

CITY REPORTER FOR RESILIENT SMART CITIES: A CROWDMAPPING MOBILE PLATFORM OF URBAN ASSET PROBLEMS

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ABSTRACT :

The population living in urban areas with respect to rural areas is growing. Today the 54% of the world's population reside in urban areas, in 1950 only the 30% was living in cities and it is expected that the 66% will be urban by 2050. In this context a key challenge is promoting a strategy for sustainable urban development and climate change resilience in urban areas. This paper will show how social media can be used for enhancing the preparedness and resilience of people and communities against natural hazards. More in detail, we present a smart urban fault reporting web platform, which has been developed to help citizens in reporting common urban problems such as in general street faults, potholes or broken streetlights. But in this paper will deepen the use of this web platform for fostering the crowdmapping of urban weak points in the urban drainage system.

The main goal of this platform is mapping the location of less effective street gutters, which according to the season or because of the occurrence of other kind of hazards, they can be occasionally clogged and unable of collecting rainwater flowing along the street. We aim at filling this gap by designing an urban fault reporting and management platform for Smart Cities. Our platform overcomes the limits of existing platforms, e.g. FixMyStreet, by facilitating the integration between fault reporting and fault management. To this aim, we make extensive use of semantic web technologies. We developed a prototype application by implementing an urban fault reporting and management system that integrates an urban fault reporting service available to the citizen and a road maintenance management system for the Public Administration. The platform allows to experience the eGovernment digital environment developed within the PRISMA project, and is currently under demonstration in the town of Catania. This platform has been further enhanced within the CLARA project in order to face the issues related with natural hazards affecting an urban scenario. The effectiveness of such social platforms for fostering the participation of citizens in making their cities more resilient towards natural disaster will be finally discussed.

KEYWORDS:

social semantic platform, crowdmapping, natural hazards, urban floods

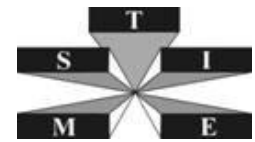
1. INTRODUCTION

Social media can play an important role in communicating with people before, during and after an emergency. The use of social media during an emergency has already been experienced in Italy during several events (earthquake of Aquila 2009 and Ferrara 2012), and in particular it has been experienced during local events, even of high intensity, as they are hydrogeological or industrial hazards. The main reason is the reliability and availability of mobile internet (3G, 4G) networks during local events, while during a large-scale event almost all kind of communication systems collapse, mobile internet included. The main advantages in using social media are the following:

- It is able to broadcast information to the public straight away
- It is a rich media, which is able to inform the public about the hazard and on how to react
- It is also able to rapidly balance false information, mitigating the impact of rumors
- It is a widely used and available technology
- It a two way media, it allows to find out a lot of information from the public

The first time the Civil Protection of Sicilian Region experienced the usefulness of social media was just after the flood of the town of Trapani in the west cost of Sicily in 2009. During this event 150 mm of rain fell down in only 3:20 hours, causing several urban flash flood in the town of Trapani and its countryside. The post event analysis of flood damages had been performed leveraging the videos captured by affected people during and after the storm with their mobile phones and which have been posted to you tube (Basile, 2009).

Recently also the National Institute of Geophysics and Volcanology (INGV) has deepen the use of Social media



for both getting information from people and alerting/informing them. INGV in the Italian civil protection framework has the responsibility of alerting people for both seismic and volcanic risks. In the following section has been reported their experience in informing people on earthquakes through social media (Amato, 2014).

2. THE INGV EXPERIENCE IN LEVERAGING SOCIAL MEDIA

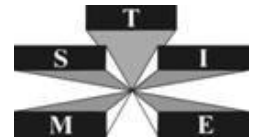
The 11th of May 2011 INGV has felt for the first time the need of having an institutional social media account. That day a false information about a next terrible earthquake in Rome had been broadcasted through internet, social media, radio and TV, which had panicked many people. In that case INGV had to reply to the false rumours by forwarding the voice of the seismic Italian Authority through social media. In particular, INGV posted several information video on you tube, and today those video have been visiting more than 400.000 times. Today the INGV twitter account has more than 100.000 followers, and this channel is used in both the ways, for keeping people informed and for getting information from people. Just after an earthquake people uses to tweet something about their traumatic experience, and those tweet are also GeoReferred, and those tweets can be displayed in a map showing the extent to which people sensed the earthquake. In other words, through twitter, people can be used as human sensors. Tweets spread very fast in the first 5 minutes after the earthquake, and unfortunately, INGV is able to release its first official communication about it after 20-30 minutes from the event. In order to avoid the spreading of false information there is the need of increase the capability of informing correctly people about the seismic event since the first moment after the event. A threshold of 5 minutes after the event has been set. INGV is trying to reach this goal by increasing the effectiveness of automatic analysis of sensed seismic waves. In conclusion it is valuable the INGV's experience with social media, which must be taken into consideration not only for their effectiveness and their performance for informing people but because they are already widely used by people, and that's it. INGV has experienced the fact that since few minutes after a significant earthquake, rumors and false information spread on twitter, and that information must suddenly contrasted by scientific and distinguish ones, which are made available on the same social platforms. Furthermore, it is valuable that these participative communication platforms can be used in both directions, for informing people and for keeping informed by people, which can be used as human sensors. What should be deepen in the next future is the real time content analysis of tweets. The sentiment analysis of people, while they are sharing information about a hazard, can be used to estimate, since from the first minutes after the event, the impact of the hazard. The sentiment analysis can be also used to adapt the messages in order to induce correct behaviors in the population during and after an emergency.

3. CITY REPORTER: THE URBAN FAULT REPORTING PLATFORM FOR SMART CITIES

PRISMA is an open cloud platform for supporting Smart Cities. It has been developed by a pool of Italian Universities, Research Centers and IT Companies, under the National Operational Program for Research and Competitiveness 2007-2013. PRISMA platform has been used to develop several vertical applications to demonstrate its capability in enhancing municipal e-services. City Reporter is one of these applications (Consoli et al., 2015). It aims to support the local public administration on managing the fixing of urban faults, such as potholes, garbage to be collected, street light out of order, graffiti and others. City reporter is a participative (social) platform which involve both citizens and public administration officers, which are the main actors behind the management of urban assets. City reporter main architecture can be broken down in the following components:

- A back office module, which has been designed following the principles of Business Process Management (BPM), and which aims to monitor step by step the development of the fixing process.
- A front office module, which has been implemented as a web application, and which allows the fault reporting and through which it is possible to receive feedbacks about the fixing process.

The back office module is a management system allowing municipal officers to validate fault reports and to forward them to the responsible management departments for being fixed. On the front side of City reporter, each citizen is allowed to post an alert about any urban asset's fault to be fixed. The citizen may provide the address of the fault, provide its geolocation coordinate, and provide some notes and a maximum of three images. In addition, he may also specify the fault type. Through the same web application, each citizen can get feedbacks about the status of his records (e.g.: "opened", "ongoing", "fixed"). Once a new asset's fault has been reported, the back office module allows to accept or refuse it; if it is accepted it is also validated and recorded with an unique identifier. The validation step consists to verify the completeness and validity of data given as



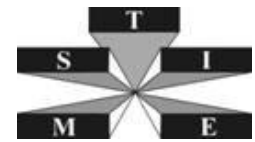
input. The record about the asset's fault is then forwarded to the maintenance department to be fixed. If City reporter administrator recognize that several records concern the same asset's fault, he can link all of them each other and he can process them as a single record. The record is then processed and closed either successfully, in case it has been fixed, or not in case the maintenance task has been not performed. The following figures show some screenshots of City reporter front end:



Figure 1 City reporter main page trough which a citizen may record an asset's fault



Figure 2 City reporter asset's fault record summary page



Catania SmartCity
 CityReporter

 mytowncittadino ▼
Nuova Segnalazione

Posizione Segnalazione

Dettagli segnalazione

Oggetto	buca in centro carreggiata
Nota	
Stato	in lavorazione
Indirizzo	Viale Africa,31,Catania,CT,Italia
Tipologia	Buche stradali
Data/Ora	14 Luglio 2015 16:39
Data Chiusura	
Immagini	

Figure 3 City reporter summary page of records

4. CITY REPORTER FOR URBAN FLOODING PREVENTION

Both flash floods and debris flows are an important problem in most of the Mediterranean catchments resulting from severe thunderstorm typical of these regions. High intensity short duration rainfall events can cause extreme flash flood conditions resulting in loss of life, property damage and expensive emergency response. It is also well known that debris flows are triggered by short intense storms and constitute a major threat for several urban settlements located on the hillslopes of mountain catchments and for other infrastructures such as highways and motorways. Urban flooding is also expected to impact more often in Europe and in particular in the Mediterranean area, and main pressure factors are:

- climate changes
- growing urbanization
- ageing of drainage infrastructure

The consequence is that people should accept that flooding in the urban area is normal. This means that runoff should be managed on the surface (roads), and during a heavy rain the excess water would be directed from roofs, roads and paving to low value areas, safeguarding houses and critical infrastructures. But in this case frequent short term flooding has of course a relevant impact on the economic and social structure of urban life, and it isn't well investigated the degree of bearableness (in both economic and social terms) of this kind of events. In the following pictures two different flood effects are shown.



Figure 4 Comparison between minor e major urban flood

The first picture could be classified as an irritating situation, with a moderate impact on urban mobility (the footbridge is a sign of flood habit). The second one could be instead classified as a danger situation in which both the water speed and its depth might be risky for life. In particular water speed is a risk factor too often

neglected, because of expensiveness of flow gauging in an urban environment. But although it is well known what are the best practices to be followed for increasing the resilience of our towns to urban flood, as they are for example the installation of green roof, permeable pavement and rain garden, they can't be easily implemented in highly urbanized regions because the expensiveness of their retrofitting. In these already highly urbanized regions the first chance for mitigating the impact of stormwater runoff is enhancing the management of already existing drainage infrastructures. Street curbs and gutters (inlets) are the main components for controlling street runoff, they are widely distributed in urban areas but their effectiveness in intercepting water runoff depends from the hydraulic local condition and from the degree of maintenance of each of them (Figure 5).



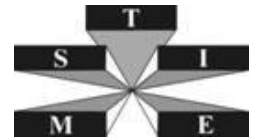
Figure 5 Street gutter cleaning affect their effectiveness

But street gutters' capability of intercepting the water runoff does not decrease over the time with the same speed for all of them. Many local factors contribute to speed up the obstruction process of street gutters, one of them is the local speed of the shallow water flow and another is the amount of debris delivered by the water runoff. Sometimes other kind of hazards can impact the conveyance capability of the urban drainage network, and this is the case for example of the ash eruption (Figure 5).



Figure 5 Impact of Mount Etna ash eruption on urban resilience to flood (BlogSicilia)

Because is in general too expensive to run at least yearly a cleaning process of all the street gutters, the main problem to overcome is to find the easiest and cheapest way to run before any rain season a gutters survey to find out which one actually need to be cleaned. In order to cope with this problem we are deepen how to leverage the involvement of citizens to perform this task. More in detail we aims to leverage people daily observations to find out where are the gutters to be cleaned. A crowdmapping platform is the solution we will use, but because this task should be performed periodically, we need to a software tool which is able also to stimulate people's participation. An expected side effect should be the enhancing of people's knowledge about urban water runoff management and their preparedness to cope with urban flood. The previously described City Reporter s the social platform we will use for the street gutters' crowdmapping. The main advantage of City



Reporter is its get feedback feature, which allows you to share your observations about the urban drainage system effectiveness (e.g.: obstructed or misplaced street gutters) and to get feedback from the local authority about which one has been planned to be cleaned or moved and so on. Each step of this process of fault reporting and fixing is monitored by City Reporter and the related record can be anonymized, aggregated and published as open data. The resulting open data can be used to find out which urban area is more flood prone, and where the citizens are more actively interested and involved in such a kind of problem and where they are less responsive. An extended field test of City Reporter while used for the street gutters crowdmapping will be performed at the municipality of Catania, and the field test will start the next September 2015.

4. CONCLUSION AND ACKNOWLEDGEMENTS

In this paper we have described how leverage social platform to improve people preparedness and resilience to hazards. We have then described how we will use an already developed social platform, which has been implemented within the PRISMA project framework for reporting urban asset fault. This platform will be used for experiencing the active involvement of citizens in the management of the urban drainage system. In more detail it is expected that through this platform, which is named City Reporter, we will record a wide participation of people in the process of crowdmapping of street gutter's location and of its working condition. The use of City Reporter will be experienced by the municipality of Catania.

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