Mobile Resilience: Designing Mobile Interactive Systems for Societal and Technical Resilience

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ABSTRACT

Digitalization and interconnectedness, facilitated by the Internet of Things (IoT) and the widespread distribution of mobile devices, can be used to tackle important societal challenges. This is maybe most prominently visible in the response to the COVID-2019 Pandemic. However, the design of mobile technology, functionality and underlying infrastructures must be resilient against disruptions caused by man-made (e.g. bombings, hacking) and natural (e.g. earthquakes, hurricanes) crises, emergencies and threats. To explore challenges, designs and potentials of interactive technologies, this workshop investigates the overlapping space of mobile technologies and resilient systems, including future application domains such as smart cities.

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1 BACKGROUND

Today, in 2020, more than half of the world population already lives in cities. According to forecasts, this percentage will increase to two-thirds of the world population by the year 2050. Information and communication technologies are used increasingly to solve existing and rising challenges within cities. As such, so-called smart cities emerge, which can be described as "a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants" [12]. Cities are characterized by geographically concentrated complex interdependencies between social, natural, and technological systems that cause extraordinary challenges in times of crisis [13]. However, to achieve resilient socio-technical-environmental systems, interdependencies with and innovations for current and future smart rural areas [17] must be considered.

While digitalization and interconnectedness can solve many challenges, others arise from it:

- How can the functionality of current and future smart cities or rural areas be secured in extreme situations, crises and catastrophes [18]?
- How can citizens participate in crisis response [4, 15], and how can they coordinate efficiently with authorities?
- How can big crisis data be prepared for a meaningful analysis, also mitigating the issue of information overload [10, 16, 19]?
- How can the availability, integrity and reliability of critical infrastructures in digitally interconnected societies be improved in the future [1, 3]?

These are only some questions, which we, as a society, need to address in order to increase societal and technical resilience. In this specific context, resilience can be understood as "the ability of a [socio-technical] system to cope with perturbations such as crisis and shocks while preserving its functions" [8]. Furthermore, resilient systems are described by the characteristics of absorption, recovering, adaptation or transformation [2] and technologies for resilience by the properties of assessability, diversity, evolvability and usability, amongst others [11]. Importantly, all challenges combine technological questions with questions of legality, legitimacy, and ethical considerations that are shaped by the socio-political context.

At the same time, the research field of crisis informatics increasingly investigates the potentials and limitations of IoT [14] and mobile technologies such as crisis and warning apps [6]. They constitute a relatively new public service for citizens and are specifically designed for the dissemination of disaster-related information and

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communication between authorities, organizations and citizens [9]. If critical communication or energy infrastructures fail, for instance, the distribution of warning messages is called into question and requires alternative infrastructures [1].

In our research as well as in the workshop "Mobile Resilience", we want to explore the overlapping space that mobile interactive technologies and resilient systems offer as fields of research. Of particular interest is how to integrate mobile warning applications into smart city or rural infrastructure and how to interconnect both to mutual advantages that are technologically feasible and socially acceptable.

2 GOALS

Above everything else, we want to produce empirical findings related to design possibilities for resilient mobile and interactive systems. Furthermore, we aim at exploring the state of research in the fields of mobile interactive technologies and resilient systems from multi-disciplinary perspectives. Lastly, avenues for further research and the potentials of both fields are within the scope of this workshop. Key topics of the workshop include but are not limited to:

- Case studies, surveys, use cases and theories on social and technological resilience, including application domains such as smart cities, urban environments and smart rural areas.
- Algorithms and systems for user-centered analysis of big crisis data, including social media analytics, credibility and relevance assessment, social sensors.
- Concepts and technologies for mobile stakeholder participation, including authorities, organizations and citizens, in smart cities and smart rural areas.
- Human and technical factors in decentralized infrastructures, edge computing and wide area networks.
- Innovative analysis, (interaction) design and evaluation of resilient (mobile) information systems.
- Usability and user experience of resilient technologies such as mobile crisis and warning apps or wearables.
- Best practices, methods and strategies for the development and deployment of resilient (mobile) technologies in diverse application domains, including smart cities.

3 CONTRIBUTIONS

The submissions for the workshop address some of the open issues mentioned above. The following contributions have been accepted for presentation:

The first contribution "*Crisis Informatics Challenges from a Political Science Perspective*" by Cornelia Fraune and Michèle Knodt [5] explores challenges of informal volunteerism and crisis communication from a political science perspective. By utilizing Ostrom's coproduction theory, the authors discuss governance challenges of informal volunteerism in crisis and disaster management (CDM). Referring to objectivist and constructivist conceptions of crisis, they argue that crisis communication is not only a matter of accurate information but is also a matter of power relations. The authors show that crisis informatics not only addresses technological or ethical challenges but also political ones.

The second contribution "*Crisis Volunteering Nerds: Three Months After COVID-19 Hackathon #WirVsVirus*" by Steffen Haesler, Stefka Schmid and Christian Reuter [7] focuses on the hackathon #WirVsVirus in March 2020, which can be considered as one of the biggest hackathons in history. Under the patronage of the federal government of Germany, 28,361 participants worked together in 1,498 projects, finding innovative apps and solutions against the COVID-19 pandemic. Three months after the event, the authors conducted an exemplifying analysis of the topics, used technologies and remaining activity of these projects. Shedding light on this instance of citizen science allows to highlight the potential of hackathons and startup culture regarding socio-technological resilience. At the same time, it may be understood as an impulse for crisis informatics to consider new forms of volunteering in the course of crisis management.

The third contribution "*Information Sharing, Coordination and Decision Making*" by Tina Comes addresses a major challenge in resilience thinking: using coupling the rapid response to crises with the adaptation to long-term trends. Due to the differing underlying timeframes and decision-making paradigms, a important dilemmas and frictions arise for information sharing, coordination and decision-making. Through case studies on disasters in Bangladesh, Syria and the Philippines, the following topics are explored: 1) policy effects on information sharing 2) timing of information and decisions, and 3) the implications for coordination and decision-making.

ORGANIZERS

The interdisciplinary workshop "Mobile Resilience" was organized by the following people:

Christian Reuter is Full Professor and holds the chair for Science and Technology for Peace and Security (PEASEC) at the Department of Computer Science at Technical University of Darmstadt, Germany with secondary appointment in the Department of History and Social Sciences. His research focuses on interactive and collaborative technologies in context of crises, security, safety, and peace.

Marc-André Kaufhold is research associate at the research group Science and Technology for Peace and Security (PEASEC) at the Department of Computer Science at Technical University of Darmstadt. His research interests comprise crisis informatics, mobile crisis and warning apps, and social media analytics for crisis response. He defended his PhD on information refinement technologies for crisis informatics, examining both user expectations and design implications for social media and mobile apps in crises.

Tina Comes is Associate Professor at the faculty of Technology, Policy and Management at Delft University, the Netherlands and Full Professor at the Centre for Integrated Emergency Management at the University of Agder, Norway. Tina also serves as Scientific Director of the 4TU Center on Resilience Engineering and is a

member in the Norwegian Academy of Technological Sciences. Her research focuses on the collaborative and informational aspects of resilient societies. Tina investigates the role of information in urgent and ill-defined problems to design better sensemaking and decision support systems, which are applied in areas such as critical infrastructures, supply chain risk and humanitarian logistics.

Michèle Knodt is Full Professor and holds the chair for Comparative Politics and European Integration at the Department of History and Social Sciences Technical University of Darmstadt. Her research group focuses on governance in the European multi-level system, European foreign policy, climate and energy governance, perceptions of European governance, external democracy promotion of the EU as well as interest intermediation.

Max Mühlhäuser is Full Professor and head of the Telecooperation Lab at the Department of Computer Science at Technical University of Darmstadt. His lab conducts research on smart ubiquitous computing environments for the 'pervasive Future Internet' in three research fields: middleware and large network infrastructures, novel multimodal interaction concepts, and human protection in ubiquitous computing (privacy, trust, and civil security).

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