Smartphone based Emergency Reporting and Response System

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Abstract The emergency case reporting and finding the shortest path to incident place in Myanmar is developed in this paper. The proposed system is to overcome the common problem of having manual intervention while reporting emergency in developing countries. The system will also record and report emergency in real time. As a result we can maximize the ability to respond the hazard incidents.

Keywords : smartphone-based emergency report, Dijkstra's algorithm, GIS

1. Introduction

With the development of technology, everyone can use Internet easily from mobile devices. Recently, the mobile devices become a most powerful communication device in Myanmar. Therefore emergency reporting and response system is a useful application for developing countries. The technology lead to save the daily life of citizens and the location-based information system can support many beneficial for citizens. Therefore emergency reporting system from smartphone and response system become challenging topic in research.

Emergency can cause people to the loss of life or property, to the harm of the physical integrity of individuals, or to damage of property. Emergency situations are typically events that can be handled by local authorities (police, ambulances, fire departments), whereas disasters are situations, in which damage with serious consequences occur on a regional or national level and affect the population. Geographic Information Systems (GIS) was designed to support geographical inquiry and spatial decision making. This paper focused on emergency situations that can be handled by local authorities. Finding the shortest path to take the prompt action of emergency case is the main part of this system.

Traditionally, whenever there is an emergency case we call to emergency dispatcher. And the emergency dispatcher has to take notes of the emergency location, which can

be a problem because addresses can be confusing and not really well organized. Besides they need to try to understand the emergency situation. A location-aware system displaying shortest path on online map (e.g. Google Maps) by using GIS technology can greatly improve mutual understanding of where the emergency happened or where to go next. This will result in reducing damage to both people and property of the citizens of emergency happens.

Dijkstra's algorithm is the most powerful algorithm for determining the shortest path and it is not too complicated to implement. With the combination of Dijkstra's algorithm and GIS technology, we can provide the emergency response system so as to extend the response to hazardous occurrences. Based on the Spatial Network Database (SNDB) in emergency response arises directly from the benefits of integrating a technology designed to support spatial decision making into a field with a strong need to address numerous critical spatial decisions. For this reason, new applications of GIS in emergency management have also flourished in recent years along with an interest in furthering this trend [1].

This paper aims to develop the emergency report and response system by combining the web services with GIS technology. To study how to create the vector and raster map for creating the shape file. To find the optimal shortest route with GIS data.

The remaining paper is structured as follows. Section 2 presents the Graph Theory and Dijkstra's Algorithm. Dijkstra's Algorithm is not too complicated and can find shortest path on the map or application on the network. Section 3 represents the architecture and functional detail of the proposed system. Finally, section 4 concludes the paper with possible enhancements to the proposed system.

2. Graph Theory and Dijkstra's Algorithm

Graph theory is the study of graphs, mathematical structures used to model pairwise relations between objects from a certain collection [5]. In computer science, graphs are used to represent networks of communication, data organization, computational devices, the flow of computation, etc. For instance, the link structure of a website can be represented by a directed graph, in which the vertices represent web pages and directed edges represent links from one page to another [3]. A similar approach can be taken to problems in travel, biology, computer chip design, and many other fields. The development of algorithms to handle graphs is therefore of major interest in computer science. Graphs provided a powerful tool to model objects and relationships among objects. Graphs are defined by a set of vertices and a set of edges, where each edge connects two of its vertices. Graphs are further classified into directed and undirected graphs, depending on whether the edges are directed. A graph structure can be extended by assigning a weight to each edge of the graph. Graphs with weights, or weighted graphs, are used to represent structures in which pairwise connections have some numerical values [5].

A network is referred to as a pure network if only its topology and connectivity are considered. If a network is characterized by its topology and flow characteristics (such as capacity constraints, path choice and link cost functions) it is referred to as a flow network. A transportation network is a flow network representing the movement of people, vehicles or goods. The approach adopted almost universally is to represent a transportation network by a set of nodes and a set of links. A transportation network can be referred to as a valued graph, or alternatively network. Directed links are referred to as arcs, while undirected links as edges. The relationship between the nodes and the arcs, referred to as the network topology, can be specified by a node-arc incidence matrix: A table of binary or ternary variables stating the presence or absence of a relationship between network elements. The node-arc incidence matrix specifies the network topology and is useful for network processing [2].

Dijkstra's algorithm is an algorithm used to find the shortest path. The algorithm is not too complicated and can be applied to find the shortest route on the map or the application in the network. It is also called the single-source shortest path and is referred to as the standard shortest path algorithms [1][5]. It computes length of the shortest path from the source to each of the remaining vertices in the graph. It can also be used for finding costs of shortest paths from a single vertex to a single destination. It can also be used for finding costs of shortest path to the destination vertex has been determined.

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Algorithm   :   DIJKSTRA
Input       :   A weighted directed graph G = (V, E), where V= {1, 2, ….., n}
Output      :   The distance from vertex 1 to every other vertex in G
1.  X = {1};  Y ⟵ V - {1};  λ [1] ⟵ 0
2.  for y ⟵ 2  to  n
3.      if  y  is adjacent to 1 then  λ [y] ⟵ length [1, y]
4.      else  λ [y] ⟵ ∞
5.      end if
6.  end for
7.  for  j ⟵ 1  to  n-1
8.      Let  y  ∈  Y   be such that  λ [y]  is minimum
9.      X ⟵ X ∪ {y}      {add vertex y to X}
10.     Y ⟵ Y - {y}      {delete vertex y from Y}
11.     for each edge (y, w)
12.         if  w  ∈  Y and λ [y] + length [y, w] < λ [w] then
13.             λ [w] ⟵ λ [y] + length [y, w]
14.     end for
15. end for
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Figure 1: Dijkstra's Algorithm

In this algorithm, a weighted directed graph with vertices is the input for algorithm and the output is the minimum distance from source vertex to destination vertex. It

compares length of edge and choose the minimum distance one. So finally, we can get the shortest path with minimum distance. V is the vertices in the graph. X will be the visited vertex and Y will be the list of unvisited vertices.

The shortest path is a classical and main problem in network analysis and it is mandatory for GIS. Recently, much work was carried out in the application of exiting studies for emergency response systems considering shortest path analysis.

3. System Design and Implementation

The system developed the client- and server-side data processing, and data visualization on Google Maps. Therefore, the system includes two parts of application: client side application for emergency reporting and server side application for emergency response.

Details will be showed in our presentation.

4. Conclusion

By applying the GIS technology with Web Services, the emergency case can be reported with accurate data in time. It is the ongoing research work and it can extend many research work based on the road condition and traffic congestion not only the length. For the good experimentation result, some indexing method should be applied in storing and searching the path and agency with corresponding spatial data of road network.

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