First Aid Emergency System Using Network Voronoi Diagram Based K-Nearest Neighbor

Proposal for Final Project

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Pertolongan Pertama Gawat Darurat Menggunakan Network Voronoi Diagram dan K-Nearest Neighbor

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Abstract

Emergency is an event that can threaten and disrupt a person's life. Emergency situation occur suddenly with unexpected place and time. One of emergency situation is traffic accident. In a traffic accident, first aid has a vital role for the survival of the victim. Network Voronoi diagram is able to optimize the role of emergency units such as police, ambulance and firefighter by dividing each unit based on their respective territory. If a traffic accident occurs, the client can send an emergency signal so that nearest emergency unit, which selected by using K-Nearest Neighbor, will immediately be able to get to the emergency location to do first aid.

Keywords: First aid, Emergency, Network Voronoi, KNN.

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Chapter I

Introduction

1.1 Background of the Study

Emergency is an abnormal event that have negative impact. Emergency can threaten and disrupt a person's life. Emergency situation occur suddenly with unexpected place and time. One of emergency situation is traffic accident.

Bandung, which is the largest metropolitan city in the province of West Java is the center of various activities such as government activities and tourism activities. This causes the transport activities in Bandung never stops and every day there is an increase transportation mobility affecting increasing the road user which is also prone to traffic accidents. Polrestabes Bandung release data on traffic accidents, during 2013, from a total of 838 cases of traffic accidents, 122 people died. While in 2014 from a total of 733 cases of traffic accidents, 126 people died. There was a decrease in the number of traffic accident cases, but inversely proportional to the traffic accident death toll.

Many fatal injuries can be prevented or reduced by adequate first aid from emergency unit. The travel time from emergency unit to the place is very crucial. Because the difference in seconds influences to person's life. In Bandung, emergency unit such a police, ambulance, or firefighter works in different system. Many of them works with private companies which of course hard to organize them in emergency situation.

This final project focus on creating first aid traffic accident system using Network Voronoi Diagram and K-Nearest Neighbor. NVD works by dividing each type emergency units with one another so we get territory of them. When traffic accident occurs, the client can send an emergency signal like coordinate location to the nearest emergency unit. If nearest emergency unit on duty, KNN will looking for next nearest emergency unit. The responsible emergency unit will get notification about the client so they can immediately be able to get to the emergency location.

1.2 Research Problem

Problems to be discussed in this final project are :

1. How to make territory of each emergency unit?
2. How to get k-nearest emergency unit to emergency location?
3. How to find fastest path from responsible emergency unit to emergency location?

1.3 Limitation of the Study

Limitation provided in completing this final project are:

1. This research only focused on traffic accident in Bandung.
2. Network used in Voronoi is protocol road.
3. Emergency units are divided into police, ambulance and firefighter.
4. Determination of emergency unit by looking into fastest path ignoring traffic jam.

1.4 Objective of the Study

The purpose of this study is to get k-nearest emergency unit (police, ambulance, firefighter) and find fastest path from their location to emergency location in Bandung.

1.5 Plan Activity

- Study of literature

  At this stage, author tries to learn the concepts and theories about Network Voronoi Diagram also K-Nearest Neighbor from existing literature in books or international papers.

- Collecting Data

  At this stage, author collecting necessary data as dataset by searching for information in advance on the internet and confirm it to speaker who are more competent.

- Design and Implementation System

  At this stage, author designing and implementation Network Voronoi Diagram KNN for building the system from problems.

- Testing and Analysis Results

  In this stage, author do the test such black box testing and white box testing. Author also gives the opportunity for some people to do the testing for strengthen the analysis results.

- Preparation of final report

  At this stage, author preparing written report based on research conducted documentation and attach the conclusions and recommendations of the research results.

1.6 Timeline

No	**Kegiatan**	**Bulan ke-**					
		1	**2**	**3**	**4**	**5**	**6**
1	Study of Literature						
2	Collecting Data						
3	Design and Implementation System						
4	Testing and Analysis Result						
6	Preparation of Final Report						

Table 1.1: Proposal Final Project Timeline

Chapter II

Underlying Theory

2.1 Spatial Database

Spatial Databases is a technique to analyze in extracting the object in the space of images and also prepare for storage, manipulation and take raster images as discrete entities [1]. In the view of Ralf Hartmut Guting revealed that [1]:

1. Spatial database system is a database system is filled with the added ability to handle spatial data.

2. Spatial Database offers a spatial data type (SDTS) on the data model and query language.

3. Support for spatial data types in the implementation, providing spatial indexing and spatial join algorithm efficiency.

Based on this can be interpreted in general that the Spatial Database is a database system that handles spatial data processing that stores information relating to the object and space or territory.

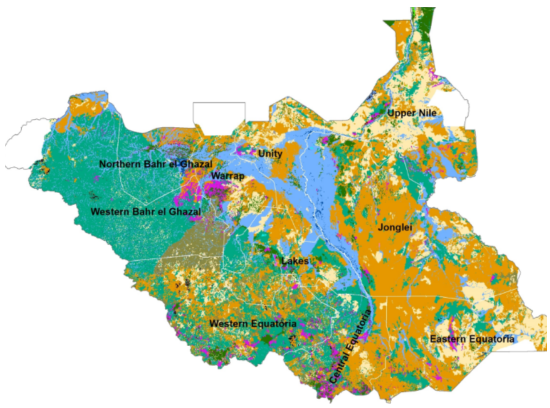

Figure 2.1: Spatial Map

Spatial data processing requires a modeling of data as a representation of spatial data. For example represents in the form of two-dimensional space and can be expanded into three dimensions. Alternative view to that required to represent as object and space. Object is interest in different entities governed in any space that already has its own geometrical description. Examples are cities, forests or rivers. Meanwhile dpace, describes the space itself that is at each point of space. As one of the thematic maps that describe the use of land or the division of the country into regions [1].

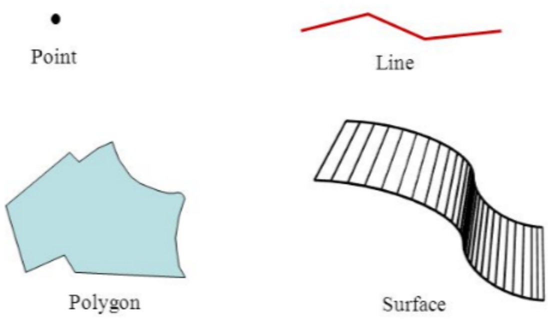

Figure 2.2: Spatial Data Type

Segmentation is one approach to build topology and method for geospatial. Segment classify the data in the form of a polygon or region. Segments are usually visualized using different colors to adjacent colors. It is intended to make it easier to analyze the data. Needs segmentation becomes important in determining the classification of spatial data. Interest on Spatial Database segmentation methods, among others [1]

1. Simplify data classification.

2. Mapping defined contours and areas using an image.

3. Menstruksturkan information to be represented visually.

4. Allow selection of the data area to be analyzed.

2.2 Voronoi Diagram

For example there is a set point generator on Euclidean field (in general, the generator can be any type of spatial objects). We associate all locations in the area for their closest generator. Set the location assigned to each generator forming region called Voronoi cell. This Voronoi Cell basically based of it generator. More specifically, Voronoi polygon formed by dividing the midpoint between the generator with other generators. Set of Voronoi polygon formed is called a Voronoi diagram [2].

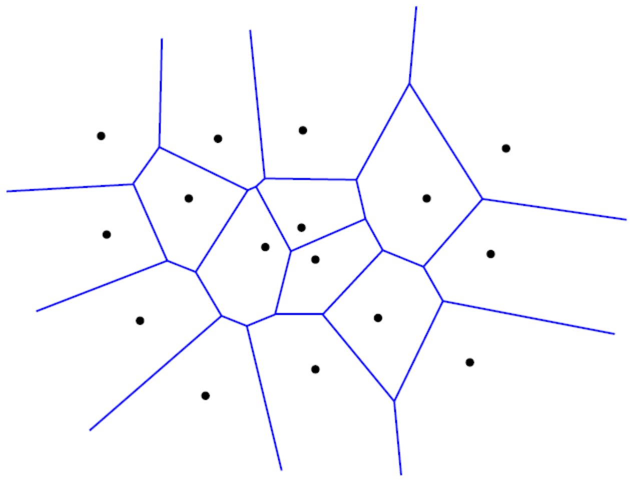

Figure 2.3: Voronoi Diagram

Here's a review four of the basic geometric properties of the Voronoi diagrams [2].

1. Property 1: The Voronoi diagram of a point set P, VD(P), is unique.

2. Property 2: The nearest generator point of pi (e.g., pj) is among the generator points whose Voronoi polygons share similar Voronoi edges with V P(pi).

3. Property 3: Let n and ne be the number of generator points and Voronoi edges, respectively, then ne · 3n ¡ 6.

4. Property 4: From property 3, and the fact that every Voronoi edge is shared by exactly two Voronoi polygons, we notice that the average number of Voronoi edges per Voronoi polygon is at most 6, i.e., 2(3n ¡ 6)=n = 6 ¡ 12=n · 6. This means that on average, each generator has 6 adjacent generators.

2.3 Network Voronoi Diagram

Voronoi diagram in the plane is sometimes inadequate for the location problem. The reason is that the distances can not be measured by the Euclidean distances in some problems. So there's a network and defined by nodes and arcs which is the partition of the two [5]. In principle there are three types of network diagrams Voronoi such as [3] :

1. Node Network Voronoi Diagram: give every node in a network to the generator by the rules that the network distance from the node to the generator are smaller than other generators in the network.

2. Arc Network Voronoi Diagram: give each arc in the network to a single generator, or divide the arc into two parts so that the dots on one part of the arc is assigned to one generator (closest to the points), and points in other parts of arc assigned to another plant.

3. Area Network Voronoi Diagram: the partition of the area carried out as every point is assigned to the closest station, is regarded as the minimum Euclidean distance to the next network point, and the distance from the point of the network. This diagram is different from the planar Voronoi diagram described above and require planar network

Figure 2.4: Road Network Voronoi

NVD is defined by consider a set of points $P = p1, ..., pn$ on the network. Given $d(p, pi)$ is arbitrary distance between point p and point pi on the network is measured by shortestpath, $dN(p, pi)$. In this case, the NVD is defined as a set of subnetworks, (referred to as subnetworks Voronoi), $V = V1, ..., Vn$, where Vi is given by the Voronoi subnetwork [4] :

$$V(pi) = P|dN(p, pi) \leq dN(p, pj), i \neq j, i = 1, ..., n$$

For the construction of the network Voronoi diagram an algorithm is used based on the shortest path algorithm of Dijkstra. Dijkstra's algorithm calculates in a connected network the shortest path from a selected start node to any other node in the network. In the given context, it has to be modified to calculate the shortest paths from many generators in parallel. Each node in the network is assigned by this way the shortest distance only to the next generator. Assumes that the weights of the arcs are identical with their Euclidean distance between their start and end nodes. Furthermore the shown network is undirected, i.e., the weights are considered to be symmetric in both directions. For the Arc Network Voronoi Diagram, the arcs with a start node assigned to a different generator than their end nodes are the critical ones. In this method the points on these arcs that have equal distance to the two generators is calculated simply, and the arc here with a node representing a Voronoi boundary is split [3]. The construction of the Arc Network Voronoi Diagram is usually sufficient. Consider a street network: if its arcs are assigned to closest generators, then we know also the assignment of buildings along the streets to generators. The entrance point of the building is the decisive factor [5].

2.4 K-Nearest Neighbor on NVD

The nearest-neighbor problem takes as input a query point q and returns the point p in some underlying set P which is nearest to q. A common variant is the k-nearest neighbors problem, which returns the k closest points in P to q, where k is a constant. Using the help of network voronoi diagram, nearest p to query point q can define by look into p's territory [6].

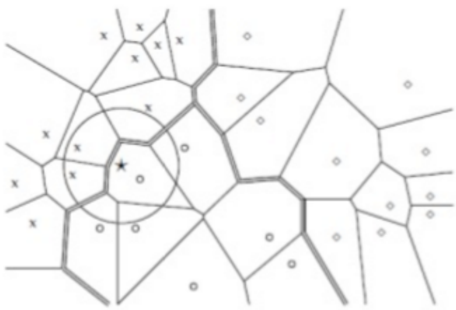

Figure 2.5: K-Nearest Neighbor on Voronoi

Chapter III

Research Method

3.1 System Description

The system built on this final project is the first aid emergency system by using K-Nearest Neighbor on Network Voronoi Diagram. In general, the system can be seen in Figure below. First, system accepts input user location where emergency happens. Then the system will process the input from the user to determine the nearest emergency units to user each type unit area that has been divide using Network Voronoi Diagram. If unit selected in on duty, system will searching for next nearest emergency unit by using K-Nearest Neighbor. After getting fix nearest emergency unit, the system determines the fastest route from their location to emergency location. And the last, system sends data to the results of this process to each responsible unit so that they can immediately go to the emergency location.

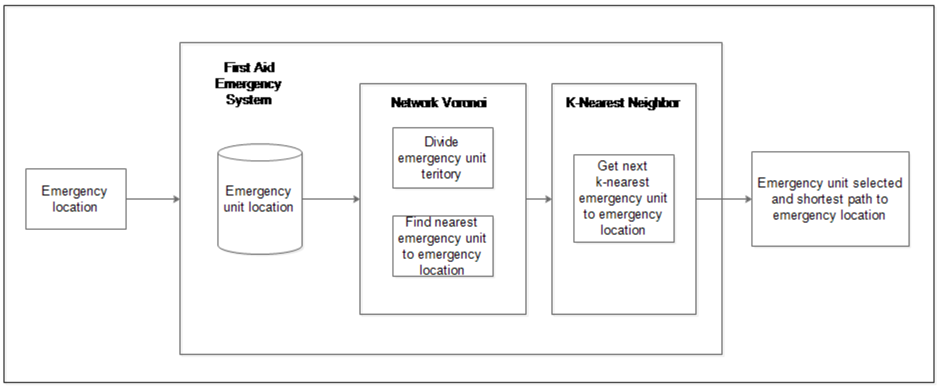

Figure 3.1: System Description

3.2 System Flowchart

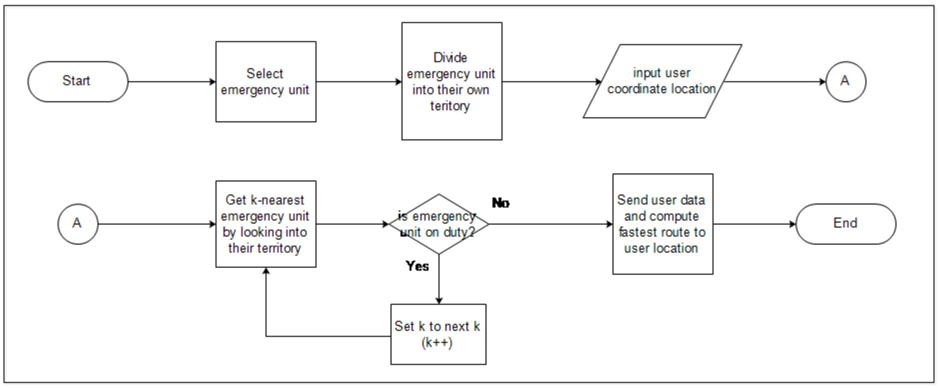

Figure 3.2: System Flowchart

explanation of the flowchart above as follows :

1. System select all emergency unit (police, ambulance, and firefighter) from database to get their location data.

2. System divide each emergency unit based on their type using Network Voronoi Diagram so each emergency unit with same type has their own territory.

3. System accepts input coordinates of user's location where emergency happens.

4. System determine k-nearest emergency unit by looking into their territory.

5. If emergency unit selected on duty, system will looking for next k-nearest emergency unit.

6. If emergency unit selected not on duty, system will send user data to the emergency unit and also fastest route from emergency unit selected location to user location.

7. System sends feedback form to user for system evaluation.

3.3 System Spesification

The hardware used to develop this system as follows.

1. Computer with Intel Core i7 3.2Ghz processor.
2. Memory 8 GB
3. HDD 500 GB
4. GPU Intel HD

The software used to develop this system as follows.

1. Android Studio
2. Java JDK 8

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