METHOD

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A new method to distinguish patterns of lasiked eyes

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ABSTRACT

These days intelligent systems have variety of usages in classifying complicated patterns in medics, industry and other fields. Problems as local minimums and etc. In these systems have made them less practical, likewise statistical methods are used to real execution. This article is a real task deals with eye bank and based on it we can determine on the quality of offered corneals. Here statistical methods have been used in classifying medical data and the results are examines in a database of corneal topography images which shows very good results. Using computers to classifying different data, in order to improve corneal graft is the goal of this article. The classifying of corneal data can be done in different ways. That in this article, different classes were separated by statistical methods. Introducing some tasks is done for the rest.

Keywords: KNN, Classifier, topography, corneal.

1. INTRODUCTION

Using statistical classifiers, which have high volume have become very useful and for instance we can mention, finger print classifier (Andrew Senior, 1997) or faces classifier (Donald. Tanguay 1995; Asherman et al. 1996). According to this some statistical methods have been introduced like Beiz, Fischer classifier (Theodoridis et al. 1999: Fukunaga, 1990), Hidden Markov Model (Rabiner, 1986), etc. In this article KNN (nearest neighbor method) has been used. Also using appropriate features can speed up classifying and improve recognize rate. Among them all, choosing statistical features for identifying faces using nervous system (Said et al. 2000) or other methods are mentioned in (Kenji Nagao, 2000) and (Guang Dai YuntaoQian, 2004). In this article new features are mentioned to facilitate classifying and improve recognizing rate. One of the important issues in optics and especially corneal graft is to determine the quality of the offered corneas. Because the corneal graft is a complicated and difficult process for both patent and optic and it's impressed by the quality of the corneal. For instance, there are some wyes despite ophthalmolyist is satisfied with their function, they can't improve the sight of the patient, and the main reason for is that they hadn't determined the quality of the offered corneal before the surgery and in this way all the attempts has been made become ineffective (Noor Clinic, 2004). First of all in this article some picture processing algorithms have been used to provide necessary information subsequent parts and omit the extra parts.

Actually there's a try to do a process on offered eyes by using picture process algorithms in order to use that for classifying offered eye's pattern and improve the results of corneal graft surgery. Then some important and appropriate features have been figured out for classifying corneal data and the results have been examined by database of data exit in Noor clinic and eye bank and have shown that the outcome features are able to distinguish and separate different classes containing patterns which have been lasiced or not lasiced very well and finally by classifying nearest neighbour the function of classifying has been done with such a fine rate.

2. PREPROCESSING

In general this project has dealed with pictures of two systems, consist of 1: Humphrey and 2: Orbscan (Thomas Mckay, 1998; Zeizz Publisher, 1998). As the topography pictures of each systems differs from the others, picture process algorithms have been used on each of them in order to either maintain the information and be able to put them in a shape to obtain

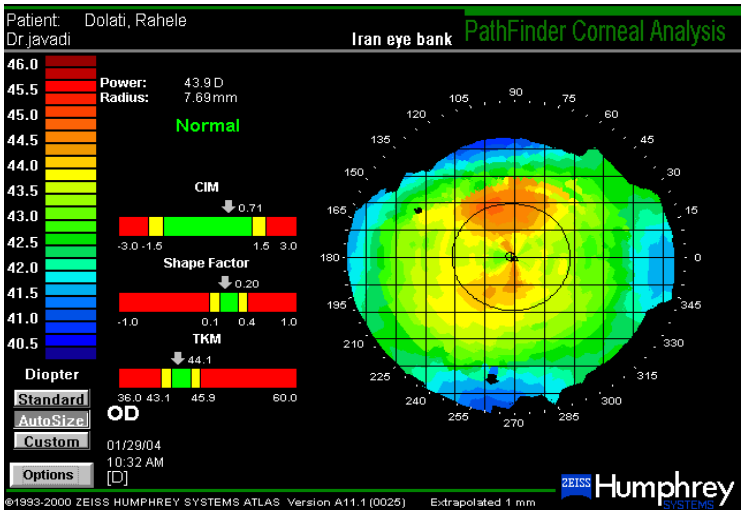


Figure 1

The Instance of Pathfinder topography using Humphrey device

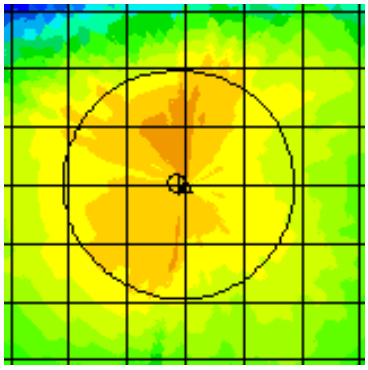


Figure 2

The division section of image including corneal information in 159*159 dimensions.

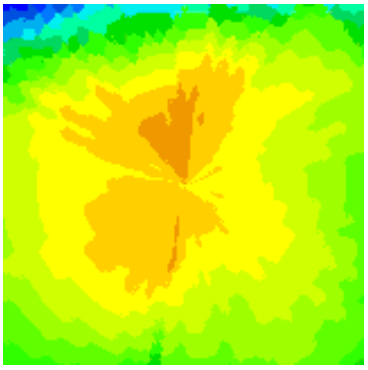


Figure 3

The image obtained from eliminated lines program.

desired features easily and do the classification with high accuracy. In the rest of the article we have discussed about each systems and picture process algorithms.

2.1. Pre-Process for Humphrey system

This system has Q different cut put picture which have different usages, here we're only used topography picture or pathfinder. This stage is depened on the general shape of the entered pictures. To some extent, for instance the output picture of the Humphrey system is shown in Fig.1. As we can see this picture contains extra details besides corneal picture. So the first step is to divide demanded part of the picture. In order to do this, in the first step of the pre-process program, a square of 159 × 159 squares is divided from the part contains corneal picture from the input picture to the system, a sample of that would be like the Fig.2. As it's seen in Fig.2 the obtained picture has some lines which have been added to the main picture, in order to help the ophthalmologist by the system.

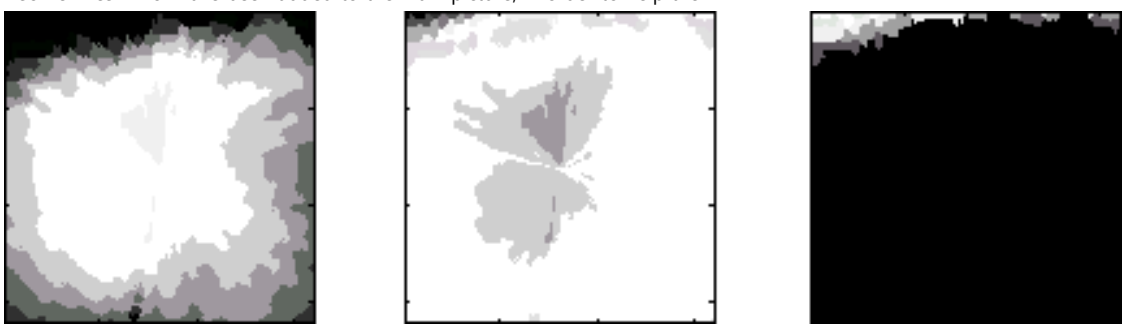
As these lines can cause troubles for the system for evaluating the picture and they're not real information. So they have to omitted before each evaluation the method for doing this is to fill black points with the average color of the neighbor points. For this function a kind of middle filter is exerted to the picture. For the best results some changes have been mode in the medium middle filter in a way that after arranging colors and before choosing the middle color, those colors which are darker than desired ones would be omitted from the list and the middle color would be chosen only among the colors of the main picture. A sample of using this middle filter is shown in Fig.3. As you see in this picture (Fig. 3), this method has recovered the main picture very well. Here it's necessary to mention that the filter is only used on black points of the picture and other information have remained unchanged in the picture. On the other hand when the extent of black points is excessive it's possible to filter the result picture until all the black points are removed and as this filter is designed in way to use only four squares without data, we can be sure that no real data will be lost. In Fig.4 it has been shown how much of each main color; blue, red, green have been used to make the main picture. After this stage in order to simplify the task other calculating are done on the average picture, the final result is shown in Fig. 5.

3. OBTAINING FEATURES

Obtaining a feature is one of the most important process in every recognizing system, and it's very important to supply features that can distinguish data very well. Here both mathematically and mentally. Sensitively features are used for creating separating space. In this task a lot of features are discussed to obtain desired quantities that distribute data in a sample space and among them all we can mention issues such as correlation, auto correlation, cross correlation, fast furia transform and spectrum of the discussed picture, all of them are mathematical features. Based on this, some features like picture spectrum are not appropriate for classifying and other features such as correlation, auto correlation, cross correlation and furia transform have their own effect on distinguishing classes of lasiced-eyes and not lasiced-eyes, so using one of them would be enough.

The distribution of patterns are too complicated and using one feature doesn't allow to distinguish the results well. Despite the FFT is not a good feature by itself but it's been considered because it shows good results in the mixture by correlation in a way that it was possible to distinguish classes. On the other hand as the patterns are gathered together in a complicated manner and besides the number of sample patterns were few so to increase the insurance for better distinguishing the classes, searching other features seems to be necessary. Also according to the information gained by the second system or Orbscan, it was detected that this system does other measurements too which are indistinguishable in the discussed pictures. For instance of one of the pictures (specially shows the thickness of the corneal and called pochemtery) different quantities obtained by the system showed that these quantities are (5) which shows the maximum thickness of the five main points of the corneal. With other comparison some more features were obtained as below:

1. (Maximum Power) maximum value = middle value of the corneal – maximum value of the four sides numbers.
2. (Minimum Power) minimum value = middle value of the corneal – minimum value of the four sides number.



(c) (b) (a)

Figure 4

The image showed the role of three principle color in contrast image (a) blue (b) green (c) red

4. STATISTICAL CLASSIFIER OF NEAREST NEIGHBOR

In KNN rule for classifying each unknown sample of x in a n dimension space K finds the nearest neighbour base on a distance scale and among this, K finds nearest neighbour of the class contains majority and attribute x to that class. Now if this majority is not decisive or if is a forced majority, in order

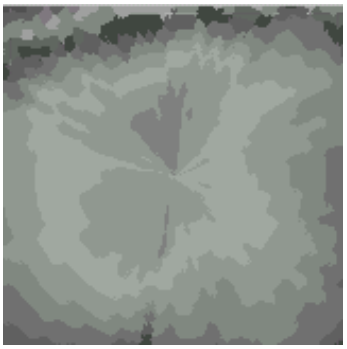


Figure 5
The final image got after filtering

to find K nearest neighbour x starts searching in a long distance from that and in this way there'll be the case of uncertainness in decision making. Here for decreasing the fault in decision making, making decision would be rejected or called the sample x reject. 1: ambiguity reject, 2: distance reject, based on this it seems necessary to explain these two kinds shortly.

4.1. Ambiguity reject

In this rule the axis x is attributed to the class wi in a way that at least k' samples between k samples belong

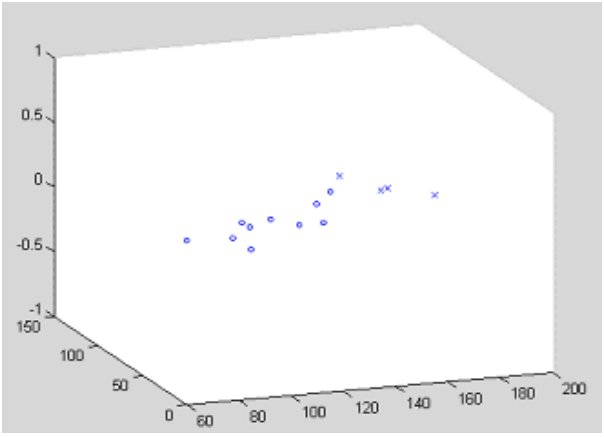


Figure 6
Two classes of data is separated by K-Means method

to the class wi. The above rule is called (k,k') rule in general and is explained as below: X relates to the class wi if at least k nearest neighbour of that belong to the class wi. In the case of two classes if a,b in order the biggest and the smallest

integer, in a way that:

$$a \le k/2 \le b \quad (1)$$

It's obvious if we want to have reject we need:

$$ki \ge b \quad i = 1,2 \quad (2)$$

In the above term ki shows the minimum samples contain majority for the class wi. So the rule for decision making of (k,k') in the case of two classes would be:

$$k_1 \le k_1' \Rightarrow d(x) = w_1 \quad (3)$$

$$k_2 \le k_2' \Rightarrow d(x) = w_2 \quad (4)$$

$$k_i \le k_i' \Rightarrow d(x) = w_3 \quad (5)$$

4.2. Distance Reject

A solution to decision making for rejecting sample x for its long distance from k is to make a threshold value T the nearest neighbour on distance. For instance we can consider that the average distance of K the nearest neighbour of x from that is less that the threshold value T. otherwise x would be rejected and this state would be like below:

$$1/k \sum_{y} d(x,y)^i > T \Rightarrow d(w) = w$$

4.3. Distance choosing in the KNN rule

For choosing distance in the KNN rule, Euclidean distance, equation 7 is used, which is used to specifying the space of features too.

$$\|x-y\| = \sqrt{(x_1-y_1)2+(x_2-y_2)2+(x_3-y_3)2} \quad (7)$$

The algorithms of classifying nearest neighbour which has discussed before, is used to distinguish classes in the way explained in the next chapter.

5. USING GENERAL CLASSIFIER WITH THE KNN METHOD BASED ON USING OBTAINED FEATURES AND THE RESULTS

In this part the classifying is considered based on using three purpose features as below: 1: FFT, correlation and maximum value 2: FFT, correlation and minimum value 3: FFT, correlation, maximum value and minimum value. By using this experiment it got obvious that the second method didn't help to improve classifying process however the third and first methods were more successful in distinguishing classes and probably we can say classifying was done in the best for the existing patterns. However in the third method, four features are used and naturally, this would decrease the speed of decision making, but based on the few number of patterns the third method is more assured than the first one. The outcome features space by using the first method is showed in Fig.6. But we're to consider in order to gain high accuracy in the task the third method was used that it's data are in a four dimension space. In the figure, a sample of pattern classes for 14 data, by using the first method only, is shown (Gheisari et al. 2011; Gheisari, 2011, Porker et al. 2011).

6. CONCLUSION

In this experiment a general process for distinguishing pattern with new usage was occurred. At first some pre-processes were done on the output pictures of the systems and then the main process were done on obtaining desired feature that can make distinguished classes in the feature space. The classifying was done by using the statistical method of the nearest neighbor. However this project was done for improving the results of corneal surgery at first. The data classes of the offered eyes need to be specified and the pre-process stage completed so that the results become practical. The first step to distinguishing lasiced eyes and not lasiced eyes was done and probably this stage is considered the most important among the series stages for improving corneal graft in the ophthalmogist view.

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