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Enabling Rapid Disaster Response using Artificial Intelligence and Social Media

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According to The Economist, meteorological disasters that are caused by extreme weather including cyclones, blizzards, heat waves, hurricanes, droughts are increasing in the 21st century. While more people are being suffered by these disasters, the number of fatalities is actually decreasing as response to these disasters improves. However, the devastation in terms of human-lives and economic damage caused by these disasters is still huge. For instance, the recent Hurricane Harvey is being estimated as the second-costliest natural disaster in U.S. history after Hurricane Katrina in 2005. Humanitarian organizations and first responders look for useful information during disasters to improve their decision-making and relief operations. For instance, the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) seeks to gain situational awareness in the first 48 to 72 hours after a sudden-onset disaster to understand urgent needs of affected population (e.g., food, water, shelter, medical assistance), disaster severity, and local government capacity to respond, among other factors. Gathering such information at the sudden-onset of a disaster, especially in the first 24 hours is nearly impossible, as it requires human experts and crisis severity assessors to visit the disaster areas.

To bridge this information scarcity gap, humanitarian relief organizations have recently started acknowledging social media platforms as vital information sources for disaster response and management [Verity et al. 2014]. The widespread use of social media sites such as Twitter, Facebook provides convenient ways to share and consume public information as fast and easy as never before. People use web and mobile technologies to share different types of information including textual and multimedia content (images and videos). If accessed and processed properly, this information could be useful for a variety of disaster response operations.

Despite the fact that information available on social media is timely and potentially useful, making-sense of it is challenging due to a number of reasons. Among others, the time-critical analysis of social media streams requires processing millions of messages arriving at high-velocity, real-time parsing of brief and informal content, handling information overload, determining information credibility, and prioritizing useful information for stakeholders.

In this paper, we present the Artificial Intelligence technologies developed by the Qatar Computing Research Institute (QCRI) towards addressing the challenges in the use of social media for disaster response. Artificial Intelligence for Disaster Response (AIDR) [Imran et al. 2014] is a system conceived and developed at QCRI to harness information from real-time tweets that emerge from an area struck by a natural disaster to help coordinate relief activities. The AIDR system combines human and machine intelligence to categorize crisis-related messages during the sudden-onset of natural or man-made disasters. The United Nations OCHA now routinely uses AIDR for the coordination of humanitarian affairs as well as by many other emergency departments in the world. The system has been used during several major disasters such as the 2015 Nepal Earthquake, Typhoon Hagupit by a number of different humanitarian organizations including UN OCHA and UNICEF.

In addition to the textual content, multimedia content such as images and videos can be valuable for response organizations. The AIDR system was originally designed to process textual content in real-time, however, recently we extend it to process imagery data posted on social media [Alam et al., 2017]. There are a number of ways in which multimedia content can aid relief operations. As a first step, currently we focus on the task of disaster severity assessment. We use social media images to measure the extent of damage to critical infrastructure such as buildings, bridges, and roads. Specifically, we have developed Deep Neural Networks based models to assess the severity of damage shown in an image in three levels: SEVERE damage, MILD damage, and NO damage.