Project Draft

Title: Estimation of Earthquake Relief Routes
Notice: Dr. Bryan Runck
Author: Tzu Yu Ma
Date: September 26, 2023

Project Repository: Link
Time Spent: 8 hours

Abstract
Disasters always result in tragedy, including wildfires, earthquakes, tornadoes, and others. My objective is to establish a data importation process that enables us to estimate suitable routes for disaster response. To streamline the project, I would like to focus on earthquakes, as Taiwan, my home, experiences numerous earthquakes every year. I can download data from the Central Weather Administration Taiwan Geophysical Database Management System. As part of my responsibilities in disaster relief, the ability to estimate these routes would significantly enhance the efficiency of our response and help prevent tragedies. In the future, I hope this system can be extended to cover not only earthquakes but also other types of disasters promptly, such as Taiwan's typhoons (known as tropical storms in the US), which are a recurring annual disaster, and that it can be applied to other regions as well.

Problem Statement
When serious earthquakes occur, buildings and roads may become damaged or destroyed. The timely identification of efficient rescue routes can greatly reduce response times and is essential for the safety of rescue teams.

Table 1. Requirement data

#	Requirement	Defined As	(Spatial) Data	Attribute Data	Dataset	Preparation
1	Road network	Roads Dataset	Road geometry	Route system	National Land Surveying and Mapping Center (NLSC)	
2	High volume traffic	> 100 cars per hour	Road geometry	None	Freeway Bureau AADT Data	VPN need to locate to Taiwan
3	Earthquake history points	Seismic intensity Epicenter Depth	JSON, CSV	None	Central Weather Administration	Determine the affected area through calculations

Input Data
The input data comprises three key components: road network data, high-volume traffic information, and earthquake history points. The road network dataset encompasses various types of roads, including county roads, which are crucial when the location is not in proximity to major highways. High-volume traffic data will be sourced in real-time from the Freeway Bureau API, providing up-to-date information on road conditions for route planning. Given the unpredictable nature of earthquakes, earthquake history points will be employed to validate and enhance the

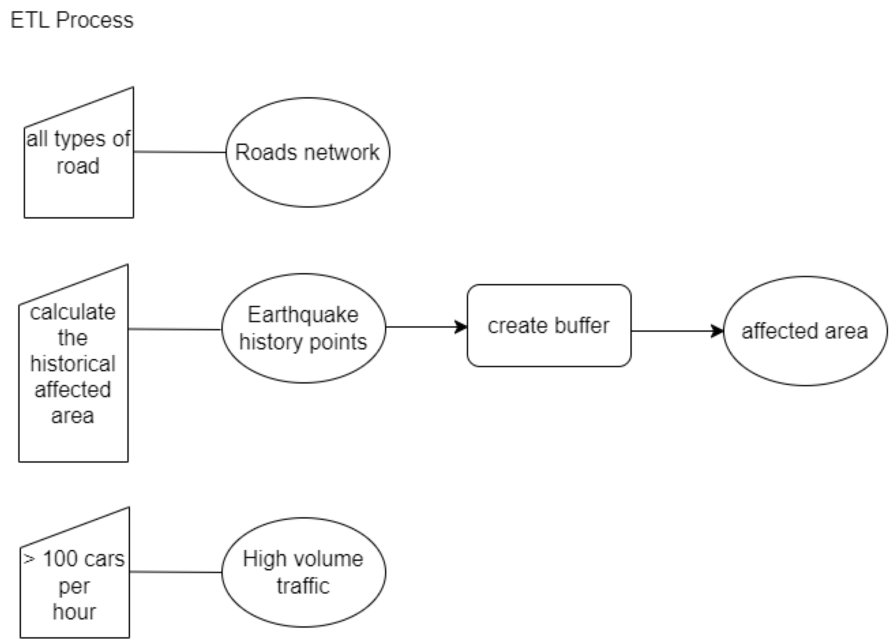
process. I will calculate historical earthquake points and their corresponding affected areas. This analysis will enable the identification of routes that are both safe and free from congestion, ultimately facilitating the planning of suitable routes for disaster response.

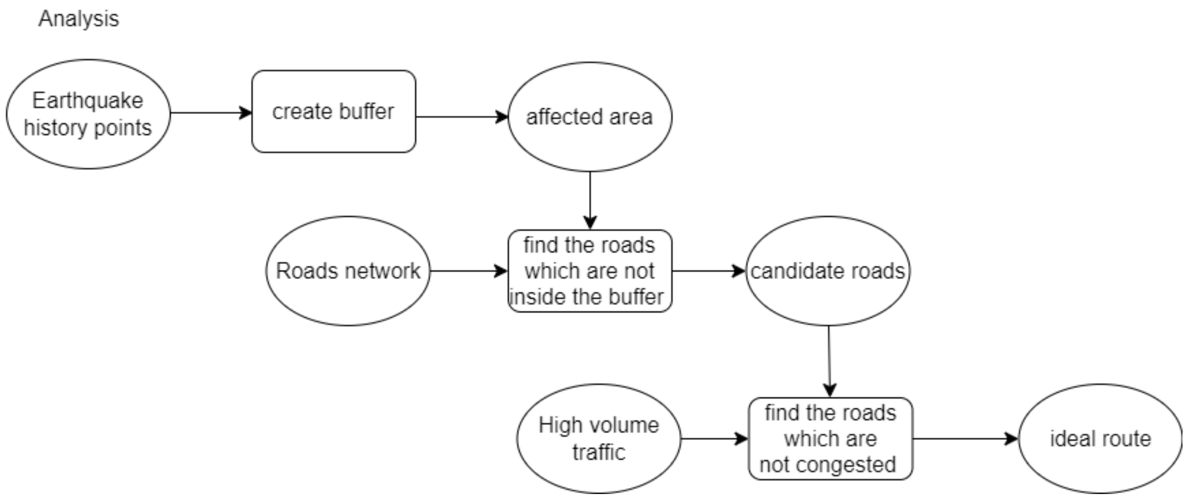
Table 2. input data in this project

#	Title	Purpose in Analysis	Link to Source
1	Roads network	Road dataset for routing analysis from NLSC	National Land Surveying and Mapping Center (NLSC)
2	High volume traffic	Analyze the route that is not congested and appropriate	Freeway Bureau AADT Data
3	Earthquake history points	Location of the incident and analysis of the affected area	Central Weather Administration

Methods

Figures 1. Data-flow diagram





1. Data Collection:
(1) Collect road network data: Gather information on road types, connectivity, and locations, including county roads.
(2) Obtain high-volume traffic data: Access real-time traffic information through the Freeway Bureau API.
(3) Gather earthquake history points: Compile historical data on earthquake occurrences, including their epicenters and magnitudes.

2. Data Integration:
(1) Combine and preprocess the collected data to create a comprehensive dataset suitable for analysis.
(2) Ensure that all data is geospatially referenced.

3. Analysis and Model Development:
I will utilize historical earthquake data points to calculate the affected area. Subsequently, I will determine an appropriate buffer zone distance and road's geometry to identify roads that remain unaffected, carefully considering the connectivity of these roads.

4. Testing:
(1) Use historical earthquake data points to test the model's performance.
(2) Verify that the calculated routes align with known safe and congested routes during past earthquake events.
(3) Make any necessary adjustments to improve accuracy.

Results

The expected result is that when an earthquake occurs, I can input the location and calculate the affected area to avoid the predicted affected roads and congested routes. Then, the system will display the suitable route for disaster response.

Results Verification

I will use historical data points to test the system, as these events have already occurred. By searching and cross-referencing the results, I can ensure that the calculated routes are accurate and functional at the time of the tested events.

References

López-Caudana, E., Ruiz, S., Calixto, A., Nájera, B., Castro, D., Romero, D., ... & Lara-Prieto, V. (2022). A Personalized Assistance System for the Location and Efficient Evacuation in Case of Emergency: TECuidamos, a Challenge-Based Learning Derived Project Designed to Save Lives. Sustainability, 14, 4931. https://doi.org/10.3390/su14094931

Self-score

Category	Description	Points Possible	Score
Structural Elements	All elements of a lab report are included **(2 points each)**: Title, Notice: Dr. Bryan Runck, Author, Project Repository, Date, Abstract, Problem Statement, Input Data w/ tables, Methods w/ Data, Flow Diagrams, Results, Results Verification, Discussion and Conclusion, References in common format, Self-score	28	**28**
Clarity of Content	Each element above is executed at a professional level so that someone can understand the goal, data, methods, results, and their validity and implications in a 5 minute reading at a cursory-level, and in a 30 minute meeting at a deep level **(12 points)**. There is a clear connection from data to results to discussion and conclusion **(12 points)**.	24	**24**
Reproducibility	Results are completely reproducible by someone with basic GIS training. There is no ambiguity in data flow or rationale for data operations. Every step is documented and justified.	28	**28**
Verification	Results are correct in that they have been verified in comparison to some standard. The standard is clearly stated **(10 points)**, the method of comparison is clearly stated **(5 points)**, and the result of verification is clearly stated **(5 points)**.	20	**16**
		100	**96**