Chapter I

Introduction

1.1 Overview

Voronoi diagram is a method used to divide the area into smaller area based on the principle of nearest-neighbor [1]. Voronoi diagram has many variations based on the number of neighborhood. The first variant is Order-1 Voronoi diagram. The second variant is the Higher order Voronoi diagram (HOVD), and the latest variant is Highest Order Voronoi Diagram (HSVD) that is a new variation of Voronoi diagram intended to extended HOVD capability. In this final project use the latest variation of Voronoi Diagram is Highest Order Voronoi Diagram (HSVD) because it can be applied for all orders of Voronoi diagram.

HSVD is a set of Voronoi cells or region where each cell consists of a set of points (vertex) and segments, which have adjacency with the other cells. The each cell has distance order information to all generator points. HSVD can identify the farthest point and region but this method can't be directly used to find the object query point and the access time is high. To access it can use linear search for checking. The polygon will be checked one by one each polygon own label [2][10]. However, linear searching unefficient it takes a long time.

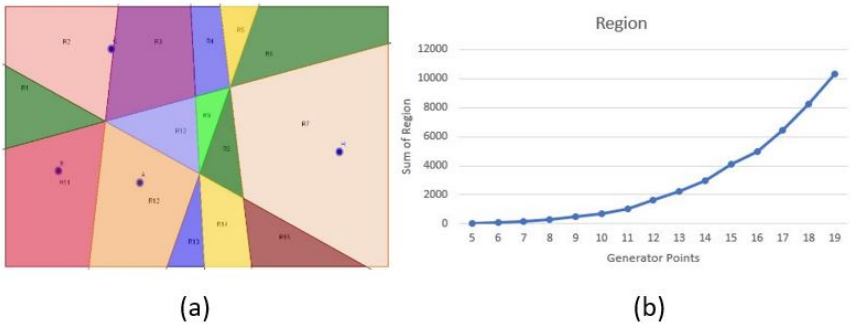

Figure 1.1: The effect of HSVD to region increase

Figure 1.1 shows relatedness between generator points and the number of region be produced. Just imagine how to find the region which contain query point quickly. Then, the problems solved by using the index. Index is a data structure to increase the access speed by dividing the search area data.

There are several kinds of index in spatial especially in Voronoi diagram, such as R-Tree, VoR-Tree, Quadtree and K-D Tree. R-Tree is a method that is generally used for multi-dimensional indexing problems. R-Tree has the weakness that there are overlapping regions of the Minimum Bounding Rectangle (MBR) so that during a search of several sub-tree must be processed. VoR Tree is combining R-Tree and Voronoi diagram that only can be used in order-1 Voronoi diagram [9]. Quadtree is a common spatial index can divide it into four equal sub-spaces, but the balance of the index tree is difficult to control. K-D Tree is a space-partitioning data structure for organizing points in k-dimensional space [8].

In this final project, K-D Tree data structure will be developed on Highest Order Voronoi Diagram. K-D Tree can also dividing partition to the smallest part. The result is coordinate point of each cell that will be used to contruct data structure for this final project.

In addition, K-D Tree divides the area into two parts. Every non-leaf node as a splitting node. Points to the left of this are represented by the left subtree of that node and points right are represented by the right sub-tree. This method can be used to speed up the searching process of a region. Therefore, K-D Tree method potentially be used to index Voronoi diagram.

1.2 Research Problem

Based on overview described above, then the research problem as follows :

1. How to apply indexing method using K-D Tree on Highest Order Voronoi Diagram to find the region which contain the query point;
2. How K-d Tree affect the execution time to find region in Voronoi cell.

1.3 Objective

The purpose of this final project as follows :

1. To implements K-d tree on HSVD;
2. To analyze the affect the execution time to find region in Voronoi cell.

1.4 Scope

The scope of this final project as follows :

1. Dataset using random uniform distributed, the meaning that the object data is spread evenly to all areas that are in the Voronoi diagram;

2. Each random point has some region label;
3. Each node K-D Tree has a single point coordinate.
4. The result will compare by three algorithm; K-D Tree, Quadtree and Linier search.

1.5 Hypothesis

Study focus using K-Dimensional tree data structure. Thus, this algorithm makes the search regions faster because that can process the points. If points of region is known then we can find region from query point.

1.6 Problem solving methodology

The project planning will be conducted as follows.

1. Literature Study

   Collecting the basic theory, data and description about Indexing Voronoi Cell using K-D Tree in Spatial Database

2. Data Collecting

   Collecting the data of Highest Order Voronoi Diagram which will be used as dataset.

3. Analysis and Design

   Analysis and design the method that implement K-D Tree to resolve the problem.

4. Result Analysis

   Testing the result of system and to analyze performance of indexing K-D Tree.

5. Final Project Report Writing

   The result will be documented and attach the conclusion and suggestion of this research.

1.7 Summary

This chapter is about the summary of this final project. From the problems stated previously, this final project becomes a solution. The main problem is how to find the region which contain the query point quickly considering the number of regions is quite many. This final project using K-Dimensional Tree data structure as a solution.