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Shape Features Based Conic Arcs for Unclassified Wheat Identification

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Abstract

Wheat is one of the main nutrients used in the world. Consumption of foodstuff produced from quality wheat is of great importance for healthy generations. It is necessary to separate the high and low quality wheat. In this paper, a new recognition method for quality wheat and unclassified wheat is presented. The most distinctive feature for determination of wheat quality is its shape. In this study, objects are first represented by a few descriptive points on their contours obtained from their images. Neighboring points are connected by linear or conical curve fitting. The objects are then represented by an attribute vector constructed from parameters of the curves. Finally, these vectors are used to classify objects (wheat) using support vector machines (svm). Performance is improved with cross validation for each class.

Key words

feature extraction; wheat; unclassified wheat; shape descriptor

1. INTRODUCTION

Here we are recognizing quality wheat and unclassified wheat. In computer vision shape is a distinctive feature for object recognition. The presence of curvature and straight lines and soft and sharp transitions, helps us visually identify and analyze the object more easily. Therefore, there are many studies in literature related to shape-based descriptors. A good descriptor should be robust, fast running, distinctive against noise and geometric transformations with few attributes. Shape-based descriptors are generally divided into regional and contour based representatives. Contour based descriptors first extract the outer line of the object in binary format and try to identify the object through this line. Sometimes it is too complicated to describe large images. Especially on large shapes when there is occlusion, and overlapping with each other is one of the problems encountered in recognition performance. In order to get rid of them we can make meaningful interpretations of the whole shape by separating small parts. On the contrary, we can construct a whole shape by adding the vertices and curves from specific dominant points. These dominant points are mostly the corner points on the boundary (Figure 1). The points where the curvature is broken by other expressions are referred to by such terms as dominant point, interesting point, corner point. The dominant point extraction is usually achieved by two basic methods; polygonal approach methods and direct methods (corner detection algorithms). The main idea in the polygonal approach is to determine meaningful points on the contour of the shape. The polygonal approach is applied in two different ways by joining or separating the parts of the shape. During joining process; small changes are eliminated by trying to express the shape by curves and straight lines. In separating process, is made by fitting the curves and lines between points.

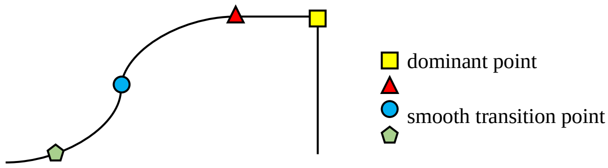

Figure 1. Dominant, smooth transition, inflection and candidate points

In direct methods, the points which have the highest values are generally determined as the dominant point. At later stages, curvature correction can be achieved in a variety of ways [1,2,3]. To find the dominant points, Wu proposed the adaptive inflection value for each point on the boundaries of the shape, and determined the dominant points depending on this measure [4]. In another study, an algorithm is developed to eliminate contiguous points on the same line on the contour [5]. The area to the right and left of the dominant points is called the support region [1]. At that study, to find the support region, a ratio was developed to find the distance between each point to its beam [1]. In another method, the k-cosine [3] measurement was used to calculate the support region [6]. In [7], Z. Kurt and et al proposed a method based on the difference of the absolute angle between the support points on the right and left side of the candidate point on the contour. They used Principle Component Analysis (PCA) to calculate the support regions.

This work has been done with an object-based identifier and object parsing [7,8]. In the second section, the method used is mentioned, in the third section the experiences are explained and in the fourth section the result is explained.

2. METHOD

Here we use the progressively developed method [8]. In the method, as expresssed in Figure 2, the contour of the shape is extracted by an edge detection algorithm. Each point on the contour is determined as a candidate point and tried to find which one is more important (Figure 1). The meaningful points are fitted by line and curve. In this way, the contour have been tried to be described in the most obvious way. First Canny edge detector is used to find the contour of the shape (Figure 4.a.). Each of the points p_i, on the contour is treated as the candidate point. Then on the candidate meaningful points, the right and left support regions are calculated by Principal Component Analysis (PCA) method [7]. Here, the neighboring pixels in the vicinity of the candidate point are searched for the presence of the support region (Figure 3). The direction of the eigenvector gives us the support region which is the largest eigenvalue of the covariance matrix of the data. At the beginning, PCA is applied by taking three points and the angle that the largest eigenvalue is made with the coordinate axis is calculated. The operation is performed by increasing the number of the points. The obtained angle is compared with the previous ones. This process continues until the angle reaches a sifnificant threshold value. This process is applied to both the right and left sides of the candidate point. In this way, the right S_r and left S_l support regions are calculated (Figure 3). Meaningful points are found by the means of right and left support regions of the candidate point. The angle θ between the distribution directions of the support regions is calculated (Figure 3).

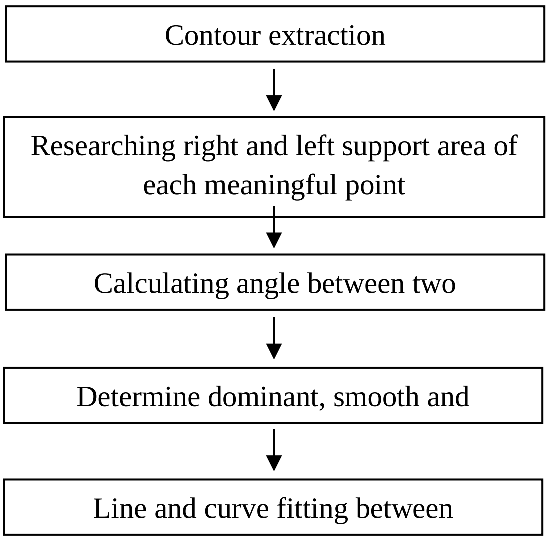

Figure 2. Block diagram of shape description

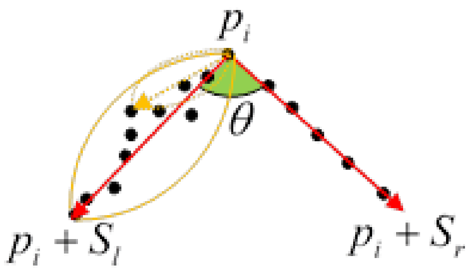

Figure 3. Researching right and left support regions

This angle θ is called a certain meaningful point when it is greater than a first threshold angle: $\theta > T_1$. It is called a weak meaningful when it is between first and second threshold angles: $T_1 > \theta > T_2$. If the angle is less than the second threshold value $\theta < T_2$, it is not a meaningful point and deleted from the list.

When the shape is describing by the polygonal approximation, at first straight lines and circular arcs are used between certain points [7,9]. First break points described as c, the corner points and as s the smooth transition points (Figure 1), as l lines and as a arcs [10]. These are 5 types including: c-ll:line-corner-line, c-la:line-corner-arc, c-aa:arc-corner-arc and s-la:line-smooth transition point-arc and s-aa:arc-smooth transition point-arc. These types are then expanded to 29 types by adding arcs respectively c:circle, e:ellipse, p:parabola and h:hyperbola [11]. These are c-ll, c-lc, c-le, c-lp, c-lh, c-cc, c-ce, c-cp, c-ch, c-ee, c-ep, c-eh, c-pp, c-ph, c-hh, s-lc, s-le, slp, s-lh, c-cc, s-ce, s-cp, s-ch, s-ee, s-ep, s-eh, s-pp, s-ph, s-hh.

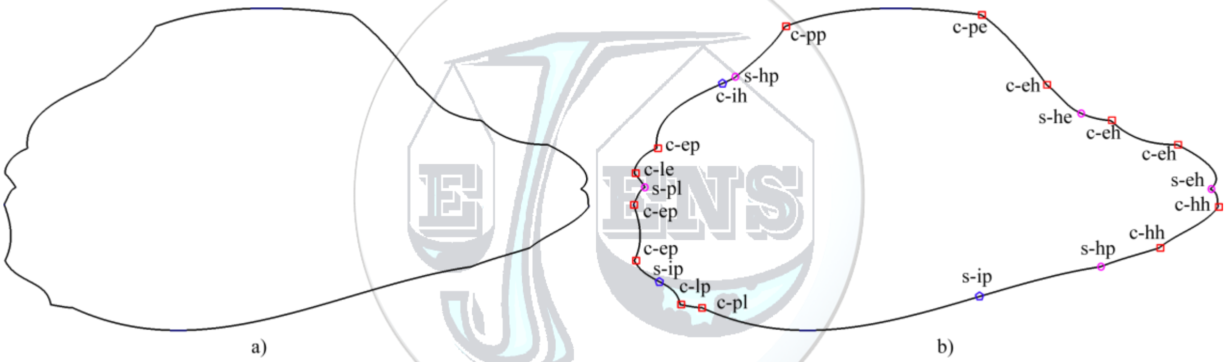

Figure 4. a) contour of the image, b) line/arc fitted image.

With considering the inflection points, Z. Kurt and et al expanded the types to 43 types [7]. Inflection point is the point at which the curve changes its direction. Which is the solution points of the equation: $f'(x).f''(x) = 0$. Thus, meaningful points are defined as certain, weak and inflection points. In this study, because circle is the special form of the ellipse, the circle was removed and types is reduced to 26 types [8]. In this way, the shape was tried to be described with the most accurate and least lines and arcs (Figure 4.b.). Finally, number of the lines and arcs are counted to create the feature vector (Table 1).

3. EXPERIMENTS AND RESULTS

The dataset used is consists of two classes. 60 of them are quality wheat images and 60 of them are of unclassified wheat images, totally 120 piece of Turkish Aldane class wheat images (Figure 5). Wheat images lying face down, supine, or side-lying. Size of the images are 800×1600 pixels. The pictures are taken under the same conditions: illuminance, distance. Under these condition scaling factor is elaminated and didn't need to use a scaling filter like Gaussian low pass [8]. The application is implemented with MATLAB software. Feature vectors are finally classified with Support Vector Machines (SVM) [12]. In the SVM classifier, the C parameter

Table 1. Feature representation of a shape

type	s-ll	s-lp	s-le	s-lh	s-pp	s-pe	s-ph	s-ee	s-eh	s-hh	c-ll	c-lp	c-le
count	0	1	0	0	0	0	2	0	2	0	0	2	1
type	c-lh	c-pp	c-pe	c-ph	c-ee	c-eh	c-hh	c-ie	c-ip	c-ih	s-ie	s-ip	s-ih
count	0	1	4	0	0	3	2	0	0	1	0	2	0

Figure 5. Top side: quality wheat, bottom side: unclassified wheat images.

was selected 1.0 and the kernel 2.0 for high performance. Images are divided as training and test clusters. As a result of the randomly chosen pictures, the classes were separated by a performance ratio of 70.83%.

4. CONCLUSION

The method used is a recent shape-based descriptor. Instead of a whole shape, it represents shapes, by dividing them into lines and arcs is an advantage, especially in case of occlusion. With this way, the synchronization speed is also increasing. It is obvious to improve meaningful points and calculating support regions which are referenced in the creation of the feature vector. Different variations can have better results depending on the type of data set. In the next phase of the study, different classifiers are planned in order to increase the recognition performance and the result will be examined.

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