Chapter 5

Seeking an Online Social Media Radar

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ABSTRACT

In this paper we identify a method, which rapidly analyzes vast amounts of data present in social media in order to forecast crowd sizes. Based upon comparative analysis of related literature, a conceptual model is proposed and research conducted to develop capabilities to forecast mass collective action behavior such as crowd formation using Social Network Analysis (SNA) tools applied to online social media. We demonstrate that a simple model of online social network parameters can produce situation awareness of crowd sizes in much the same way that radar sensors can produce situation awareness of air traffic density. A prototype online social media ‘radar’ sensor system is developed and tested in a pilot study with a dataset of tweets gathered regarding the Occupy Wall Street movement. Further work is suggested which could provide anticipated crowd location, movement and intent in addition to size.

INTRODUCTION

Studies have shown that effects of mass collective actions such as diffusion of information across a network, network traffic bandwidth consumption, movie ticket purchases stock prices and Academy Awards winners can all be predicted by leveraging social network analysis tools to evaluate online social media (Asur & Huberman, 2010; Bothos, Apostolou, & Mentzas, 2010; De Choudhury, Sundaram, John, & Seligmann, 2010; Gloor, Krauss, Nann, Fischbach, & Schoder, 2009; Vashist, Mau, Poylisher, Chadha, & Gosh, 2011). With threats from non-state, terrorist organizations on the rise, analysis of online social network media may be a factor in providing an accurate early warning system. The Secretary of De-
fense (2011) recognizes recent research advancements made in the analysis of sociocultural behavior and recommends work to develop a “social radar” using multiple technologies to sense changing trends and forecast collective perceptions and actions (Costa & Boiney, 2012). Such a tool would require integration of multiple modalities to support prediction of population attitudes, sentiments and ultimately behaviors using multiple sources of information including online social media (Maybury, 2010). For the purposes of this study, we initially define our prototype ‘online social media radar’ as a software tool, which uses correlation of data gathered from online social media to sense and forecast sizes of crowd formations. Further development and extension of this prototype, combined with other prototypes under development could meet the needs identified by the Department of Defense (Costa & Boiney, 2012). We survey the trade space of applicable theories and techniques, identify alternative solutions and evaluate the alternatives using a pilot study dataset.

APPROACH

In the course of our investigation of the predictive capability of online social network media we elicit and refine high-level mission needs and user requirements for a radar-like sensor system, which scans social media instead of the skies. Next, we explore the trade space of innovative social networking analysis tools using the sensor system requirements as criteria. Using the trade study results, we identify alternatives for use in our prototype. Then we incorporate candidate approaches in a conceptual prototype model. Using empirical data, we test the approaches for validity in a candidate evaluation. We analyze the test data and report the results obtained from the prototype online social media radar. Finally we validate the results of the analysis for conformance to the high-level sensor system requirements.

BACKGROUND: SENSOR SYSTEM REQUIREMENTS

If the sensor to be evaluated were a new radar system, requirements might include a set of statements such as ‘the radar beam shall sweep through 360 degrees of airspace. One complete rotation of the beam shall be accomplished in no more than 5 seconds. Positional error of radar plots shall be no greater than 20%.’ For an online social media ‘radar’ system, we derive a high-level set of generic system requirements shown in Table 1 (for the purposes of prototype development, this is not an exhaustive set of all possible system requirements) from published very high-level electronic radar system specifications (Lockheed Martin, 2010; Thales Raytheon Systems, 2011; Wolff, 2009). First we need to define ‘online social media radar’. Maybury (2010) defines a ‘social radar’ as a tool that “needs to sense perceptions, attitudes, beliefs and behaviors” and that it would use signatures “and correlation to sense, if not forecast, a broad spectrum of phenomena” including changing trends in population behaviors. For the purposes of this study, we initially define our prototype ‘online social media radar’ as a software tool, which uses correlation of data gathered from online social media to sense and forecast sizes of crowd formations.

Our first requirement parallels the basic operation of a radar system, which is to report the position and altitude of detected radar reflections in near-real time (Lockheed Martin, 2010). The positions of radar reflections are raw data points in a radar system. For our online social media radar system, we derive our first requirement: The sensor system shall report raw social network parameter data points from online social media channels in near-real time. This derived requirement is consistent with the