Auto-Reading Depth Values from Nautical Charts

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ABSTRACT

Auto-reading water depth values from nautical charts is important for setting up the Nautical Chart Information Database of ECDIS (Electronic Chart Display and Information System). First, the characteristics of the images of the values are analyzed. The isolated digits can be recognized by pattern matching of the chain code features extracted from the coded contours of the digits. Then, the values can be got in the form of floating point digits by putting the relative digits into strings. Finally, the values are recorded with their position.

Introduction

Electronic Chart Display and Information System is a new developed navigation aids. The original way to set up the Nautical Chart Database for the system is to read the available paper charts by means of X-Y digitizer. It is reasonable for us to apply the technology of image processing and pattern recognition on automatic reading the data from the scanned images of charts.

The key problem is the recognition of various navigational information from the chart images. The information represented by lines is the majority on a chart usually. The water depth values are the second majority. The recognition of various lines has been discussed[1]. Water depth value is the topic here.

Characteristics of the Depth Value Images

Some examples of the water depth values are shown on Fig.1.

The characteristics of the values can be summed up as following.
1. All of the value digits are printed horizontally;
2. All of the digits incline with a certain angle;
3. The decimal part of the value is printed on lower level.

27　　　　3₆　　　　10₉

(27)　　　(3.6)　　　(10.9)

Fig.1 Examples of the water depth values.

The Recognition of Isolated Digits

The width and heigt of a figure's outline is the general features to distiguiash isolated digits from other figures. The chain codes of a digit outline contain the geometric features of the digit in thinned image. Therefore, the numbers of the 8-direction chain codes of the outline can be used as the features of the digit. The numbers include the information not only of the common features of digits, such as corners and arcs, but also the inclined angle by which a digit can be distinguished whether it is a depth value digit or not.

However, the counted numbers of the codes have lost the information of mutual positions. As a result, some digits are confused because of the symmetry between them such as '6' and '9'(Fig.2). To solve the problem, we can simply divide the digits into 2 parts vertically and count the codes respectively.(Fig.2)

The features of the digits can be obtained by interaction at the very beginning. Then, they are modified toward expected feature vectors with an error vector as thresholds when the system learns more and more.

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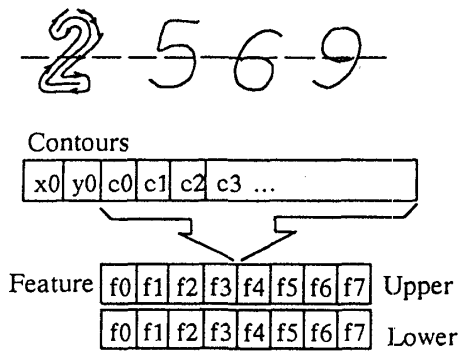Pattern Matching here employs the distance between the sample and the learnt features in 16-D space.

Contours

| x0 | y0 | c0 | c1 | c2 | c3 ... |

Feature

| f0 | f1 | f2 | f3 | f4 | f5 | f6 | f7 | Upper

| f0 | f1 | f2 | f3 | f4 | f5 | f6 | f7 | Lower
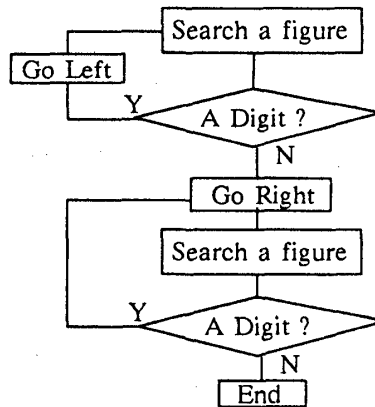
Fig.2 Isolated digits and the feature structure

Fig.3 Digit string -> Floating point value

Strings of the Values

According to the first and the third characteristics of depth value images mentioned above, the digit string of a value can be recognized by searching relative digits horizontally after a digit has been found. The procedure is shown in Fig.3.

Conclusion

Fig.5 is an example of the method discussed above. It shows that the method is effective. In the example, the features are learnt at least twice and 5 times at most before they can be used for auto-reading. (To save space, Fig.4 and 5. are only a part of the experiment.)
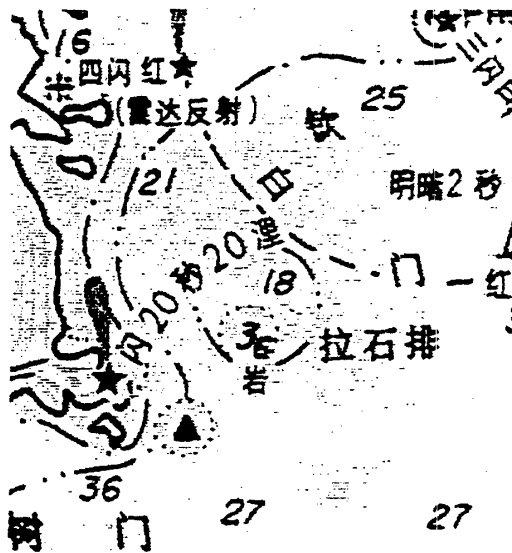

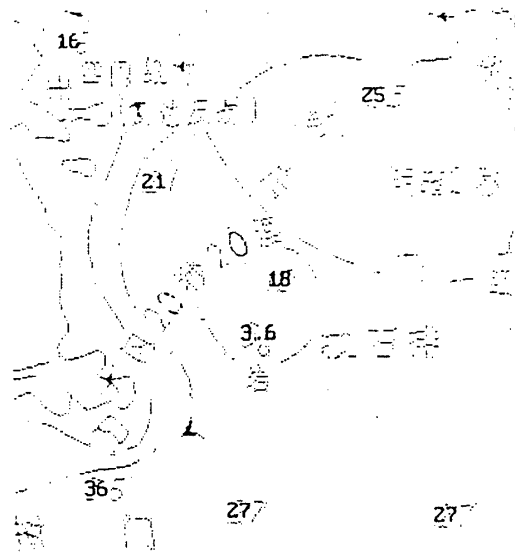Fig.4 The clustered Nautical Chart Image

Fig.5 The recognized data are overlaid on the thinned image

References

1 Weizhong Zhang, Yonghong Song and Zhihang ZHENG,"A Line Recognition Method for Digitizing Navigational Charts", Proceedings of International Conference on INFORMATION & SYSTEMS, AMSE, HANGZHOU, CHINA, October 9-11,1991.

2 Keinosuke Fukunaga "Introduction to Statistical Pattern Recognition", Academic Press, 1972