Temporality in Crisis Informatics: Representations of time in digital humanitarian systems

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Abstract
Crisis-affected people generate millions of points of data from social media and other sources during natural disasters. Extracting actionable information from these streams is especially challenging in fluid, time-critical scenarios for digital humanitarian groups that serve as human-computational support networks to on-the-ground emergency responders. Temporal representations are often not well-reflected in crisis informatics systems which raises concerns about data validity and trust. This paper seeks to critically reflect on design challenges for crisis informatics systems that account for multi-scale, multi-stakeholder time perspectives.

Author keywords
Crisis informatics; Crowd work; Disasters; HCI; Temporality; Time

ACM Classification Keywords
H.5.3 – Groups & Organization Interfaces — collaborative computing, computer-supported cooperative work; K.4.2 – Social issues

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Introduction

The time elapse from a tweet for help to a physical response during a natural disaster can feel like an eternity. The unresolved time-gap between user-generated social media during a crisis, and its collection, verification, and synthesis into actionable information is problematic for affected people and emergency responders alike [4].

To overcome these barriers, the study of temporality in crisis informatics research has tended to focus on "clock time" and how the sequential passage of past, present, and future influence emergency response data collection, decision-making, task coordination, risk/probability models, etc. Measuring linear time in terms of speed, recency, and priority are important considerations in crisis-driven social computing, human–computer interaction (HCI) work, and emergency management.

However, time also manifests in other ways that help people make sense of sequential events including classical mechanics, spacetime, social constructs, cognitive models, and sensory experiences. These temporal representations are not accounted for in crisis informatics systems but can be just as important in emergency/natural disaster scenarios as clock-time.

Temporal characteristics of crisis actors

The study of crisis informatics is as much an endeavor of social science as it is of computational science [8]. Cognition and behavior matter—whether it is prosocial acts like social media participation, helping, cooperative work, sense- and/or decision-making. Understanding how temporal characteristics may influence digital humanitarian crowd work is underexplored.

A focus of our initial research is *time perspectives* [14], the cognitive frames that people innately and unconsciously use to perceive time and that contribute to sense-making that drive decisions, risk taking, and action. Computer-supported cooperative work (CSCW) also offers important context for how time is collectively experienced [5] and the ways in which temporal logic emerges in group work [7].

But in a disaster, whose time perspective matters most: The individual or the group? The crisis-affected person using social media to call for help? The humanitarian crowdworkers who triage the deluge of data? Or the emergency responders prioritizing organizational resources? If one or more matter, how is this information captured in crisis informatics systems?

Time and digital humanitarian crowd work

Crisis informatics is an emerging subfield of information science that integrates human- and machine-computation, sociotechnical systems, and human–computer interaction (HCI) methods to improve information sharing about natural disaster warning, response and recovery [8]. The Too Much Information (TMI) Lab at the University of Colorado Boulder is examining issues of temporality in system design, information quality, and collaborative groupwork. One branch of our work is situated in the Digital Humanitarian Network (DHN), a virtual body of 31 volunteer and technical communities (V&TCs) that provide human-computational support to the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) and a global network of emergency response organizations [2].

In the seven years since the devastating 2010 Haiti earthquake that gave rise to citizen-driven online crisis coordination, specialized V&TCs were organized to provide rapid-response teams to collect, verify, analyze, and visualize crisis data to augment formal, on-the-ground situational awareness [12] during distant emergencies [9,11]. V&TC groups rely on free, open-source, and donated cloud-based collaborative tools for document sharing, asynchronous communication channels, and mapping to form virtual networks.

From a computational perspective, the ad hoc crisis informatics systems used by V&TCs are not well-equipped to represent different temporal states of data. Take, for instance, the vast amount of social media data collected during a crisis event that often exceeds several million data points. The capacity to classify data in present or past states, and model potential future states would mark a major advancement in determining crisis zone situational awareness with more precision.

Further, our initial research reveals a conflict between how time is represented/supported in the range of open-source and proprietary cloud-based, collaborative tools that DHNs currently use versus the way time is perceived/experienced by people. While timestamped meta data is easily collected, stored, and analyzed, other temporal representations that provide important social/cultural contexts or help optimize sense-making are not as well integrated into these systems.

Why Study Time in Crisis Informatics?

Natural disasters are a constant threat to humanity. The aftermath of 6,457 weather-related disasters recorded between 1995-2015 are staggering: 606,000 lives lost worldwide, more than 4 billion people injured, left homeless or in need of humanitarian assistance, and more than US$2T in economic losses suffered [1].

Meteorological disasters tend to be classified as slow-onset disasters and embody their own rhythms of event genesis, emergency alert, immediate response, and recovery period. On the other hand, rapid-onset geophysical events, disease epidemics, mass political disruption, and chronic climate-driven events, possess their own unique temporal characteristics. A primary question for our team is whether time representations in the data are bounded by the onset type [3].

The severity and complexity of recent natural disasters coupled with the explosive growth of social media use in even the most far-flung places around the globe is driving the need for more sophisticated data collection and analytical triangulation. As V&TCs continue to mature, the need to look beyond timestamps and incorporate additional temporal representations becomes even more urgent in time-critical situations to better articulate the ground situation [13].

Prior work in crisis informatics has focused on several important data validity concepts: The triad of *credibility, trust* and *helpfulness* [10] and the broader notion of *information quality* [6]. While temporality has been acknowledged as an important element, it has received little direct attention in the literature.

Research Questions

Symbolic, time-oriented cues embedded in crisis data are essential for making sense of emergency information. Yet, existing systems do not consistently

preserve or reflect these cues, leading to breakdowns in data validity and information trustworthiness. We offer some initial research questions to critically reflect on design challenges for crisis informatics systems:

- How is temporality reflected in crisis data?
- How does the time-perspective of DHN crowd workers affect data collection in a rapid-response disaster scenario?
- What are the design tradeoffs for cloud-based, collaborative data platforms that integrate time perspectives as central interface affordances?
- How can interfaces that use time perspectives to identify, filter, and organize data improve quality and trust in time-critical scenarios?

Symposium participation

The TMI Lab team is especially interested in learning from our CHI colleagues with expertise or interest in HCI design, temporality, and crisis informatics.

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