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A Survey of Human-Sensing Methods for Detecting Presence and Identity

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ABSTRACT

The appearance of online social Networks (OSNs) matched with the universal multiplication of cell phones have empowered social sensing frameworks. Over the most recent couple of years, the inclination of humans to immediately gather and auspicious offer setting data has been misused for emergency detection and crisis management. Aside from event-particular highlights, these frameworks share specialized methodologies and structural answers for address the issues with catching, separating and extricating important data from data presented on OSNs by systems of human sensors. This paper proposes a reasonable and building structure for the outline of emergency detection frameworks in light of the "human as a sensor" (HaaS) worldview. A metaphysics for the HaaS worldview with regards to emergency detection is characterized. At that point, a measured engineering, autonomous of a particular emergency compose, is planned. The proposed engineering is shown by an actualized application for identifying seismic tremors by means of Twitter. Approval and test comes about in light of messages posted amid seismic tremors happened in Italy are accounted for.

Keywords: Twitter, Social sensing, Social media mining, Event detection, Crisis informatics, Emergency management

I. INTRODUCTION

Established public safety systems are based on centralized emergency detection approaches, often relying on expensive infrastructures of physical sensors which may not be available everywhere. The proliferation of handheld devices, equipped with a large number of sensors and communication capabilities, can significantly extend, or possibly substitute, conventional sensing by enabling the collection of data through networks of humans. Novel paradigms such as crowd-, urban- or citizen-sensing have been coined to describe how information can be sourced from the average individual in a coordinated way. Data gathering can be either participatory or opportunistic, depending on whether the user intentionally contributes to the acquisition campaign (possibly receiving an incentive), or she simply acts as the bearer of a sensing device from which data is transparently collected by some situation-aware system (Sheth 2009; Kapadia et al. 2009; Cimino et al. 2012).

In this scenario, the advent of online social network (OSN) platforms, such as Twitter, Weibo and Instagram, that have grown bigger becoming a primary hub for public expression and interaction, has added facilities for ubiquitous and real-time data-sharing(Demirbas et al. 2010). These unprecedented sensing and sharing opportunities have enabled situations where individuals not only play the role of sensor operators, but also act as data sources themselves. In fact, humans have a great aptitude in processing and filtering observations from their surroundings and, with communication facilities at hand, in readily sharing the information they collect (Srivastava et al. 2012). This spontaneous behavior has driven a new challenging research field, called "social sensing" (Aggarwal and Abdelzaher 2013), investigating how human-sourced data, modeled by the "human as a sensor" (HaaS) paradigm (Wang et al. 2014), can be gathered and used to gain situational awareness and to nowcast events (Lampos and Cristianini 2012) in different domains such as health, transportation, energy, social and political crisis, and even warfare. Among the advantages of social sensing is the natural tendency of OSN users to promptly convey information about the context (Liang et al. 2013; Cresci et al. 2015b) and that those proactively posted messages, especially when witnessing emergency situations, are likely to be free of pressure or influence (Zhou et al. 2012). The utmost case is Twitter, where users are encouraged to make their messages (tweets) publicly available by default and where, due to the 140 characters length limitation, they are forced to share more topic-specific content.

Given this picture, it is not surprising that OSNs, and Twitter in particular, have drawn the attention of designers of decision support systems for emergency management, and that during recent disasters, such as the Tōhoku earthquake and tsunami (Japan—2011), the Hurricane Sandy (Central and North America—2012) and the Himalayan earthquake (Nepal—2015), civil protection agencies turned to the Web and to OSN data to help tracking stricken locations, assessing the damage and coordinating the rescue efforts. Based on the observation that an unfolding emergency is likely to give rise to a burst of alerting messages, which may be used to early detect the event, followed by more reflective messages, whose content may be used to understand its consequences, several systems have focused on the collection and analysis of messages shared in areas affected by disasters (Hughes and Palen 2009; Bagrow et al. 2011; Adam et al. 2012; Gao et al. 2014; Avvenuti et al. 2014a. However, such information is often unstructured, heterogeneous and fragmented over a large number of messages in such a way that it cannot be directly used. It is therefore mandatory to turn that messy data into a number of clear and concise messages for emergency responders (Cresci et al. 2015b). Challenging issues highlighted and faced by pioneer systems include the real-time acquisition of unstructured data not specifically targeted to the system (data is often free text without structure or codified semantics) (Goolsby 2010), the extraction of critical data overwhelmed by high flood of meaningless babbles, the identification of the most stricken areas in the aftermath of an emergency (Cresci et al. 2015c; Sakai and Tamura 2015), security and privacy issues including the lack of guarantee that human sensors correctly deliver information about specific facts at specific times (Rosi et al. 2011). Despite these common findings, an analysis of the state-of-the-art in the field of social sensing-based emergency management systems highlights a multitude of domain-specific, unstructured and heterogeneous solutions. In fact, in the literature the design of monolithic and vertical ad-hoc solutions still prevails over architectural approaches addressing modularity, generality and flexibility (Imran et al. 2015). This paper presents a framework for detecting emergent crisis events using humans as sensors. According to the framework, different emergency types (e.g., seismic, hydrological, meteorological) can be detected by configuring a software architecture, where re-usable components can adapt to different contents and patterns of messages posted to the OSN while the event unfolds. The contribution of the paper is both conceptual and practical. To the purpose of deepening and sharing the understanding of the properties and relationships of data provided by human sensors, we have defined a terminology and an ontology for the HaaS paradigm in the context of emergency detection. From the practical point of view, we have designed a domain-independent, architectural and modular framework that encompasses the vast majority of systems proposed to date. The effectiveness of the proposed architecture in solving common problems, such as data capturing, data filtering and emergency event detection, has been demonstrated by a proof-of-concept implementation involving earthquake detection via Twitter. The application has been validated using datasets of tweets collected during earthquakes occurred in Italy.

II. RELATED WORK

In this segment, we layout the most pertinent works in the field, examining the primary contrasts with our approach and the principle likenesses, keeping in mind the end goal to bring up the works that motivated our compositional model. Therefore, this area substantiates our approach under the more broad umbrella of the HaaS worldview for emergency management. A few activities, both in logical and in application conditions, have been produced over the most recent couple of years with the point of abusing data accessible on social media amid crises. Works proposed in the writing either depict working frameworks utilizing answers for a portion of the essential difficulties of emergency management, or spotlight on a solitary particular test and altogether ponder it. The frameworks studied in this area exhibit diverse degrees of development. Some have been sent and tried, all things considered, situations, while others stay a work in progress (Imran et al. 2015). By far most of these frameworks share objectives or functionalities with the structure we are proposing and can be mapped, absolutely or to some degree, on the design in this manner characterized. Among the proposed frameworks some methodologies are custom-made to suit prerequisites of a particular sort of emergency and are along these lines area particular. Generally, a significant number of the overviewed works show weaknesses with respect to their reusability. The works introduced in Bartoli et al. (2015) and Foresti et al. (2015) portray novel emergency management stages for savvy public safety and situational mindfulness.

The proposed arrangements abuse both remote sensor systems and social media to help leaders amid emergencies. In Bartoli et al. (2015) an abnormal state structure is proposed which incorporates subsystems intended for the procurement and the investigation of heterogeneous data. The subsystems chipping away at social media data play out the data obtaining and data examination assignments and can be straightforwardly mapped to the relating segments of our design. In this system data obtaining from social media has a negligible effect since it is enacted simply after the detection of an emergency.

In this way Bartoli et al. (2015) just imperceptibly manages the difficulties identified with the procurement and treatment of a major stream of social media data. A case of an application situation for the framework is additionally proposed for hydrological dangers, for example, surges and avalanches. The ASyEM framework (Foresti et al. 2015) centers around data procurement and data combination. Creators present a disconnected strategy for the extraction of emergency-particular terms which are in this way utilized by the online framework to assemble applicable messages from social media sources. The detection of an emergency is performed by methods for a neural tree arrange beforehand prepared amid the disconnected stage. Both Bartoli et al. (2015) and Foresti et al. (2015) do not have a data separating part. Correspondingly to Foresti et al. (2015), the work examined in Salfinger et al. (2015) utilizes data combination strategies in a framework intended to increment situational mindfulness amid crises. Creators propose an abnormal state engineering for a versatile structure misusing both customarily detected data and additionally social media data. Among the different sorts of crises, seismic events are those which have been researched the most over the most recent couple of years. Tremor emergency management is a subject worth concentrate not just for the huge danger seismic events posture on groups and frameworks. The nitty gritty quake portrayal realistic from seismographic systems can be abused as a pattern for novel social media-based emergency management frameworks and utilized to accomplish better outcomes as far as responsiveness and situational mindfulness. The openings conceded by the use of the HaaS worldview to seismic tremor detection and reaction have been right off the bat imagined in works, for example, Earle (2010), Allen (2012), and Crooks et al. (2013).

The examination depicted in Sakaki et al. (2010, 2013) is one among the main works proposing procedures for emergency management in light of social media data. Creators examine the plan and improvement of a social ready detection and tremor detailing framework. The detection of an event is performed by methods for a bayesian factual model. Creators completed tests to evaluate the nature of the detections and their responsiveness. Detection comes about are assessed just by methods for the Recall metric (proportion of effectively identified seismic tremors among the aggregate happened quakes) and the framework could opportune distinguish 67.9 % (53 out of 78) of the seismic tremors with JMA (Japan Meteorological Agency) scale at least 2 which happened more than 2 months. It is important that the JMA scale can't be specifically mapped into the around the world embraced Richter size scale utilized as a part of Table 1 to assess our system1. The approach proposed in Sakaki et al. (2010, 2013) is tried on the two seismic tremors and tornadoes and the accomplished outcomes appear to be persuading towards the work of this answer for other substantial scale crises also. Be that as it may, the work just spotlights on the event detection assignment, without managing the meaning of a full working framework. Additionally, data obtaining is performed by methods for the Twitter Search API2 which gets to just a segment of the measure of tweets delivered. While this restriction can be immaterial for vast scale events, it can hinder the framework's capacity to distinguish events felt by few social sensors, hence constraining the reusability of this framework for little scale crises, for example, landslips, congested roads, auto collisions, and so forth.

US Geological Survey (USGS) endeavors towards the advancement of a quake detection framework construct exclusively in light of Twitter data are portrayed in Earle et al. 2012). The arrangement is assessed with various settings as indicated by the affectability of the event detection module. In any case, even in its best design, the framework could just identify 48 comprehensively conveyed quakes out of the 5175 seismic tremors happened amid a similar time window. Additionally this framework obtains data through the Twitter Search API, in this manner experiencing similar constraints portrayed previously. Essential data separating concerns are considered and significant messages are chosen with a heuristic approach. Event detection is performed by a STA/LTA (here and now normal/long haul normal) calculation. Despite the fact that speaking to an intriguing show of the likelihood to perform emergency event detection by means of social media, this framework has a couple of deficiencies which seriously restrain its exhibitions. The more profound level of examination bolstered in our proposed engineering and performed in our usage enable us to outflank USGS's framework.

By and large, we trust the primary explanations behind our better exhibitions lie in the appropriation of more complex separating methods (i.e. machine learning classifiers rather than heuristics) and an all the more effective event detection calculation (i.e. a burst detection calculation rather than a STA/LTA). USGS continued dealing with the venture and as of late reported the official work of a Twitter quake detection framework named TED (Tweet Earthquake Dispatch). As guaranteed by USGS, such detection framework demonstrated more responsive than those in light of seismographs in areas where the quantity of seismographic stations is low3,4. In Avvenuti et al. (2014a, b, 2015) is depicted the improvement of the Earthquake Alert and Report System (EARS). EARS is an ongoing stage intended for the detection and the appraisal of the results of seismic tremors from social media data. The proposed arrangement utilizes data mining and regular dialect preparing methods to improve situational mindfulness after seismic events. In spite of the fact that the proposed framework is space particular and utilized just in the field of tremor emergency management, the discourse in Avvenuti et al. (2014b) delivers issues normal to every social medium emergency management frameworks. Preparatory aftereffects of the works proposed in Sakaki et al. (2010, 2013); Earle et al. 2012) and Avvenuti et al. (2014a, b, 2015) are general empowering, particularly in connection to the responsiveness of the detections. In the present work we based on the key highlights of these frameworks with a specific end goal to outline an answer relevant to an expansive scope of crises.

Situational mindfulness amid crises is the objective of the work portrayed in Yin et al. (2012). The Emergency Situation Awareness (ESA) stage works over the Twitter stream by contrasting terms utilized as a part of late tweets and those of a standard. The pattern has been created in a disconnected stage and speaks to a factual model of the terms utilized amid a settled time window of a while. ESA raises cautions for each term which shows up in late tweets fundamentally more than in the pattern. The downside of this approach is that the gauge does not represent theme regularity. Also ESA does not perform data sifting neither utilizes watchwords for the data securing and in this way a significant number of the produced cautions are of little intrigue. ESA speaks to anyway one of the principal area autonomous ways to deal with the issue of emergency management from social media. The center of the general ESA stage has been later extended with impromptu channels and custom-made to perform event detection in the seismic tremors (Robinson et al. 2013) and out of control fires (Power et al. 2013) spaces. Different works have rather explored the abuse of social sensors for the detection of congested driving conditions (D'Andrea et al. 2015).

Group sourced crisis mapping from Twitter data is the objective of the frameworks proposed in Middleton et al. (2014), Cresci et al. (2015c). Crisis mapping worries with the catching, preparing and show of data amid a crisis with the objective of expanding situational mindfulness. Following an approach received in other already looked into works, these frameworks are made out of both disconnected and ongoing (on the web) subsystems. The disconnected subsystems ascertain benchmark measurements amid a verifiable period when no fiascos happened. Among the constant subsystems Middleton et al. (2014) likewise incorporates a data sifting part which, correspondingly to Earle et al. (2012), applies heuristic standards to choose significant tweets. Despite what might be expected, Cresci et al. (2015c) utilizes machine learning strategies to channel and break down data.

Ultimately, the examination in Imran et al. (2015) presents an overview on computational strategies for social media data handling amid crises and can be considered as a further reference for works in the fields of social media emergency management, crisis informatics and crisis mapping.

III. CORE CONCEPTS AND FUNCTIONALITIES

Our calculated system is expected to work in an expansive class of spaces. Therefore it ought to develop from an express formal detail of terms and of connections among them. Along these lines, specialists are bolstered with shared comprehension of their spaces of intrigue. A decent detail fills in as a premise to impart being developed, to ensure consistency, to limit misconstruing and missed data, to beat obstructions to the procurement of determinations, to reuse and break down area information, and to isolate it from operational learning. Among the appropriate formalisms, ontologies are organized vocabularies with meanings of essential ideas and relations among them. Ontologies have fascinating properties that can be formally checked, for example, culmination, accuracy, consistency, and unambiguity (Siegemund et al. 2011).

In this segment we present the phrasing of the "human as a sensor" (HaaS) worldview by means of a philosophy outline. In Fig. 1 base ideas are encased in dim ovals and associated by properties, spoke to by dark coordinated edges. The crucial property is on the right: Decision System recognizes Emergency. This property can't be straightforwardly detected (i.e., instantiated) by the framework, and is hence spoken to as a theoretical property, appeared by a spotted edge. Without a doubt the general choice framework is gone for in a roundabout way distinguishing crises by methods for a progression of data gave by sensors. As the framework ought to be adaptable as far as kinds of emergency, diverse particular crises have been considered. In figure, Seismic, Hydrological, Meteorological, and Terrorist are cases of specific ideas, appeared with white ovals and associated by white guided edges to the base idea.

A Decision System is claimed by a Public Safety Agency, and adventures both Artificial and Social Detection Systems. The previous is an ordinary framework in view of physical sensors: an Artificial

Detection System examines Observations, which are given by Artificial Sensors, i.e., a sort of particular Sensor. Another kind of specific sensor is human Sense, which is translated by Humans. Here, the idea Human goes about as a Sensor would then be able to be inferred as a particular human. Surely, both Human and Sensor are in the Territory, where Emergency happens and Effects of it are estimated by Sensors. Uniquely in contrast to a manufactured sensor, a Human as a Sensor can specifically see an emergency and claims a Terminal to convey Messages in an Online Social Network. Therefore, he can alarm by means of an Online Social Network. Area is a basic property of a terminal.

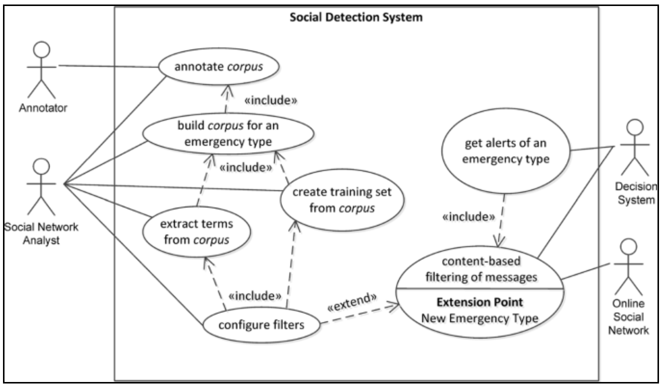

Figure 1. Use Cases of the Haas Paradigm for Emergency Management

Specific cases of Online Social Networks are Twitter, Weibo, and Instagram. With regards to online detection, a basic property of a message is the timestamp. Different properties are content-based and should be perceived as particular kinds: a Trusted Message, i.e., a message which isn't sent for malevolent, troublesome or harsh purposes (Mendoza et al. 2010; Castillo et al. 2011); a Primary Message, i.e., a message sent by a client who is really present at the alluded event and can specifically portray it (Kumar et al. 2013; Morstatter et al. 2014); an Emergency Message, i.e., a message detailing a genuine social emergency and not, for example, announcing an individual issue by means of a figure of speech made of emergency words (Avvenuti et al. 2014a). In the event that every one of these properties are accessible in a solitary message, that message can be viewed as a case of a further specific idea, the Ongoing Emergency Message, which is a message revealing a continuous emergency. Likewise, an Ongoing Emergency Message must have another property: being transiently near another message of a similar typology. Along these lines, the Social Detection System perceives various transiently close messages. Consequently, the detection of a real social emergency includes numerous messages, distinctively orchestrated in time contingent upon the kind of emergency.

Dealing with a Social Detection System requires connection between various outer specialists (individuals or frameworks), spoke to in Fig. 2 as UML utilize cases. Here, connecting operators are called performing artists and are spoken to by the "stick man" symbol, though functionalities accessible to on-screen characters are spoken to by an oval shape. An on-screen character can speak with the framework through a relationship to a usefulness, spoke to as a connection. Utilize cases have been identified with other utilize cases by the expand and incorporate connections, permitting to increase an utilization case and to determine a bit of the utilization case separately, individually. A relationship is spoken to as a dashed coordinated bolt, whose bearing means reliance.

All the more particularly, for a given emergency compose (e.g., seismic tremor, flooding, or their subtypes) the Decision System asks the Social Detection System (in the future called System for quickness) to be set up to get alarms of that emergency write. This usefulness incorporates the initiation of the substance based separating of messages, which is accountable for giving, among the messages caught from the Online Social Network on-screen character (e.g., Twitter), just those containing data identified with the unfurling emergency circumstance. We call this utilization case the online procedure. Emergency-particular learning of the substance of messages is hence important to broaden the System's ability in perceiving numerous emergency composes. Such an information can be removed from a message corpus, an extensive and organized arrangement of messages (electronically put away and handled), utilized for measurable examination and theory testing, checking events or approving separating inside a particular emergency write. Separated information can be encoded as: (1) terms that are every now and again contained in the objective messages, set up by means of measurable strategies; (2) highlights removed from a preparation set of target messages, built up through machine learning techniques; (3) parameters of accumulations of messages identified with a similar emergency event, set up by means of factual techniques. In this manner, when another emergency write must be dealt with, the substance based separating of messages usefulness must be beforehand stretched out with emergency-particular learning gave by the arrange channels usefulness. This procedure is overseen by the on-screen character in charge of the System's support and setup, the Social Network Analyst. Arranging channels incorporates making preparing sets and extricating terms from corpus. To fabricate a corpus incorporates to comment on corpus, as a team with various Annotators. We call the design channels utilize case the disconnected procedure.

IV. CONCLUSION

In this paper we have talked about how the HaaS worldview can be misused for emergency detection. Center ideas, real parts and functionalities have been determined to work in a wide class of crises. The outline of structural parts reusable for some sorts of events, and perhaps versatile regarding the distinctive qualities of each kind, has been nitty gritty. Conveyance of detection delays versus INGV notice deferrals and stage autonomous applied structure. Later on we anticipate tending to these issues by stretching out our secluded structure to incorporate segments performing investigations went for expanding situational mindfulness and equipped for giving early harm appraisals.

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