Integration of Media Sources for Situation Analysis in the Different Phases of Disaster Management

The QuOIMA Project

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Abstract — in this paper we describe work in progress on a cross-media content analysis approach and framework, which is currently being developed within the QuOIMA project. We describe the role of media, and how possible links between social and traditional media and terminology and communication patterns are envisioned to be connected to the different phases of a disaster model. The paper continues with a discussion of potential benefits for decision makers and planners and concludes with an outlook on further planned activities and developments.

Keywords—disaster management, risk management, multimedia processing, network analysis, speech processing, situational awareness, open source information

I. INTRODUCTION

Traditional media have a long history in covering disasters and crises. As several examples of recent natural disasters have shown, social media can provide additional useful and effective information which in turn can lead to significantly improved situational awareness for decision makers and planners [1, 2]. Social media combine with traditional media in various ways – sparking off initial coverage, providing different and unfiltered angles or amplifying information – and produce a wide spectrum of coverage of an event. In the process, the boundaries between social media and traditional media and the different types of sources have become increasingly blurred as news providers use social media as alternative channels. As helpful as all this information may potentially be to disaster relief organizations, it usually comes in multiple formats, multiple languages, immense amounts, across multiple media and is generally unstructured and inhomogeneous. Stakeholders have to survive in this dynamic world with a 24-hour news-cycle and manage information and communications. Events will be reported about – whether they participate or not – putting pressure on them to compete and fill the information void [3].

To help meet this challenge, the QuOIMA project [4] has embarked on developing representative scenarios and models to demonstrate how extensions of existing technologies can be applied to improve the situational awareness and knowledge of decision makers. The approach described in this paper is technologically based on the SAIL LABS Media Mining System (MM-System), an open source information (OSINF) platform, and strategically based on a five-phase disaster management model developed at the National Defence Academy of the Austrian MoD. Together they form the framework within which the QuOIMA project tries to improve situational awareness in the area of natural disasters.

II. THE ROLE OF MEDIA IN DISASTER MANAGEMENT

Traditional media, such as TV, radio and web-sources have long been employed to provide information about crises and disasters. Even today, depending on the infrastructure and social factors, these media may still form an important and highly additive source of information. With the advent of social media, the way people communicate, search for and receive information has undergone a radical transformation. Not only have social media changed the way people communicate in their day-to-day lives, but also - and increasingly so - during emergencies and crises. Effectively it can already be assumed, that in many cases a part of the population will indeed turn to social media during crises [5]. Particularly micro-blogging systems like Twitter, with an open communication structure, play an important role in this respect and form a new way to disseminate and receive crisis information [6,7]. Engaging with and using emerging social media to interact and intervene may place the crisis response community in a better position to respond to disasters on a timely, broad and citizen-involving basis. Social media lend themselves to two-way communication, thus allowing data to be gathered as well as distributed using these channels. This type of communication is valued not only because it allows first responders to send important disaster-related information to the persons who need
it most, but also because it allows them to include critical updates from individuals who experience the incident or crisis first hand. The public has thus turned into an important participant in the crisis management community – everyone has turned into a potential watchdog [3]. People share their observations, opinions and emotions and communicate through social media thus acting as a crowd-sourced means to gather and disseminate data. The active dissemination of information, communication with affected persons or mere observers, corrective measures such as clarifying rumors or correcting misinformation form just a few of the possible patterns for outbound communication from the perspective of crisis response organizations [8].

For decades, communities and the public have been relying on specific groups to assist in times of disaster. But the present day communications environment with its new and increased expectations has changed the game, not just for first responders, but also for the general public [9]. (Near) Real-time communication/information, personal involvement, reliable, critically-challenged and -questioned sources, as well as multimedia content are common requirements and assets of currently shared information. The technology is constantly evolving which will result in people having even higher expectations of first responders and vice-versa. Affected persons may indeed expect authorities to respond quickly to information provided via social media [3]. There remains no doubt that the impact of social media on crisis communication is already significant and will only continue to grow in significance in the years to come.

III. EXISTING WORK AND CASE STUDIES

Recent events illustrate the active use of new technologies in crisis-situations. During the South East Queensland floods of 2011, social media played a central role in crisis communication. In particular the Queensland Police Service used Twitter to communicate effectively with affected people [11]. The use of social media has been studied in the course of various natural disasters, such as the earthquakes in New Zealand [10], Haiti [11], Chile [8], and the US [12], grassfires in the US [13], or hurricanes Ike and Gustav 2008 [14], typhoons in the Philippines and floods in Brazil [15].

Reference [6] provides an overview of social media in the context of crisis information. They find that media – traditional as well as social – form an important source for sending out and retrieving information about different aspects of a crisis or disaster. In particular they examine various approaches and channels which can be used for dissemination of crisis-relevant information. [16][8] and [14] elaborate on the structure and types of communication which emerge on Twitter, [3] does so particularly for the crisis-case. [17] provides an overview of social media in the disaster context using a set of case spotlights covering specific events. [7] provides an in-depth and comprehensive overview of how social media played a role during the 2011 Queensland floods. [18] focuses on the connection between Twitter and TV from the point of view of how to combine social network interaction with programming. [19] provides a brief overview of existing and potential future uses of social media in disasters. Relatively little attention seems to have been paid to the actual use of language in the context of social media and natural disasters: [8] and [20] deal with this topic to some extent.

Reflecting events such as natural disasters and acknowledging the importance that social media play in them, various research projects aim at improving the effectiveness of communication and alerting during crises. For example, in the FP7 project Alert4All [21], the screening of new media (SNM) tool [6] serves to enhance situational awareness among crisis management personnel with regard to public opinions and emotions found in on-line web content from tweets, blogs, and other social media. In the FP7 project MASSCRISCOM [22] social media is likewise taken into account as an emerging means of mass communication in crisis situations. MASSCRISCOM focuses on the changing demands of the communication systems. However, the strengths and possibilities as well as the risks and weaknesses of use are only addressed superficially.

In the Austrian Security Research Program KIRAS, the meta-study SMD4Austria [23] is centered on an overall evaluation of social media use in police work including risk- and crisis communication. Another KIRAS project, MDL [24] which concentrated on the use of multi-media data for situational awareness, provides some of the infrastructure and setup that the QuOIMA project builds upon.

Besides the various research-projects, actual on site use of social media for crisis and disaster management is already practiced e.g. in Australia by the Queensland Police via the @QPSMedia Twitter account [7]. Its use during the 2011 floods forms one of the most important success stories of social media in crisis communication to date.

IV. THE QUOIMA PROJECT

The QuOIMA project aims at fusing diverse and complementary sources of information – in particular social media and traditional media - and at allowing decision makers to make sense of a large, multi-lingual and inhomogeneous body of mixed data. Users are enabled to access data from different modalities just minutes after they have been published and perform various types of visual analytics activities by connecting and inter-linking information from different sources and types of media. The early detection of structures and patterns of communication are expected to allow users to react earlier, swifter and more adequately in situations of crisis or disaster. The fusion-approach contrasts the QuOIMA project with most research on the use of social media in the scope of disaster management, which mainly focuses on individual social channels such as Twitter. In addition, to a large extent the work carried out to date is typically performed on English data only, whereas the QuOIMA project emphasizes a multi-lingual approach.

Studying changes in language and terminology as well as of patterns of communication stretching across social media and traditional media (e.g. tweets linking to web-pages, quotes in tweets, quotes originating from TV being re-used by social media) as well as integrating results from visual analysis form areas of investigation. The detection and classification of such patterns may lead to the subsequent assignment of affected groups of citizens to particular phases of a disaster - not all affected persons might be in the same stage, e.g. flooding may be at its height for some part of the population whereas for
others it may actually already have passed – which may allow for improved and finer-grained situational awareness regarding the overall scenario.

Communication and language patterns will be put into context within a newly proposed model of disasters which has been developed at the National Defence Academy of the Austrian MoD by Johannes Göllner and Andreas Peer [25]. The five phases of the model are depicted in Figure 1.

![Figure 1 Five-phase disaster model](image)

The perception, information, and analysis processes of the model in combination with identified patterns of communication are used to investigate, design and develop a generic model of risk- and crisis communication. In particular communication patterns and their connection and relation to the respective phases will be investigated.

As the QuOIMA project focuses on the harvesting and collection aspects of information from the point of view of a first responder or crisis manager, emphasis is placed on the gathering and analysis of (incoming) information, rather than the management of active (outgoing) communication.

Figure 2 depicts a few of the numerous possible cross-media communication patterns expected to occur, to be detected and to be associated to individual phases of a disaster. Particular terminology and usage patterns might be attributed to each of the links in the graph according to the particular phase of a disaster.

The association of particular terminology as well as of communication patterns with phases of a disaster is expected to allow first responders to assess more effectively what stage a given part of the population is in and to communicate more effectively and in a more targeted and timely manner. It enables first responders to obtain a common and complete operational picture with a significantly higher resolution regarding the needs and status of individual groups.

Technically, the SAIL LABS MM-System forms the framework within which developments in QuOIMA take place. The MM-System is a modular system aiming to cover all activities within the OSINF process. It enables professionals to quickly extract meaningful information and perform analyses from unstructured data in a variety of formats across multiple languages and sources. The MM-System consists of a set of technologies packaged into components and models, combined into a single system for end-to-end deployment [26]. The addition of social media input mechanisms (interfaces) and processing components form some of the recent developments within the MM-System. Further components include the processing of TV, radio and web-content in a variety of languages. Visual analysis, such as the detection of text via on-screen OCR or the classification of scenes as well as interfaces to automatic translation engines form further components in the MM-System.

Together, these technologies form the basis for development within the QuOIMA project. Mechanisms, such as the ones being developed for cross-media fusion of content, are envisioned to be incrementally added to the MM-System with minimal effort, thus allowing for quick transfer of research results to products.

The input mechanisms of the MM-System are also used to collect suitable corpora of data – different types of media, all covering the same natural disasters – an ongoing activity within the project. These corpora are used for model development as well as evaluation purposes.

V. BENEFITS FOR DECISION MAKERS AND PLANNERS

As stated in [19], monitoring information flows – in our case flows which span multiple media and languages – could help establish and increase situational awareness. Obtaining real-time information as an event unfolds can help officials determine where people are; assess victims’ needs, and alert citizens and first responders to changing conditions and new threats.
An analysis of communication content and patterns might not only lead to improved targeted information to decision makers, but also lead to the identification of structures indicating a specific situation or crisis-phase, such as the follow-up phase already having started. From a practical point of view, it is a strategic advantage for decision makers sending in first responders to know how a situation is developing, especially how people affected by a disaster are reacting to the circumstances. Being able to identify certain forms of stress, disappointment, chaos and maybe even a developing tendency to resort to violence against first responders is essential information for team configuration and mission preparation. Being able to detect resilience and self-organized recovery efforts may reduce the requirement for specialized resources.

VI. PRIVACY

Regarding user-provided content and social media, QuOIMA’s goal is clearly to use publicly available (open) sources only and explicitly not to focus on individuals or their means and networks of communication, nor to determine anyone’s actual identity. Rather, the scrutiny of privacy and data protection form essential aspects of the project. For research use apart from emergency situations in which lives or higher values are at stake, only consensually provided, open and public information is taken into account, retrieved, compiled, selected and used for the proof of the QuOIMA-concept. It is of importance for the legal compliance [27] of the project that no sensitive personal data are processed.

VII. OUTLOOK AND NEXT STEPS

Data collection has been going on since the project’s start (11/2012), already yielding several instances of natural disaster coverage across sources (e.g. the recent floods in Central Europe). Models for cross-media clustering of documents (audio, visual and textual) and the detection of links between media are being investigated and developed and will undergo initial stages of evaluation. Should the evaluations be as successful as envisaged, we plan to address further types of first responders, such as the Austrian Red Cross, and to integrate modules into situational awareness centers on a prototypical base.

VIII. REFERENCES

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