EXTRACTION OF TOPOLOGICAL PROPERTIES FROM A 2D CONTOUR MAP AND RECONSTRUCTION OF THE 3D TERRAIN

A PROJECT REPORT PRESENTED BY

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to the Board of Study in Statistics and Computer Science of the
POST GRADUATE INSTITUTE OF SCIENCE

in partial fulfillment of the requirement
for the award of the degree of

MASTER OF SCIENCE IN COMPUTER SCIENCE

of the

UNIVERSITY OF PERADENIYA
SRI LANKA
2005

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Topological features provide useful information about a geographical area. For example surface area is an essential information in surveying and agricultural applications. In hydrology it is required to measure the volume of a given reservoir. Usually, 2D contour maps are used in these processes to estimate the required topological information. However, it would be beneficial if the process of extracting topological information from 2D contour maps could be automated. This will make the process much faster and large volumes of image data can be processed in this way to automatically construct the databases containing required topological information.

Three dimensional terrain maps provide important information to users compared to a two dimensional representation terrain information such as 2D contour maps. The users can interactively visualize the terrain details using such a model. However, most of the terrain details are still in the form of 2D contour maps. The work reported in this thesis addresses the problem of 3D model of a terrain based on 2D contour maps.

A technique based on image processing and computer graphics is developed in this research to automate the extraction of topological information from 2D contour maps and to reconstruct the 3D terrain.

The first step of the process is to obtain a skeletonized image of the 2D contour map to use as an input for data extraction process. Standard image processing techniques such as dilation, erosion, skeletonization and boundary refinement were used as pre-processing activities to obtain a skeleton.

Then a boundary detection algorithm was originally developed to calculate number of boundary pixels and hence calculate the perimeter of a given contour. The specific information about the contour, such as the elevation of the most outer contour, height difference of the contour lines, current resolution of the computer screen and scale of the map is entered manually. To obtain the area under each contour we use a boundary filling algorithm for calculating the number of pixels inside a contour.

After extracting coordinates of points on the contours in a specified distance for given number of divisions, it is saved in ASCII format, which is supported by common CAD, GIS and engineering software. The output file contains *contour_index, point_index, X, Y, Z* values in comma delimited format.

To Reconstruct the 3D terrain from extracted data (i.e.; by reading the above ASCII file), computer graphics techniques such as Projections, Viewpoint transformation, Hidden surface removal and surface texture filling were used. Customization facilities in AutoCAD was used in order to redraw the scanned digital contour map as a standard 2D drawing in XY plan.