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A mobile application to engage citizens and volunteers. Crowdsourcing within natural hazard

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ABSTRACT

Responsibility in civil protection from central to local authorities is a changing pattern in natural hazard management. Prevention and preparedness are long-term goals, based on competence of trained volunteers and on awareness of the local citizens. MAppERS Project[1] (Mobile Application for Emergency Response and Support) involves people as crowd-sources rendering through mobile application design integrated to a dashboard. Testing and training courses for public citizens and volunteers of civil protection in two pilot study cases obtain feedback fundamental to raise participation in the disaster network response, towards modules, usability and quality of the product. A synchronized platform reveals advantages of cloud data architecture with a web dashboard. A first module of the application focuses on flood processes gathering real-time data from local population and contributes to personal awareness, while the second module tests pre-emergency actions on field with rescue crews, collecting details and priority of hazards.

KEY WORDS: Crowd-sourcing, Human-sensors, Mobile, Participation.

INTRODUCTION

Natural disasters are the consequences of violent events caused by geological phenomena (earthquakes, landslides, volcanic eruptions, lahars, avalanches), hydraulic phenomena (floods, flooding, tsunamis), climatic changes (desertification, fires, hurricanes, cyclones), correlated with an increasing frequency of human presence, which assumes both a triggering role and a vulnerable presence. The possible consequences affect the safety of the population, the welfare of services and activities in a particular territory. MAppERS Project (Mobile Applications for Emergency Response and Support) focuses on territorial knowledge, risk prevention and emergency technology within pilot areas. It deals with human role as *'territorial mappers'* (Bianchizza & Frigerio, 2015) through a mobile application, for gathering and dissemination of geolocation concerning management of natural hazard. The crowdsourcing is a network of *citizen scientists* at local scales, reducing costs for data acquisition (Fienen & Lowry, 2012). Users are members of "crowd" surveys, as innovative tactic in recent years, dedicated to rescue services and public authorities (Sievers, 2015; Nguyen et al., 2016). MAppERS engages mobile phone application (MA) as a tool of crisis support and resilience of exposed people, with modules MAppERS-C (MP-C) for citizens and MAppERS-V (MP-V) for volunteers, as first strategies of surveillance (Frigerio, 2015). Training and piloting are long-term goals of participation and the empowerment of the population decreases the complexity of emergency, while the training curricula promotes awareness with correct terminology. The usability of MA integrates a study on Graphical User Interface (GUI) as communication scheme based on review of similar solutions, suggests layout and setup (Graham et al., 2011).

APPROACH AND SERVICES

The MP-V and MP-C modules endorse geolocation information by mobile for self-awareness and contribute with hazard-relevant data toward field surveys of citizens and volunteers (Frigerio et al. 2016). *Frederikssund-Halsnæs Fire & Rescue Service* manages 372 km² in north Danish lands, frequently flooded by storms, requiring continuous vigilance by local population. The MP-C permits a proper training about safety measures and provides location-based service required by rescue service. The *Citizens Kit* improves in MP-C the people's awareness as long-term aim and provides real-time support on request within crisis. *Helsinki City Rescue Department* manages a multi-risk reality for the entire Finnish capitol city, with a primarily target of safety. The MP-V simplifies the resources and volunteers management, raising the efficiency of field surveys and setting criteria for a local-based priority of personnel. The *Volunteers Kit* supports in MP-V rescue crews during crisis in real-time for injures, damages and crashes. Crowdsourcing promotes decentralization and poses rapid data gathering without overlapping to emergency procedure.

The modules have wireframes within mobile technologies and dashboard to support rescue services and man-

1 European Commission, Directorate-General Humanitarian Aid And Civil Protection ECHO A- Strategy, Policy And International Co-Operation A/5-Civil Protection Policy, Prevention, Preparedness And Disaster Risk Reduction Civil Protection Financial Instrument - Preparedness And Prevention Projects.

age a bi-directional data transfer between users and rescue teams. The piloting experiences are fundamental for contents, guidelines, translations and bug-fixing. MP-C and MP-V offer a common screen to access slides and the system assumes automatically local languages during installation (tested with Danish and English during piloting). The MP-C embraces a tool for real-time inspect and personnel preparedness. Citizens include geolocation and information about vulnerable elements (e.g. family members, inhabitants, age range, and people with limited mobility). Furthermore, a real-time tool reports damages inside or outside buildings, detailing basements, supplies and people included. Citizens can mark water level (water height in cm), validated within a slide bar for photo check. A tool of long-term preparedness is active in MP-C, including a user-friendly kit of measures and supplied stuff for flood protection, organized and explained (e.g. flood boards, drain sealers) combined with measures to tick the proper kit lists. Each update of dataset appears in the personal profiles and visible in the dashboard (e.g. energy supply, medicine measures). The MP-V is a crowd tool for fast data gathering during crisis and managed by trained volunteers of rescue services. Users can integrate in real time a state of danger with a localized and visible source. The details of events (e.g. type of accident, material state), overlap facilities exposed (e.g. numbers and type of buildings, kind of surroundings, services damaged). Volunteers share position and reveal the life threats level or "peace time" during the field surveys, tracking in real-time the geolocation, which appears automatically classified by life threating level.

The pilot experience collected a first dataset during testing, where the module MP-C assembled measurements of water levels linked to damages, as consequences of simulated floods. Furthermore, a "personal flood plan" emerged homogeneous, comparing all contributions, because it offers a tool for long-term awareness therefore completed once and updated if required. The module MP-V gathered a copious and regular dataset as "quick danger" synchronized survey. The data crowd is suitable and user-friendly within crisis and a final choice "Other" available within most of slides was originally included to update lists with assistance of users. The feedback obtained during piloting enlarged data lists but the tool "Other" was maintained for periodic check on dashboard.

ARCHITECTURE

The MA architecture includes modules with services for data gathering, organizing and transferring to dashboard. Piloting participants provided a feedback essential for both modules, testing content aggregate, bug-fixing and optimization within Android environment.

The measurements within MA are in real time and based on a graphical user-friendly kit. The "Send" button updates MySQL DB tables, transferred on dashboard by PHP Web server. In Figure 1, as example, the centimetres of water level are transmitted and the water level chart (image URL to link photos) and a slide bar dynamically control the date range.

The dropdown menus are persistent and ordered by specific aims (select by long lists of text) and update dashboard data list. For slide "facilities at risk" as example, users can enlarge menu, check building involved or add a new type by "Other" button, controlled afterwards and updated in the list if not redundant or useless, as the rescue managers evaluates content and practicability (Fig. 2).

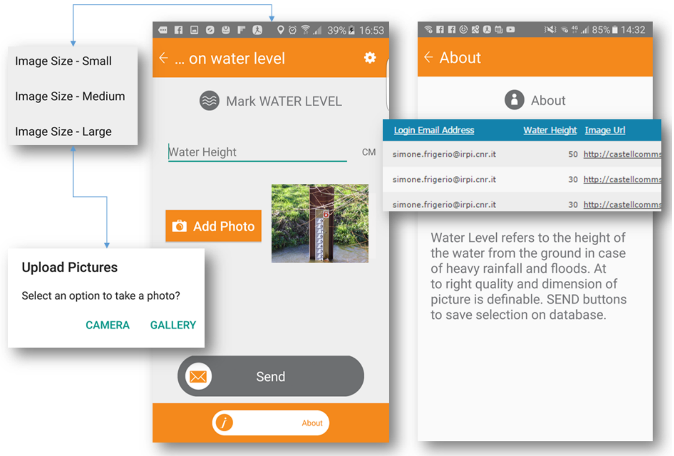

Fig. 1 - Slide for mark water and dashboard for data control.

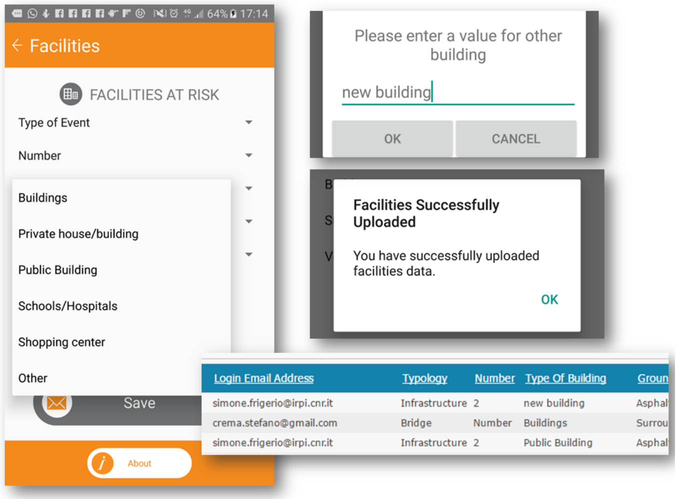

Fig. 2 - Crowd contribution for facilities types.

Users integrate spatial data with a real time survey as example of public involvement (See et al., 2016). As example, the rescue service requires details for safety during emergency. The public registry office furnishes the complete address list and jQuery service builds a location-based database by single users. The data are visible within dashboard and exportable to external QGIS project.

GPS with categorized dots is active for multi-users access, and clusters achieved are visible in the dashboard. In Fig. 3, the volunteers trigger geolocation and survey the threat of life. Each user on field marks "on-going" life threat if visible and a dot appears automatically green or red in "priority map" slide. The geo-tracking for each mobile is classified by status on field and visible within a common "crowd map". The ID codes of volunteers on field emerge within rescue squads, while details only in the dashboard for rescue teams.

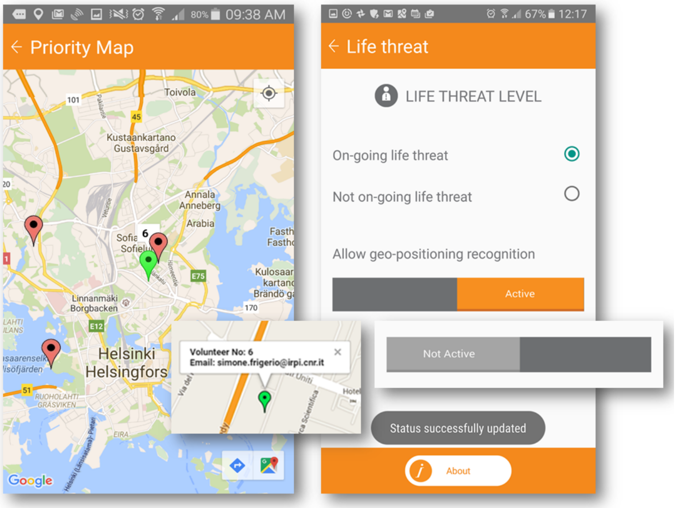

Fig. 3 - Classified map by mobile action (from Frigerio et al. 2016).

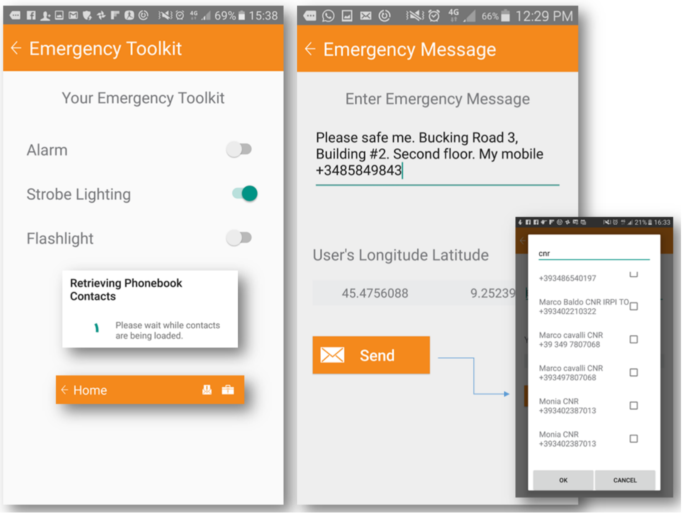

Fig. 4 - Toolkit for emergency messages.

Emergency messages with geolocation are previously prepared and request for safety (Fig. 4). Each profile saves or modifies a personal message, while the geographical coordinates dynamically depend on the user location. Retrieving the contact details of phonebook in Android loads a list by mobiles phones and not by profile, with customizable multiple list of contacts.

CONCLUSIONS

The MA technology provide a bi-directional data exchange for volunteers, citizens and rescue teams, while contents and usability are enriched with continuous updates during piloting. A vast research at world level showed examples of mobile applications to identify best solution of usability and efficiency of mobile slides. Automatic local languages, colour scheme for blindness, effectiveness of layout and shapes for icons are the criteria assumed.

Each single slide contains a "guideline" button, completed with the upgrade by crowdsourcing. Future follow-up should comprise the customization of the platform for task concerned natural hazards, remarkably related to new sensors, as low cost solutions for data gathering by crowd with the advantage of human sensors within real case studies.

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