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Tsunami Evacuation Modeling Using an Agent-Based Simulation: A Case of Barrio Barretto, the Philippines

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Abstract. A tsunami can be considered as one of the catastrophes. This study presents a simulation of an escape plan for a tsunami following the agent-based simulation. Barrio Barretto, Olonggapo City, the Philippines, is a study area of this research. It is located close to the sea and also the Philippines' Plate. The modeling uses the data of the buildings, shelters, inundated areas, and also the slope of each road. This modeling is based on a calculation of slopes, distance, and shelter capacity to get the best shortest path for the evacuation according to the evacuee's physical attributes such as age and speed. To measure the simulation's performance, this study uses the number of evacuees in a shelter to see how many people are already in the targeted shelter in a limited given time. This design can contribute to the local government or the disaster management agency to prepare the evacuation plan.

Keywords: Agent-Based Modeling, Evacuation, Tsunami, Philippines.

1 Introduction and Background

Many countries, especially the ones along the ring of fire, experienced the damages from tsunamis. Although some countries have no experience, they cannot be sure such a disaster will not reach their coastlines. This study would like to propose the simulation model as a case study to determine the situation when a tsunami occurs near the coastal city. This study focuses on pedestrian traffic in order to suggest the evacuation routes to the closest safe place. Based on the literature review, there are some studies also selected the same geographical study area. Nevertheless, the type of simulation is mainly discrete modeling with the limited consideration of human's

characteristics. Thus, this research chose the agent-based simulation with the human (e.g., age, behavior) consideration. Comparing with other simulation methods, the agent-based modeling can support the operation, tactical and strategic level as well as the agent-environment interaction and agent's independent decision making [1].

2 Research Design, Methodology, and Results

Barrio Barretto, Olongapo City, the Philippines, has been selected as a study area. They have no tsunami experience. However, based on the geological research, there is a possibility of tsunami to attack the area. The data, collected by conducting the real field surveys, consists of shelter building (type, capacity, location) and population [2], is used with the GIS map. After checking the completeness of the data, AnyLogic Simulation Software has been used to simulate the tsunami evacuation.

The agents are categorized by age: child, adult, and senior citizens. The parameter of speed is defined based on the agent's age. Based on the estimated arrival time of the nearest possible tsunami of 15 minutes for the people in the city area [2], we set this time as the criteria for a survival rate calculation. By setting the maximum capacity, the agent cannot enter the occupied shelter. Thus, the agent has to run to another nearest safe place.

The simulation showed that the evacuation with the current shelter locations, the survival rate of the people is about 20%. It can be interpreted that 80% of the people in the city cannot reach a safe place on time.

3 Conclusion

The agent-based allows us to learn the different behavior from different type of the agent. The model allows the stakeholders to consider the evacuation routes and plans. Despite no real tsunami, we can learn from the simulation that it is still essential for the urban planners, policy makers, and local disaster management team to revise the routes, the number of shelters, and shelter's location; in order to reconsider the number of shelters, routes, and location.

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