ABSTRACT

There has been a growing need for the use of information and decision support systems in evacuation planning as a part of emergency management in order to reduce as much losses as possible. To minimize the damage, an accurate evacuation plan that gives more than one evacuation path in a minimal time is imperative. The plan also has to be effective with the changing road conditions. The use of Geographic Information Systems (GIS), Decision Support Systems (DSS), and shortest path algorithms as a solution for this problem is the subject of this thesis.

A framework for providing preparedness and response plans after an emergency event occurs is proposed in this thesis. The plan provided by the proposed framework includes a calculated degree of hazard posed by that event, radius of affected area (buffer zone), identification of all the safe destinations, and the best alternative paths for evacuation from the buffer zone displayed on the map. Selection of alternatives depends on some parameters that reflect the dynamic road conditions. Such parameters are the current traffic flow, the safety state of the road, and the existence of any sudden block(s).

Calculating the degree of hazard and radius of affected area is based on the emergency event's type. Three emergency models for fire, hurricane, and earthquake are incorporated into the framework. A spatial overlay and proximity analysis are conducted, resulting in a buffer zone of the affected area shown on the map around the emergency event according to its type.

To identify all the safe destinations and get the best alternatives, a graph theory-based model is proposed. Firstly, the needed attributes are extracted from the given map and the overlay map and saved to two matrices. Secondly, an algorithm is developed into the model to get all the closest safe destinations. Thirdly, to get the best alternatives based on the travel time, Dijkstra's algorithm is executed from a single source inside the buffer to all the identified safe destinations. The path with the minimum travel time which is the fastest path and other alternative paths are displayed on the map.

To evaluate the proposed framework, analysis and design were carried out to implement a GIS-Based Evacuation Planning (G-BEP) prototype. The prototype was tested with multiple scenarios (different emergency types with different variables) and results are shown according to each scenario. The prototype was also found to respond differently based on the dynamic road conditions.