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Social Media for Situational Awareness: Joint-Interagency Field Experimentation

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Abstract

Social Media for Situational Awareness (SMSA) — the identification, tracking, and analysis of online social computing data in collaboration with other kinds of sensor data towards the derivation of 'actionable' intelligence, has recently become one of the key focuses of the Joint Interagency Field Experiment (JIFX), a regularly held event developed and facilitated by the Naval Postgraduate School. In this paper we describe: the structure of SMSA experimentation at JIFX, a situational awareness capabilities assessment, the outcomes of a SM shared task, and an integrated-technology scenario focusing on pandemic outbreak. We discuss an outline of potential future avenues for SMSA experimental designs to aid in the assessment and promotion of the use of technology for the derivation of intelligence from non-traditional sources during crises.

1. Introduction

The way in which situational awareness needs are met (e.g. [1,2]) is rapidly changing in the face of new forms of online communication (e.g. social media, cellular network usage/flows) and the relevant information that is embedded in it. Combining data from other sources (e.g. traffic monitors, weather stations, and electric grid data) opens the door for newer, more efficient, approaches for conducting situational awareness operations, less bounded

by traditional constraints such as the number of on-the-ground field personnel or the inability to effectively assess the credibility of single-sourced information.

The Joint Interagency Field Experiment (JIFX)[*], a quarterly experiment venue hosted by the Naval Postgraduate School, which began in 2012 under the sponsorship of the Office of the Secretary of Defense and the Department of Homeland Security, has issued a SMSA call for experiments that aim to investigate how large-scale data can be effectively used to solve new and existing problems related to situational awareness during crises, such as: disaster response, humanitarian assistance, military operations, and pandemic response [3].

1.1. Brief History and Goals of JIFX

Building on the highly successful SOCOM-NPS collaborative field research model, the Joint Interagency Field Exploration Program (JIFX) was created in 2012 (JIFX 12-2). JIFX was conceived out of the desire to provide a field experimentation resource for all of the unified combatant commands and federal agencies with an informing system capable of addressing their unique S&T gaps. In addition, state, local and international emergency management, disaster response and humanitarian assistance organizations participate in JIFX helping to create an innovative cooperative learning environment. JIFX is sponsored by OSD's Joint Operations Support (JOS) Office of the Under Secretary of Defense for Acquisition, Technology, & Logistics (AT&L) and DHS. This complex informing system served as a dynamic engine for NPS thesis students while enabling faculty to stay closely coupled to the joint warfighter. [3]

1.2. Participation & Structure of JIFX

The structure of JIFX is meant to encourage and enable collaboration between experimenters towards developing new capabilities on-the-fly where participants come "from government, industry and non-governmental/non-profit organizations (NGO/NPO) to include academia" [4]. Table 1 describes the tenets of experimentation as set forth by the organizers.

Table 1. Tenets of JIFX Experimentation

Principle	Description
Austere By Design	We provide the basics: space to work, an airstrip, and basic communications infrastructure. It's up to you to bring everything else you need.
Collaboration Expected	Collaboration often results in unexpected and positive results. Experimenters are required to collaborate within your ability.
Bounded, Not Controlled	Create a safe, secure, and legal sandbox in which products grow and new ideas flourish.
Inclusive by Default	Everyone is welcome to apply; good ideas come from everywhere.
Develop. Now.	JIFX is immediate; do not put off development until later; development activity happens at the event, in real time.

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[*]JIFX events are held quarterly, normally at NPS facilities on the California National Guard's Camp Roberts. The general purpose of JIFX is to provide a field experimentation resource for the Unified Combatant Commands (COCOMs) and other federal agencies. In addition, state, local and international emergency management, disaster response and humanitarian assistance organizations are invited and collaborate to create an innovative cooperative learning environment. For more details and to submit future experimentation proposals, see: http://my.nps.edu/web/fx.

2. Areas of Experimentation Interest[†]

The JIFX call for experiments has recently included the following SMSA-related areas of interest:

- Identification of phenomena through SM search based on geographic location, keyword, and/or sets of scenario-specific parameters, using Natural Language Processing (NLP) to automatically infer relevancy context
- Identification and establishment of baseline monitoring and detection of events and applicable trends in social media, based on user-generated thresholds and mission-specific operational requirements
- Assignment of relationships to SM data for aggregation purposes; assignment of geo-location based on inference or other method
- Identification and assessment of meaning and context to shared SM content (versus original), including consideration for distance and time from point of event
- Integration of crowdsourcing efforts into SM analysis and provision for a means for manual verification and/or comparison of crowd-sourcing results
- Utilization of simple graphical user interfaces to enable user-generated filtering parameters of social media data
- Automated filtering and removal of publically identifiable information from gathered SM data
- Integration of results with pre-existing datasets and other sensor data to establish meaningful relationships and context between SM data and other information sources (automated and user-generated)
- Prediction and modeling of potential outcomes based on relationships identified through integration of SM and other sensor data (automated and user-generated)
- Assignment of tags or metadata (or similar solution), production of notification and/or alerts, for the purposes of routing verified information, based on mission objectives and responsibilities, to the appropriate entity
- Sharing of results of SM aggregation, filtering, and/or analysis across third party platforms and technologies, regardless of format
- Production of visualizations from SM aggregation, filtering, and/or analysis that are meaningful and applicable to mission objectives, as identified by end user
- Integration of SM results within external visualization environments, regardless of format

3. JIFX 15-1 SMSA Experimentation

In August 2014, JIFX 15-1 was held at Camp Roberts, CA. Nine situational awareness-relevant experiments were selected for inclusion in the SMSA field experiment. Experiments were selected based on their relevancy to conducting SA with SM directly (e.g., proposing to conduct analyses using SM artifacts) or indirectly (e.g., providing integrated, disparate data to participating experimenters). The capabilities that were indicated by experimenters included: general SM search, topic modeling, and sentiment analysis; rapid mobile application development platforms for use with command center field personnel; software to enable citizen crowd sourcing.

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[†] These were identified and refined by JIFX Stakeholders with input from the community of experimenters. Notably, Sara Estes Cohen (G&H International contractor for the Department of Homeland Security's Virtual Social Media Working Group) worked to initially define these areas during the 14-1 (Nov 2013) event. See [5] for a report of the group's recent findings.

Before the start of the event, experimenters were also asked to complete a situational awareness capabilities survey meant to capture the functionality that was to be demonstrated and included as part of collaboration exercises. Figure 1 depicts a radar chart indicating the average experimenter score on each of 12 capability areas, wherein each area, an equally weighted 'point' was assigned if the technology demonstrated a function within that area. For example, if a technology was capable of performing both a classification of individual elements from SM and provided a confidence associated with that classification, that technology would have a classification score of two. The capability areas were assessed with between 3 and 6 facets that were meant to capture the relevancy and application to SMSA. During the event, JIFX personnel meet with each experimenter and evaluate the capabilities described in their survey responses.
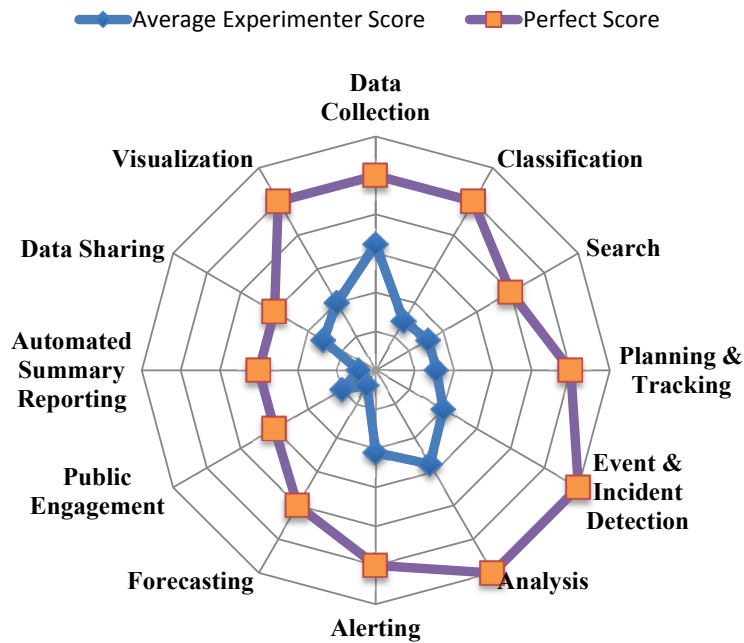

Fig. 1. Results of Situational Awareness Capabilities Assessment for JIFX 15-1, August 2014

3.1. Social Media Shared Task: Hurricane Arthur

As a part of SMSA experimentation, JIFX personnel developed a real-time disaster response scenario based on social media artifacts collected during the Hurricane Arthur weather event that afflicted the United States Eastern Coast near the beginning of July, 2014. Three datasets were collected; Table 2 describes these datasets.

Table 2. Hurricane Arthur Social Media Datasets

Dataset	Description	Number of Records
Beaufort Geo-Located	Social media artifacts from twitter that were retrieved from within a geographic bounding box approximating the city of Beaufort, NC.	1,758
US Eastern Coast Geo-located	Social media artifacts from twitter that were retrieved from within a geographic bounding box approximating the United States Eastern Coast, starting from Georgia going slightly past Beaufort, NC.	25,801
Keyword	Social media artifacts from twitter that were retrieved using a set of social media keywords. Keywords were chosen based on high correlation findings with "hurricanearthur" keyword.	2,200,000

Experimenters were given samples of each of the datasets (artifacts were JSON objects from the Twitter online social network) before the week of the JIFX event and were told the full datasets would be provided during the event.

3.1.1. Discussion of Hurricane Arthur SM Shared Task

Two out of the nine experimenters were familiar with the sample datasets and able to load them into their technology platforms. When asked about loading the full datasets, no experimenter was prepared to do this and all expressed a need to do further development outside of the JIFX event. With regard to one of the experimenters who was able to load the sample dataset, their findings were of a general nature and error-prone due to the small sample of randomly selected artifacts being used i.e. there was not enough signal present in the sample datasets for them to present very much useful information to JIFX personnel during evaluation.

3.2. Integrated Scenario: Pandemic Disease

At the event, personnel conducted an integrated scenario involving four experimenters to gain a better understanding of how an incident command center and associated field personnel would be able to gain better situational awareness through open source (social media) information.

The scenario was designed to foster experimentation designed to understand which factors, either present, lacking, or desired, that would better enable an incident response team, which consisted of an incident command center, field personnel, and autonomous flying vehicles. The goal of the team was to respond to a report of a potential person of interest who was reported to be showing symptoms of Ebola and/or other pandemic diseases as determined via SM reports.

Below is the list of events that comprised the integrated scenario.

1. A social media artifact, (in this case, a tweet), is sent out from an observer at a location containing a picture of a person of interest.
2. The incident commander receives the tweet via a system alert triggered via the mention of a specific keyword.
3. The incident commander asks officers within a specific geo-fenced area to assess and respond.
4. Officers go to the location around the location of the coordinates recovered in the observer's tweets.
5. An officer cues an unmanned aerial system to investigate the geographic coordinates using GPS coordinates sent from the officer's mobile device in order to investigate the location further.
6. The unmanned aerial system produces images that confirm the person of interest is at the location.
7. Assistance is supplied to the individual; other actions are taken to confirm and contain the outbreak.

3.2.1. Logistics and Collaboration

The exercise began with a social media 'cue' that described a person who was exhibiting potentially Ebola-related symptoms. Experimenter A then used their unmanned system to collect aerial video to assess the state of the situation, the location of which was identified by the geographical information from the social media artifact. Experimenter B utilized a second unmanned aerial system for imagery collection and data management. Experimenter C provided a web-based Android app development platform that enabled the rapid prototyping of a communication application to send data to and from the incident command center and personnel in the vicinity of the person of interest. Experimenter D provided a data platform to integrate information from multiple sources, serving as an integrating incident command center.

Figure 2 shows two items of interest during the integrated scenario: On the left-screen: a social media feed with the (simulated) social media artifact depicting a person showing potential pandemic disease symptoms. This artifact

was automatically detected by the data analytics platform (Exp. D.) relevant to the incident commander's interests. On the right-screen: a real-time video from a UAS shows a person of interest suffering from disease symptoms.
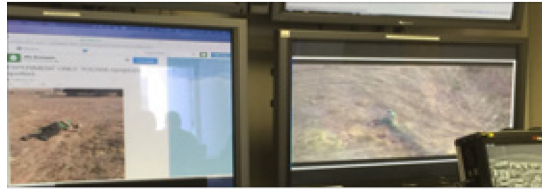

Fig 2. Simulated information report from social media (left) and confirming footage from a UAS (right).

3.2.2. Scenario Conclusion

The integrated scenario experiment was deemed successful in that the incident command center was able to meet the goal of identifying the person of interest from earlier social media reports in conjunction with field personnel using mobile communications apps and unmanned aerial systems.

4. Conclusions & Future Work

The goal of this type of experimentation is foster the understanding of how and what technologies may collaborate to provide increased and better functionality during specific types of events, such as humanitarian crises. To generally enhance the ability to conduct situational awareness field experimentation, the following list of experimental design ideas are being considered for future events.

1. Incorporate a set of situational awareness-specific questions into the experiment proposal process to understand early on the breadth of capabilities for potential situational awareness experiments.
2. Engage in a structured round of pre-experimentation collaboration formation before arriving at JIFX.
3. Require experimenters to designate themself or, a team member who will be present, as a technical point-of-contact who will be attending the event and potentially developing and integrating with other groups.
4. Develop a workflow / collaboration process document experimenters can use as they engage in collaboration and chart their progress.

While social media situational awareness experimentation at JIFX is a relatively young and evolving experiment track, it is already bringing together situational awareness researchers, technologists, and stakeholders towards the creation of new sociotechnical systems that will productively shape how societies respond to disasters, disease outbreak, and humanitarian affairs towards saving lives.

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