

An Annotation Algorithm for Digital Map

Yongling Yu, Sisheng Zong, Jinfa Shi

Zhengzhou Institute of Aeronautical Industrial Management, Zhengzhou, China

Email: yuyongling@zzia.edu.cn, zsszong@zzia.edu.cn, jfshi@zzia.edu.cn

Abstract: There are some problems in a traditional Digital Map such as annotation information lost, overlap among annotations. This paper proposes a new algorithm for point, line and polygon elements. It divides the screen into many raster grids, labels of points, lines and polygons are organically unified so that each note is not covered by each other. The algorithm is of good simplicity, efficiency. It is successfully applied in the vehicle navigation system, and the label configuration is reasonable without any overlap.

Keywords: annotation; digital map; overlap; raster grids

1 Introduction

Map annotation is one of the main contents of Map. How to choose the label location and Arrangement is closely related to the completeness and accuracy of the maps. On the general map, the map label work is very heavy. Even with the more advanced computer-aided mapping system, Man-machine interactive mode are still widely used, and the map label is Inefficient. So there is a growing concern on dynamic electronic map.

In recent years, many scholars have applied the theory of combinatorial optimization to auto-configuration labeling^{[1][2]}. There are some well-known algorithms, such as the physical relaxation, integer programming method and a continuous gradient descent method. This paper describes an auto-avoidance algorithm based on Grid, which can detect conflicts and gland during the configure labels process so that the speed and effectiveness of the configuration are improved rapidly. The algorithm takes less time and is able to unify the various elements of label on the auto-configuration. It has been applied to the label auto-configuration of the country maps, and it has resolved the key issues and achieved good results.

2 The Principles of Map Annotation

According to their distribution characteristics, objects in the maps can be divided into points, lines and polygons. Accordingly, the map labeling is divided into three categories like points, lines and surfaces. It has its own characteristics for each category. No matter what kind of geographical

element. it is, labeling should follow the following principles^[4]:

(1) Affiliation: It is easy to determine their respective relations between the label and labeled objectives. Confusion does not occur in the vicinity or others.

(2) Avoidance: Labeling should avoid significant ground objects, that is, it can not cover important surface features, especially the other ground objects of the same kind of color.

(3) Customary: The location, order and arrangement of the label must comply with ordinary habits.

3 The Algorithm for Digital Map

Because the automatic labeling algorithm of points, polygons and lines are similar, we will describe the line elements as an example in this paper.

3.1 Algorithm Description

The algorithm is based on the following ideas: Split the screen into many grids and get the coordinates location and label attribute of line elements. Next, determine the width of the label as well as the general trend and then calculate the location of each label character based on the properties of current line elements. In the calculation of a specific position, overlap and conflict between the gland are excluded, we can obtain the most suitable label location, which has the least covering and the optimal distribution. The detailed labeling electronics map is described as follows:

(1) We create a font and add it into the device context. Then we divide the screen into a large number of grids

taking pixel as a unit and calculate the side length of each grid.

(2) A one-dimensional array is defined to describe the state of each grid in the screen. The value of 0 in the array indicates that the grid is not occupied by the font labeled; and the value of 1 indicates that the grid is occupied. At the beginning, the initial value of each data element in the array is assigned to 0. It means that all grids are not occupied.

(3) We calculate the mark location of a line element. A line element (as shown in Figure 1) may contain a number of short terms. For example, Daxue Road, interrupted by Zhongyuan Road, Longhai Road, Huaihe Road and Hanghai Road, includes 5 short-terms, which are shown in Figure 1 as below. Each section is formed by a number of key points, and the key points are used to describe the state of line in detail. Let's take illustration figure 1 as an example to describe the method of calculating the mark location of a line.

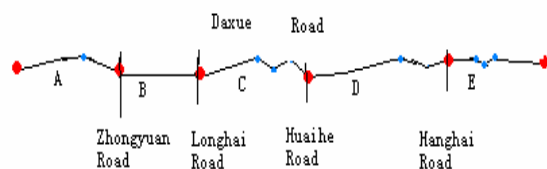


Figure 1. A line Feature

First, we calculate the number of mark characters taking pixel as a unit then determine the general trend is to the right or downward. Then, we obtain all the grids covered by the line and calculate the starting label point on this line according to the grid covered by the line. Suppose that the grid covered by this line is respectively $G_0, G_1, G_2, \dots, G_n$ and the starting point is G_0 . We judge Each G_i in turn, if the value of $\text{annoMatch}[G_i]$ is equal to 0, indicating that the grid G_i has already been marked, indicating lattice G_i have already been marked, then the time to determine the starting grid to the current from the grid to meet the mark in length is the length, if satisfied, then mark the location is from the starting grid to the current grid date.

Second, we get all the small squares covered by line-shaped elements to prepare for the location of every char-

acter. According to the small squares covered by line-shaped elements, we may get the starting point of labeling. Suppose the order of the the small squares covered by line-shaped elements are named as $G_0, G_1, G_2, \dots, G_n$ and the starting point is the G_0 square. Each square is judged in a circle. That is, if the digit group $\text{annoMatch}[G_i]=0$ indicates that G_i has been labeled. Then we to judge the length from the starting point till the present. If the length meets the standard, then the location starts from the very beginning. Otherwise, G_i can be thought as the starting point till it meets with the proper length and the circle stops. The squares between the starting point and the present are the location for labeling. At last, the coordinate of every character in screen should be stored. Do remember that each square occupied by a character must be labeled as 1 in their appropriate places, which means that the square has been used. In this way, the problem of overlap may be solved.

(4) Using the method of Step 3 to calculate the label location of all the line elements in the map.

3.2 Programming Implementation of Annotation Algorithm

NLen is employed to represent the side length of grid, and constant `gridforhanzi` is a parameter which is used to calculate the side length of each grid. At the same time, `ngridrow` and `ngridcol` are employed to represent the number of rows and columns which is divided in the the screen. And the array `annoMatch[nGridRow * nGridCol]` is used to describe the state of grid in the screen. Therefore, the label algorithm is described in pseudo-language as follows:

```

CSize TextSize=pBaseDC->GetTextExtent("map");
Len=TextSize.cx / GRIDFORHANZI;
GetClientRect(&RectClient);
RectClient.NormalizeRect();
nGridCol = RectClient.Width() * 1.0 / Len;
nGridRow = RectClient.Height() * 1.0 / nLen;
ZeroMemory(annoMatch,(nGridRow)*(nGridCol));
for(int i=0; i<nSize; i++)
{
    GRIDCODE& LocalGrid = vecGridCode [i];
    if(annoMatch[G_i]!= 0)
    {

```

if(Roads direction is The road direction is from east to west)

Calculate the distance from the current col to the starting

else

Calculate the distance from the current line to the starting .

if (nLength < the length need to mark)

{

nStart = i;

}

else if (nLength > the length need to mark)

break;

}

}

for(int i=0; i<nAnnoNum; i++)

{

LocalGrid = vecGridCode[2*i*GRIDFORHANZI + 2*GRIDFORHANZI + nStart];

PtPos.x = LocalGrid.nGridCol * m_nAnnoGridLen;

PtPos.y = LocalGrid.nGridRow * m_nAnnoGridLen;

OneArcRecord.AnnoPosition.push_back(PtPos);

For each line in the map

{

if(the length need to mark <=1)

continue;

ArrangeArcAnnoPos(DISPARCRECORD

&OneArcRecord,CDC *pDC) ;

}

4 Algorithm Application Stages

We design and implement the vehicle navigation system based on WebGIS using the design ideas and implementa-

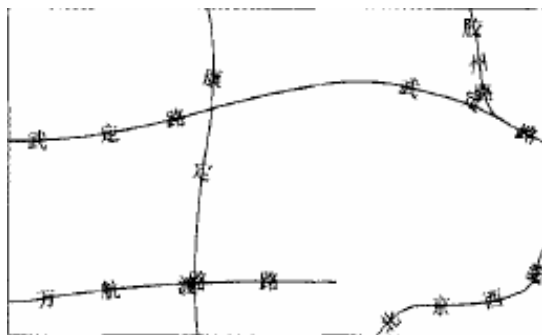


Figure 2. The effect of application based on other algorithm



Figure 3. The effect of application based on Annotation algorithm

tion methods which are previously described Applications previously described and the operation effect of vehicle navigation system is shown in Figure 3. It is based on the web user's demand for vehicle navigation and provide vehicle navigation, information search and retrieval functions.

System has achieved the following functions :

(1) The basic operation for map. It can click on the map, zoom in, zoom out and tour map by an arbitrary scale. At the same time, it achieved two-way switch between the major cities across the country .

(2) Spatial Data Information search. It can accurately query or fuzzy query the object's location and attribute information based on it' name .

(3) Distance measurement. It can Real-time display the current distance and cumulative distance with the mouse movement.

(4) Shortest Path Analysis. It providesthe method of calculating the shortest path. Based on clicking mouse and inputing the object's name, set out the shortest path to display the results, and draw the shortest path in the map.

The system configures notes using the automatic avoidance algorithm based on the grid which described in the paper and well meet the requirements of the designer in stability, security, and real-time. It can be seen from the Figure 2 that the overall auto-configuration effectiveness are good, annotation is neatly arranged , distribution is co-ordination and the number is moderate.

5 Conclusions

A new dynamic note algorithm for electronic map is presented in accordance with the note rules. According to the ideological raster grid, it divides the screen into many raster grids and considers points, lines and polygons as a

whole. It has been applied fairly in the vehicle navigation system. The effect of application is shown in Figure 2. If Using other algorithms, the configuration effect is shown in Figure 3. Comparing these two maps we can see The Annotation algorithm we presented is reasonable without any overlap.

In short, the Annotation algorithm solves the key issues of gland and conflict, improving the speed and effectiveness of configuration. Moreover, the algorithm also provides an idea of map label, which has a certain value for reference to the similar system.

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