# A platform to integrate crowdsourced, physical sensor and official geographic information to assist authorities in emergency response

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**Abstract**

In this work, a prototype GIS-based platform to integrate Volunteered Geographic Information from various sources with other spatial data is presented, aiming at assisting civil protection authorities in emergency response situations. The platform is now in the implementation phase, and this paper covers some aspects about its development and preliminary results to demonstrate the potentialities of the approach proposed.

*Keywords*: Volunteered Geographic Information (VGI), disaster management, civil protection, GIS, social networks.

## 1 Introduction

In the event of extreme disasters, such as floods, earthquakes or wild/urban fires, rapid security plans and mitigation actions are necessary. Relevant information about a disaster or accident are the geospatial location, the environmental conditions surrounding the area and the risks associated to areas or infrastructures that may crowd large numbers of people.

With the above in mind, the goal of this work in progress is to provide both human and physical sensor data through a GIS-based platform, along with official geographic information (GI) sources, where authorities can search for information related to ongoing or past disaster events. This information will be obtained from various sources, including vector maps created by citizens, data from social networks extracted using their respective API's (Application Programming Interface), data collected by physical sensors and added to the platform in real time, or official data. The platform will incorporate not only tools to extract data, but also for preliminary automated validation, processing, and visualization.

## 2 Platform Design

### 2.1 Sources of VGI

The platform proposed in this work for geospatial data acquisition and processing will gather and integrate information from various sources of VGI, with different data types and collected using different protocols.

For this application, at least the following information has to be extracted from VGI sources:

- Location data: explicit (coordinates) or implicit (e.g. text regarding a city name, a region, or a street);
- Data about events or contextual data: these may be photographs, text (tags, photographs names, etc.) indicating relevant features, such as places where many people are likely to be found (e.g. restaurants or bars), or people with mobility restrictions (schools or hospitals), locations with inflammable material (e.g. petrol stations), etc.

Another important factor is the amount of data available. Therefore, the choice of the crowdsourced projects to be used considers the number of users, i.e the ones that potentially can provide more data.

In this work, the following sources of VGI are considered:

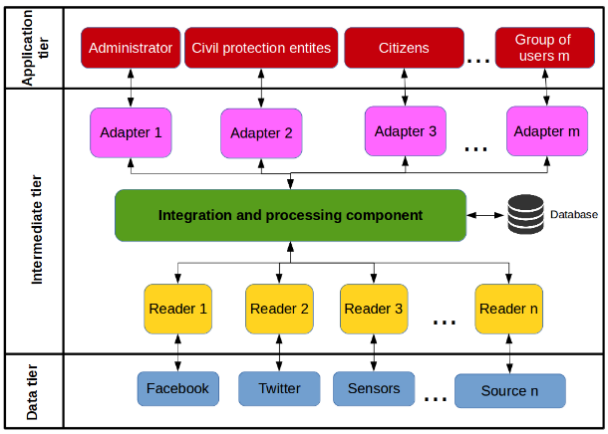
- Facebook (photographs, videos and text);
- Twitter (photographs, videos and text);
- Instagram (photographs and videos);
- Flickr (photographs);
- YouTube (videos);
- OpenStreetMap (vector-based map).

The minimum requirements for uploading photographs, as well as information that may be optionally added, have been analysed by Antoniou et al. (2016). This analysis was extended to incorporate the other types of data of interest in this case, namely text and videos, and was undertake aiming at comparing the information available in each platform with the data required for the application at stake. It was concluded that geospatial location is not a minimum requirement for uploading any of the data types indicated. With that, to increase the amount of usable data, implicit geolocation data (geonames) can be searched through the analysis of text data and descriptions associated to photos and videos.

## 2.2 Platform architecture

The architecture is based on three tiers (Figure 1): the application tier, the intermediate tier and the data tier. The application tier is responsible for interacting with users to display information queried andperform data manipulation if needed. The data tier represents the services containing the data to be queried by the user. The intermediate tier embodies a set of readers and adapters establishing the communication with the other two tiers, and an integration component that incorporates tools to combine data from the different sources (Estima and Painho, 2016).

Figure 1: Platform architecture diagram.




Source: Adapted from Estima and Painho (2016).

# 3 Preliminary results

A prototype of the platform was implemented using Python as programming language. To illustrate the potential of the proposed system some results obtained with the Flickr API are presented. An automatic procedure was developed to contact Flickr API and extract data based on a keyword (optional), latitude and longitude (required), minimum and maximum taken date (optional), radius of search (required) and the total number of photos wanted in the results (optional). An example query was performed where the following parameters were used: keyword "flood", latitude and longitude of the city centre of Coimbra (in Portugal), a radius of search of five kilometres, and a maximum of 100 images. A point shapefile was created using the coordinates of the obtained photos (Figure 2), including the following attributes for each photo: "title of the photo", "taken date", and "URL of each photo".

Figure 2: Results from the query using Flickr API


Figure 3 shows four of the obtained photos. It can be observed that two of them (A and B) are directly related with floods, whereas the other two do not seem to have any relation to floods. This shows the need for additional analysis to filter irrelevant data.

Figure 3: Photos corresponding to the locations A, B, C and D indicated in Figure 2


## 4 Conclusions and future work

This work presents a platform, under development, to integrate VGI with data collected by physical sensors and official information to assist authorities in supporting their response to emergency events. Emphasis is given here to the use of VGI, in particular to data obtained from social networks, and the system architecture. An example is presented with the current version of the prototype using photographs extracted from the Flickr initiative. The results showed that potentially useful data may be obtained, but the need of additional automated validation and filtering processes is also evident, to extract only relevant data for this application.

## References

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