secluded regions. The use of OMM and RR allows descriptions of an image on its contour and mark it out and also simplifies the process of its recognition.

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