

A Study on Advancing Strategy of Seismic Tremors Solution For Busan using Open API

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Abstract: Background/Objectives: Among the earthquake damage analysis systems developed so far, no system that could even respond from the perspective of managers in the event of a disaster.

Methods/Statistical analysis: It was intended to ensure the convenience of managers by adding additional functions to the type of seismic damage analysis system. The existing system predicted and calculated the damage caused by the earthquake. In this paper, we present a way to help respond quickly after an earthquake by using Open API, etc. It includes functions that are already being implemented, as well as those that are being researched and developed.

Findings: The existing seismic damage analysis system mostly calculates building damage caused by earthquakes, evaluates the amount of damage based on those figures, and produces figures related to refugees. But when an actual earthquake occurs, there is not much that managers can do right away with the system. This paper presents a strategic improvement plan by adding four additional functions to overcome the shortcomings of the existing system. This improvement plan is based on 3D Geographic Information System (GIS) and was intended to add Earthquake Excellence History, Vulnerable Groups Concentrated Area Information, Standard Operating Procedures, and Real-Time Evaluation Route. Earthquake Accuracy History function allows an intuitive decision on past similar records to be made. Vulnerable Groups Concentrated Area Information function helps you make quick judgments about the situation in the region where you need help first and foremost. Standard Operating Procedures are built into the system so that non-skilled people can easily perform it. Real-Time Evacuation Route feature allows administrators to have a quick insight into the path of refugees.

Improvements/Applications: The improvement plan with additional functions in the system for calculating the output related to damage can be further improved through further implementation.

Keywords: Earthquake, 3D GIS, Open API, Vulnerable, SOP, Evacuation.

1. Introduction

In 2016, a 5.8-magnitude earthquake hit Gyeongju, South Korea. It was the largest earthquake ever on the Korean Peninsula since the earthquake was observed. With the confirmation that a massive earthquake could occur in Korea, interest in seismic disaster solutions has increased. Based on the 2D GIS, the seismic disaster situation solution developed so far has implemented a function to predict the risk of buildings, weekly and resident population, and economic risk. The systems for seismic damage analysis include HAZUS-MH[1], SYNER-G[2], MCEER[3], ERGO[4], OpenQuake[5], and QuakeCore[6]. These solutions were used to predict direct damage from earthquakes, but there were many shortcomings in responding to disaster situations from the perspective of managers. Based on 3D GIS, the purpose of this study was to upgrade the seismic disaster situation solution using additional functions, such as using Open API such as past earthquake occurrence information and information on vulnerable areas and applying pop-up standard operating procedures (SOP) to help managers make quick and intuitive decisions in case of an emergency in the B2B (Business to Business) environment.

2. Materials and methods

While the HAZUS-MH and Ergo developed in the U.S. can calculate not only physical damage to disaster damage but also additional damage and recovery costs, such as fire, flooding, and collapse, which are secondary damages, use standard data values for U.S. structures, which are not suitable for direct application in Korea. MARE, developed by the Korea Institute of Science and Technology Information, complements this point so that real-time earthquake damage can be assessed, but it has a disadvantage that additional information that can be referred to from the perspective of a manager of a disaster situation is limited[7]. To overcome the deficiencies, the government decided to introduce additional information and selected what information might be needed. The earthquake ends in a few seconds. Although earthquake information can be obtained and damage prediction can be made for a simulation, it takes a considerable amount of time. Therefore, managers need a way to make decisions quickly during the simulation. The expected effect is to enable administrators to make intuitive observations based on pre-registered scenarios, etc. before simulation results are published. Besides, it was decided that the government needed rough information on where it needed support and the

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extent of the damage. Finally, I thought it was necessary for managers to find a way to evacuate people safely and quickly. To this end, they thought about what functions they needed and selected additional functions based on technologies that are already available or soon to be developed.

3. Results

To upgrade the seismic disaster situation solution, additional information such as earthquake occurrence history, vulnerable groups concentrated areas information, standard operating procedures (SOP), real-time evacuation routes, based on 3D Geographic Information System (GIS) was planned to be applied through sources such as Open API.

The reasons for using Open API are as follows: Continuously updateable information such as Earthquake Excellence History and Vulnerable Groups Conscribed Area Information has been kept up to date without administrator updates. And it is also advantageous in terms of security if security data, such as SOP, that can be accessed only by certain administrators, are received through API where authentication key exists. Finally, when setting the optimal evacuation route, the route is bypassed for reasons such as collapse or damage, or the route situation where rapid evacuation is impossible due to a surge in traffic is reflected in real-time.

3.1. Earthquake Occurrence History

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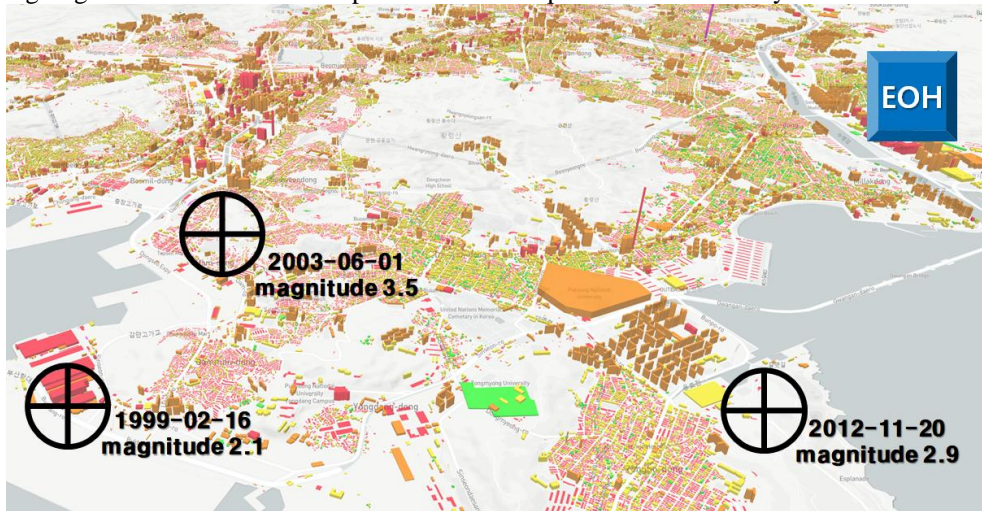


Figure 1 Indicated History of Seismic Tremors

It was intended to record past earthquake information on 3D GIS by graphicalizing it. If you look at the Korea Meteorological Administration's list of earthquakes in Korea, you can see information about past earthquakes that occurred in Busan and its surrounding areas. The latitudes and longitude ranges of earthquake information collected, such as [Table 1], are designated to enable access to information on the time, scale, depth, maximum intensity, and location of earthquakes occurring within a certain range. Besides, this information can be recorded graphically on the 3D GIS, as shown in [Figure 1], so that the manager can check the trend, such as the area and scale of frequent earthquakes, even during normal times. Through these functions, similar simulation results can be expected to allow the manager to respond quickly in the event of a real disaster.

Table1 List of Seismic tremors in Busan

Day	mag	Latitude	Longitude
2016-12-25 1:59	2.4	35.25 N	129.39 E
2014-10-21 6:33	2.3	35.21 N	129.49 E
2012-02-21 22:30	2.5	35.13 N	129.80 E
2009-02-26 15:03	2.7	35.03 N	129.59 E
2007-12-28 4:03	2.7	34.98 N	129.64 E
2007-02-06 0:35	2.2	34.97 N	129.68 E
2003-08-12 1:25	2.6	34.70 N	130.30 E
1997-06-16 22:51	2.7	35.30 N	129.10 E
1996-05-16 11:05	2.8	35.30 N	129.10 E
1985-01-15 9:59	3.4	34.70 N	130.00 E

3.2. Vulnerable Groups Concentrated Areas Information

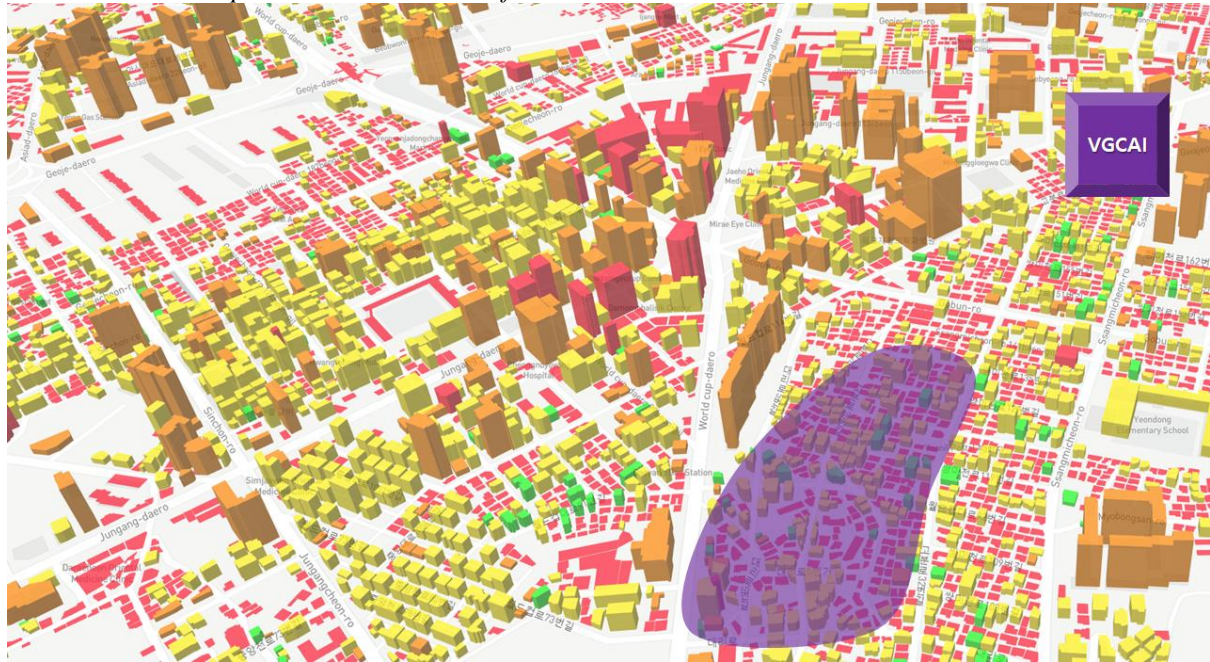


Figure 2 Indicatedd Vulnerable Groups Concentrated Areas Information

The public data portal provides access to "standard data for the nation's elderly disabled protection zones," and provides location information and addresses of places where vulnerable groups live, such as senior citizen centers, nursing homes, senior citizens' welfare centers, rehabilitation centers, and disabled welfare centers across the country through the Open API method. When presenting the simulation results of the seismic disaster situation solution, mark them on top of the 3D GIS, such as [Figure 2], so that the manager can identify the damage in the zone together when predicting the damage resulting from the simulation results. This allows the government to quickly make decisions that can minimize damage to groups that are difficult to evacuate when a disaster situation actually occurs.

3.3. Standard Operating Procedures

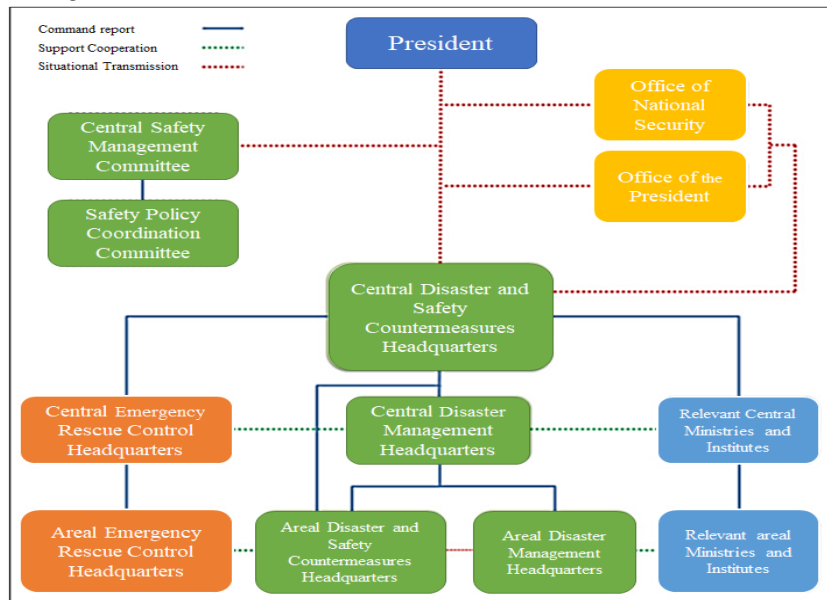


Figure 3 Standard Operation Procedure (SOP) of Seismic Tremor (Overall)

When an earthquake occurs, the manager responds according to standard operating procedures such as [Figure 3]. The process of conducting command reporting, supporting cooperation, and spreading the situation according to the urgent situation is described in the manual book, but it is not easy to follow in a disaster situation. Besides, if a manager is a novice who is not familiar with the response, he or she may waste time in a hurry. If you forget some procedures, it can be very damaging. To prevent such mishaps, the standard operation

procedure is marked as Pop-up Box so that the manager can perform it in order. As shown in [Figure 4], when an earthquake occurs, pop-up boxes are created with an alert to mark the current tasks in order. By utilizing these functions, managers can respond quickly to disaster situations without panic. This function may have greater synergy effect in conjunction with functions such as sending disaster alert text messages.

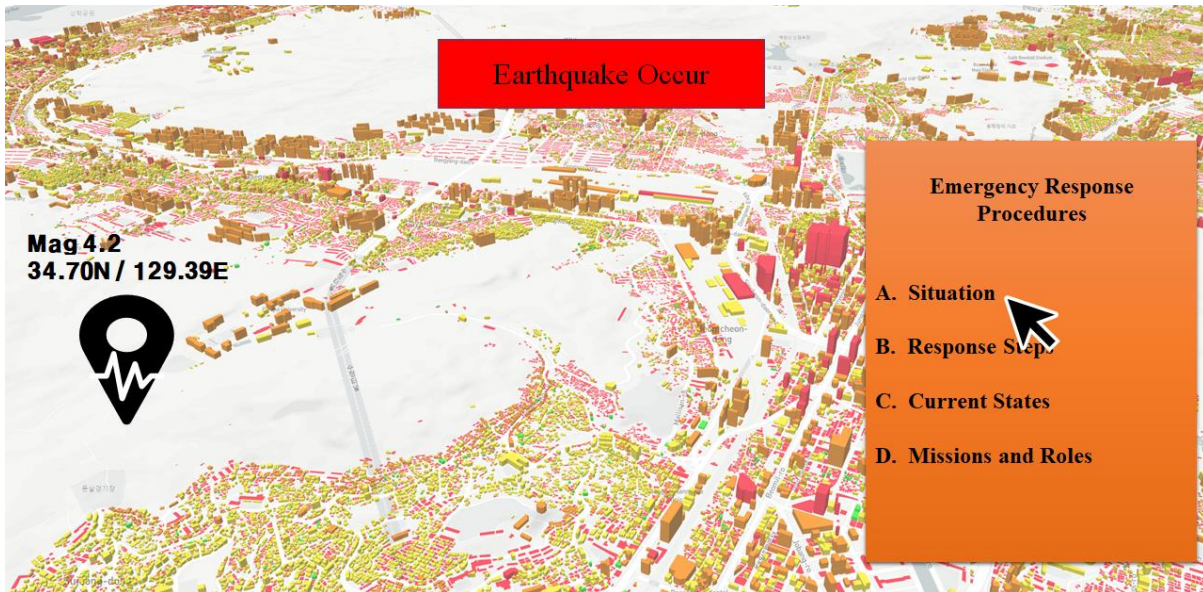


Figure 4 Pop-Up Box Menu on the Solution System

3.4. Real-Time Evacuation Routes

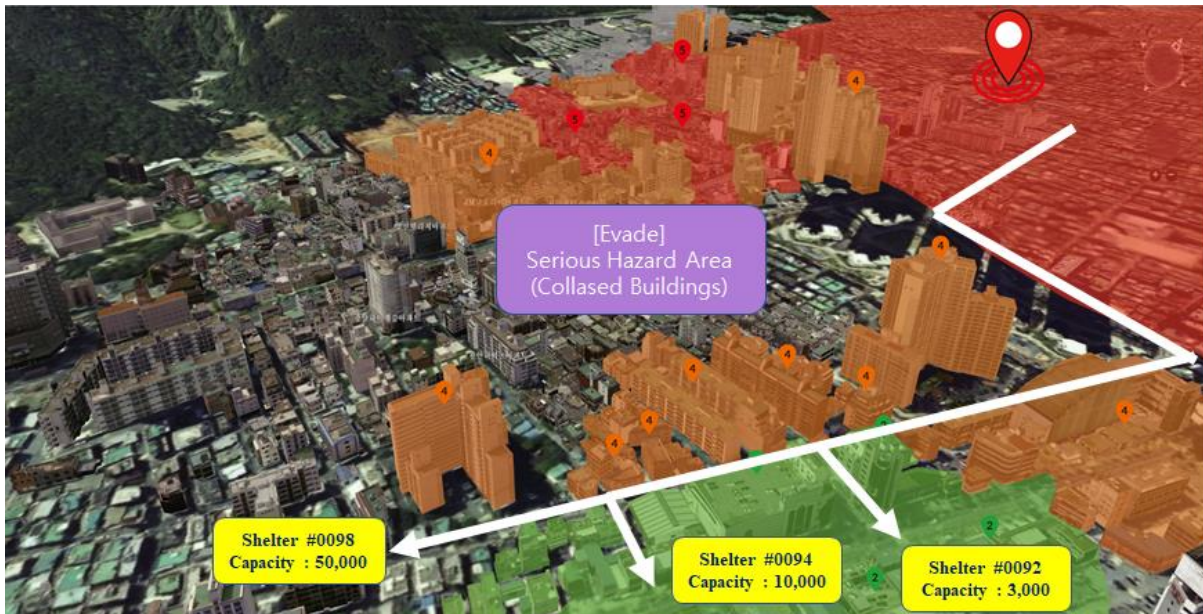


Figure 5 Indicated Real-Time Evacuation Routes

When a disaster occurs, it is also the role of a manager to quickly move people to a safe place. In the event of a serious earthquake, buildings collapse and roads are lost, making it impossible to evacuate in general. Besides, if facilities such as dams and nuclear power plants are damaged, people may have to be evacuated in consideration of the resulting complex disaster. Real-time evacuation routes are applied as one of the additional functions for upgrading the seismic disaster situation solution. Based on earthquake simulation and scenario, this real-time evacuation route predicts damage levels of buildings and bridges, and utilizes real-time traffic information using Open API to secure safe escape routes calculated accordingly. It also includes functions to guide proper distribution of population movements, earthquake shelters, and the number of people to be accommodated, as shown in [Figure 5]. Administrators can use this feature to evacuate people from affected areas in a short period of time.

4. Conclusions

This paper developed an advanced strategy for seismic traffic. This seismic disaster solution uses Earthquake Occurrence History, Vulnerable Groups Concentrated Area Information, Real-Time Evaluation Route functions to predict possible seismic damage. In particular, by utilizing information such as Open API, which was previously difficult to apply, various additional information is added to possible scenarios to promote solutions that can be effectively responded to by managers. It protects the lives and safety of the people using the information provided in detail and further provides Standard Operating Procedures on the solution screen to minimize deviations in response skills according to the proficiency of the manager. Through this strategic function, it develops manager-oriented functions that existing damage analysis solutions do not have.[8]Furthermore, the utilization of the additional functions presented in this paper can be applied not only to earthquake disasters but also to complex disaster situations accompanied by other disasters. In particular, when applied to flood damage, which has recently become a hot topic in Busan, it is easier to predict damage over time than a sudden earthquake. Therefore, synergistic effects can be expected by identifying the current status of data and related systems of complex disasters and reflecting their functions.[9-10]

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