Towards the Development of Smart Phone Based Earthquake Awareness System: An Integration of Location Information, Numerical Simulation and Augmented Reality

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(1) Introduction: In case of massive earthquakes, not just the collapse of buildings but also the falling furniture or objects inside the buildings causes injuries and in some cases fatalities as well. Such injuries and fatalities can be reduced by raising earthquake awareness and potential risks posed by falling furniture or objects during earthquakes. To raise the earthquake awareness and to minimize the potential loss, seismic hazard maps and the location based ground acceleration data of future scenario earthquakes have already been developed and available via internet. However, an easy interpretation of such maps and ground acceleration data in a real life situation might not be practical for all general public. Hence, the objective of this study is to develop a smart phone based system which realistically simulates and displays the dynamic behavior of furniture or other objects during earthquakes by integrating the location based ground acceleration information, numerical simulation and Augmented Reality (AR).

(2) Approach: The frame work of the proposed system is as follows. At first, the smart phone captures the furniture or other objects image and gets the location information from its inbuilt GPS and then sends the location information to a GIS server via network connection. Verifying the location of the smart phone, the GIS server searches and sends back the geographically nearest future scenario earthquake ground acceleration data. The smart phone then simulates the dynamic behavior of the furniture or other objects during that earthquake. Finally, the smart phone displays the dynamic behavior of the furniture or other objects as an augmented reality.

(3) Case Study: To evaluate the potential of the proposed framework, the dynamic behavior of a bookcase during two different earthquakes were conducted in a prototype model. The dynamic behavior of a bookcase was simulated for the past earthquakes of magnitude 4.7 and 6.5 Richter scale. The simulation results were displayed as an AR in an iPhone. The results showed that, during the 4.7 magnitude earthquake, the bookcase was slightly shaken. However, during the 6.5 magnitude earthquake, the bookcase was violently shaken and overturned (Fig. 1).

(4) Conclusion:

- The prototype model of the proposed smart phone based earthquake awareness system has been developed.
- The case study showed that the model is capable of simulating and realistically displaying the dynamic behavior of furniture or other objects during the earthquakes.
- The results showed that, in supplement to the seismic hazard maps, this proposed system is capable of playing a very important role in raising the earthquake awareness and educating the general public about the potential risks of falling furniture or objects during the earthquakes.

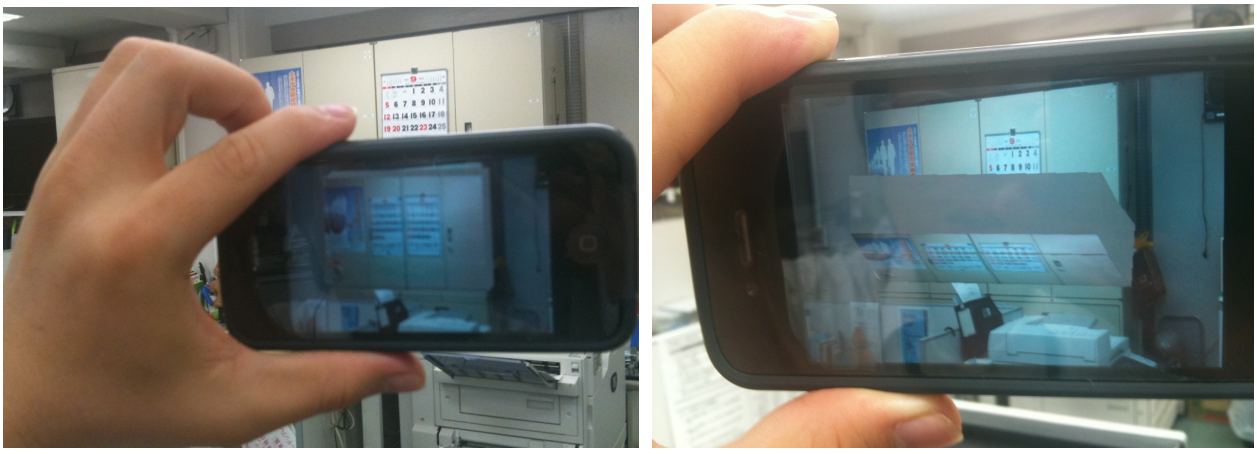

Fig. 1: Capturing the bookcase image (left) and AR based display of overturned bookcase due to the earthquake (right)