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AN EFFICIENT TECHNIQUE TO DIGITIZE POLYGON SEGMENTS OF A MAP/ IMAGE (ETDPS)

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A GIS tool has been proposed where the whole border of a closed section of a black and white map is digitized using a single click inside the section (instead of moving the mouse pointer along the border of the section). The boundary points of a segment contains similar RGB values (black, RGB value-16777216). When one inner point of a closed segment is selected by the mouse the program calculates the RGB value (which is not black) and stored in an array say inner array. Fetching elements from the inner array the program calculates the RGB values of the eight connected pixels. If the pixels are black then stored into another array say boundary array. Other points are stored into the inner array. The elements which are fetched must be removed from the inner array. The fetching and comparing RGB values of the eight connected pixels are performed until the inner array becomes vacant. When the inner array becomes empty the boundary array contains the boundary pixels. Thus boundary pixels are identified. The array elements of boundary array are arranged in a cyclic order to generate the proper boundary of the polygon object.

Keywords: GIS, Vector Map, Raster Map, Digitization, Spatial Data.

1. Introduction

Digitization or vector map generation is a process by which a map is generated using three types of objects namely polygon, line and points and which is of dynamic nature [1, 2, 6]. The scanned maps or raster maps are the maps which constitutes of collection of pixels. GIS based graphics generation on raster map is very difficult. So vectorization is an essential process in the context of GIS [2, 3]. Actually digitization means calculation of the spatial data for three basic components of vector map. For polygon objects the boundary points are calculated. For line and point objects the coordinates of the object constructing points are calculates in the process of digitization [4, 5].

There are many techniques to digitize maps in various GIS based systems but almost all of them use mouse movement, mouse clicked or dragging it along the borders of the various sections of the maps [2, 6]. For open sections, it is still a reality that it has to be selected using mouse movement or dragging along the borders of the section but for closed sections it is possible to digitize the whole section using a single mouse click inside any point of the section. The technique has been presented in ETDPS. Section 2 of the paper describes the proposed technique. The results of the implementation of the technique are presented in section 3. Conclusions are drawn in section 4. References are given in section 5.

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2. Scheme

This technique digitizes the polygon objects which are completely closed and contains no black pixel inside the segment. If the required segments are not closed by the boundary or if there exists any black pixels inside the segment then manually image correction is needed. Once the close boundary of the segment is obtain the rest of the process of the scheme can be proceed. The complete scheme may be splitted into four subtasks.

i) Image Correction

ii) Spatial Data Generation

iii) Creation of Database

iv) Output Generation

These four tasks are described in section 2.1 to 2.4. The Flow diagram of the scheme is shown in Figure 1.

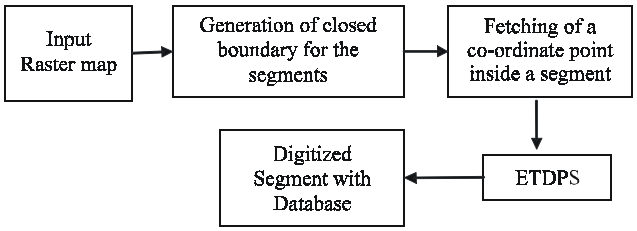

Figure 1: Flow Diagram of the Technique

2.1 Image Correction

First step of the scheme is to make correction of the raster/ Scanned map if necessary. Boundary/spatial data calculation for polygon objects are performed by single click in a closed

boundary. So the map is to be tested to identify whether there exists any discontinuity in the broader line of a segment. If it exists the boundary is to be made continuous. The correction is to be made in such a way that black pixels within the segments are also removed/converted.

2.2 Spatial Data Generation

This technique calculates the RGB value for selected point (the clicked point). Since the selected point is inside the closed boundary of the segment this RGB value must be unequal with the boundary points' RGB value. The RGB values of the eight connected pixels of the selected points (Figure 2) are then calculated and compare with the RGB value of black pixel.

1	2	3
4	X	5
6	7	8

Figure 2: Eight Connected Pixels of the Selected Pixel 'X'

The points/pixels which posses different RGB values from the boundary are stored in to an array (say array 1). RGB value-16777216 (RGB value of black pixel) indicate the boundary points of the segment. Boundary points are stores in another array (array 2). After the comparison the selected points are removed from the array 1. Fetching pixels from the array 1 the RGB values of its eight connected pixels are examined. If the RGB value is not equal to-16777216 then it stored in array 1 else stored in array 2. Using this mechanism all the boundary points are calculated. The pixels which are fetched from the array 1 are removed. At the end of the process array 1 will be vacant and array 2 contains the pixels of the boundary of the segment. The boundary pixel calculation process is shown in Figure 3.

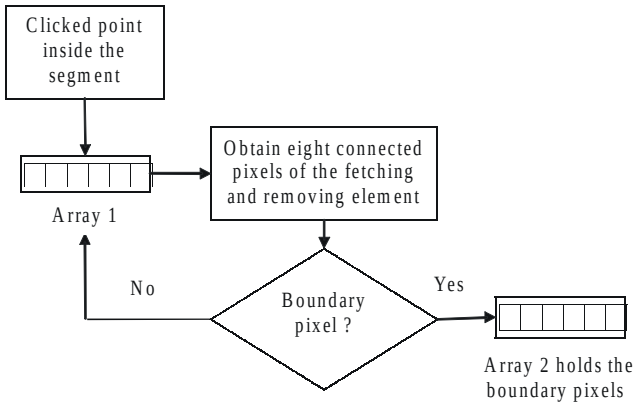

Figure 3: Block Diagram of Boundary Pixel Calculation Process

The co-ordinate points remain in array 2 are not in order so, the elements are arranged in cyclic order to generate the polygon properly. The algorithm of segment's boundary calculation is given in section 2.2.1.

2.2.1 Algorithm of Segment's Boundary Calculation

Input: Raster map, Clicked point inside the segment.

Output: Boundary points of the segment.

Method: Gradually move from the inner selected pixel to the boundary side pixels and compare the elements with the boundary. Store the obtained boundary pixels in an array in orderly manner.

Step 1. Store the clicked point in to an array (array 1).

Step 2. Fetch point from array 1 and compare the RGB values of the eight connected pixels with the RGB value of the black pixel. If the RGB value is unequal then store the pixel in to array 1 else store in array 2, which contains the boundary pixels of the segment. Remove the fetching point from array 1.

Step 3. Repeat Step 2 until array 1 contains no element.

Step 4. Arrange the elements of array 2 in a cyclic order

Step 5. Stop.

2.3 Creation of Database

In GIS, database is essential for all objects of a vector map. Since this tool produce polygon objects of a raster map, database management system is essential to store the obtained spatial data. The spatial data i.e. the coordinates of the boundary points of a segment are stored into the database. For each segment one database table is created which contains the coordinates of the boundary points of the segment. The table names for each segment are assigned in accordance with segment name. A table is also created which contains the name of the tables which contains the spatial data of the segments.

2.4 Output Generation

Out put will be the vector map which contains the generated polygon objects. Coordinates of the segments are fetched from the database table with the help of these coordinates the polygon objects are constructed. The output vector map only contains the polygon objects because it is the closed segment boundary calculation tool.

3. RESULTS

The scheme is implemented by Java swing and Oracle 9i. The DBMS is used to store the boundary coordinates in the database. Figure 4 is the first input map and the out put is shown in Figure 5. The first output only contains 17

interested polygon objects which are obtained from the segments of input raster map.

Figure 4: Input Raster Map 1

Figure 5: Out Put Vector Map Contains only 17 Segments

Figure 6 shows the second raster map and the output vector map is shown in Figure 7. This output contains all the segments of the input raster map. These output polygons are obtains by the single mouse click inside the closed segment.

Figure 6: Input Raster Map 2

Figure 7: Out Put Vector Map Contains only all Segments

4. CONCLUSIONS

This technique is applicable for the raster maps which have uniform segment color and separate boundary colors. If the image has no continuous boundary (closed boundary) for the segment the image has to make suitable for the technique manually. Image correction to obtain continuous boundary may be time consuming. But this technique is a new approach of digitization where accuracy is very high.

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