DESIGN AN EARTHQUAKES DETECTION SYSTEM THAT PROVIDES EARLY WARNING

AFTERSHOCK IN THE COURTROOM BY EDWIN CARTLIDGE

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On my honor as a university student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

In the city of L'Aquila, Italy on April 6, 2009, a magnitude of 6.3 earthquake struck the city. Constant seismic activity is nothing unusual for the people who live in the medieval city of L'Aquila. In 1349, 1461, and 1703 L'Aquila faced major earthquakes, leading the city to get accustomed to small tremors and swarms. The people of L'Aquila were informed that these tremors were only energy releases and will not lead up to the type of earthquake. Unfortunately, those small tremors led to a massive earthquake that killed 309 people and ruined the Medieval center's city. (Cartlidge, 2012). A government official and scientists who failed to warn the public and gave them a false sense of confidence underestimating the risk were tried for manslaughter. They were sentenced to six years in prison and ordered to pay several million for the damage. However, the Italian court overturned the six scientists' verdict (Pietrucci, P., & Ceccarelli, L., 2019).

The L'Aquila residents were waiting for scientists' assessment of the likelihood of a significant earthquake, and the hazards were not assessed and communicated accurately before the incident (Cartlidge, 2012). Earthquake Early Warning (EEW) system can inform many users about a potential earthquake and reduce casualty and damage caused by an earthquake. Although the EEW system informs users about possible earthquakes, it is based on traditional seismic and geodetic networks and is used by a few countries (Kong, Q., Lv, Q., & Allen, R. M., 2019). To address the downfall of EEW systems, I will propose an earthquake early detection system that alerts users generated by network-based early warning systems and sensors in smartphones.

To design an earthquake detector system effectively, both the technical and social aspects must be addressed. Also, I will investigate the social, conceptual, and technical actors that contribute to the L'Aquila earthquake incident.

Technical project proposal

Earthquakes are common global risks that take lives, interfere with daily life, and work, and destroy towns in different parts of the world. Different systems are developed over time to predict earthquakes on a small scale, and one of them is Earthquakes Early Warning (EEW). EEW uses real-time seismic data to pinpoint an earthquake's location and magnitude1,2. The expected ground motion as a function of distance from the rupture is then determined using this data as input for a ground motion prediction. Then alerts are sent to areas where the anticipated ground motion exceeds a critical threshold (Minson, et al., 2019).

It is still not possible to forecast earthquakes accurately with current science and technology, even though many scientists and engineers have dedicated themselves to studying earthquakes (Kong, Q., Lv, Q., & Allen, R. M., 2019). The recent development of Earthquake Early Warning (EEW) systems effectiveness has been demonstrated over the past ten years in numerous places by lowering earthquake-related fatalities, injuries, and property damage as well as by warning people to seek cover, slowing and stopping trains, opening elevator doors, and many other uses (Kong, Q., Lv, Q., & Allen, R. M., 2019). The deployment and upkeep of traditional seismometers are expensive since they are high-grade research-grade sensors. As a result, there are only a few areas with EEW systems and a small number of seismic networks around the world that monitor earthquakes. With a smartphone-based seismic network that transforms users' smartphones into portable seismic sensors, a system adopts a fresh strategy to get over the drawbacks of conventional seismic networks (Kong, Q., Lv, Q., & Allen, R. M., 2019).

This technical project aims to design an earthquake detector system EEW and smartphone-based seismic network that provides early warning and assistance if earthquakes

occur. Using the sensors in every smartphone, the earthquake detector system app can distinguish earthquake shaking from background noise. When a single smartphone app detects an earthquake, it transfers the information it has gathered to a central processing hub. A network detection algorithm may validate or deny the existence of an ongoing earthquake and maybe disclose its location and magnitude by compiling the data from the various recording devices in the vicinity. The available lead time and shaking intensity at any target location are then estimated using source characteristics (Colombelli, et al., 2020).

A critical feature of the smartphone app system during an earthquake is a particular module that can estimate the level of ground shaking that can be predicted at a target point up to some km away from the epicenter and seismic zone, as well as the surrounding area, are included in the possible area of interest for the users (Colombelli, et al., 2020). It can also show what procedures to follow and where to go to find a safe place. If this problem is not addressed, when an earthquake occurs the causality and the destruction of properties are going to be high.

STS Project Proposal

Seven members of the Italian High-Risk Prevention Commission were given six years in prison in 2012 for failing to fulfill their responsibilities to thoroughly assess seismic risk and offer accurate, complete, and clear information that could have saved many lives (Kerpelis, P., & Karamanou, A., 2019). Before the earthquake occurred, the resident of L'Aquila was informed that there is no danger and so they were not properly prepared, causing global interest and various reactions. Local authorities were already aware of the high vulnerability risk for public buildings in the city. Giampaolo Giuliani, a technician and amateur seismologist employed by the National Laboratory of Astrophysics at Gran Sasso, made numerous public appearances and issued numerous warnings during the pre-seismic phase. Despite the consensus of scientists, he

asserted that he could anticipate large earthquakes using gas measurements called radon (Kerpelis, P., & Karamanou, A., 2019). Allegations of "creating terror" and false alarms followed the unverifiable prediction of an impending earthquake in the city. Giuliani was forced to delete his research from the internet after Guido Bertolaso, the head of the National Department of Civil Protection (NDCP), filed a complaint about Giuliani with the authorities and banned his public utterances (Kerpelis, P., & Karamanou, A., 2019). Hydraulic engineer and former DPC deputy chief Bernardo De Bernardinis claimed that the earthquakes posed "no concern" and that "the scientific community continues to reinforce to me that in reality, it is a good scenario." De Bernardinis claimed that the continuous tremors contributed to the energy coming from the fault's discharge. Trial witnesses said this was particularly comfortable because it seemed the threat was waning with each earthquake (CARTLIDGE, E., 2012). The information supplied regarding the risks, and potential future developments of seismic activity was insufficient, imprecise, and contradictory.

I argue that the L'Aquila earthquake disaster did happen because the scientist failed in public communication which led to aftershocks in the courtroom case. Actor-Network theory examines and looks for human and non-human actors that are associated together by a network builder. I will describe human and non-human actors that were involved in the L'Aquila earthquake disaster.

Conclusion

The deliverable for the technical problem discussed in this paper will be a full design of an earthquake detector system that provides early warning capable of sending an alert system when an earthquake occurs and a what-to-do procedure they can follow. The STS research paper will strive to determine why the scientist failed in delivering a wrong earthquake prediction and

why the case went to court. This will be accomplished by applying Actor-Network theory to characterize how relevant human and non-human actors play a role in shaping aftershock courtroom cases. The combined results of this technical report will serve to address the issue regarding the implementation of a breakthrough earthquake detector system from a socio-technical lens, highlighting key considerations for the success of earthquake detector system projects and proposing the adoption of any particularly promising EEW technology.

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