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POSTER PAPERS

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Inclusive access to emergency services: An action research project focused on hearing impaired citizens

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Abstract. In case of emergency, hearing impaired people are not always able to access emergency services and, hence, they do not have equal access to social support and infrastructure. In this work we undertake the development and evaluation of a system aiming to meet the communication needs of hearing impaired citizens in cases of emergency. The system consists of (i) a mobile application that records and sends the details of an emergency event, and (ii) a central management system that handles these calls from the operation center at the emergency services. The system was completed in four cycles of design, development and evaluation with the involvement of 74 hearing impaired users and three officers from the Cyprus Police (Emergency Response Unit).

Keywords: emergency services; technology for hearing impaired people; inclusive citizen participation; inclusive design; action research

1 Introduction

In the European Union 9% of the total population, that is 44 million people, are deaf or hard of hearing [1]. In Cyprus, where this study was conducted, the number of deaf or hard of hearing people is currently approximated at 1000, according to official data from the Ministry of Labor Welfare and Social Insurance. The rights of people with disabilities are registered internationally by the UN Convention on the Rights of Persons with Disabilities and locally, by the constitution and laws of the Republic of Cyprus [2]. Unequal treatment is determined as the impossible or unreasonably difficult access to services and the failure to implement changes, such as the use of specific tools that would facilitate access to services for persons with disabilities. However, although the legislation guarantees the rights of people with disabilities, in practice the implementation of accessibility for all is limited, with an emphasis on physical access. In this work, we emphasize that the concept of access is not limited to physical access, but should also include access to services to all citizens including those with disabilities.

A few studies have focused on the obstacles faced by hearing impaired people when contacting emergency services. These studies have shown that they have significantly less recorded access to primary care and emergency services [6], which is largely due to infrastructure deficiencies [4]. According to the European Commission, the majority

of disabled people have no access to the EU emergency number 112, mainly due to weak infrastructure, equipment and procedures. Seven countries have implemented infrastructures for 112 in order to be accessible by people with hearing disabilities [1]. The solutions implemented to date vary. In some countries, specialized text phones are used and communication is made by exchanging messages, or in some cases, text is translated into voice through a relay service. Another solution implemented in France involves communication by sending a fax using preprinted sheets [1]. Some other solutions allow the exchange of SMS with the emergency services, but have the disadvantage of a possible delay in messaging as supported by Chiu et al. [3] and Meng et al. [5]. Considering that hearing impaired citizens are not always very proficient at using the written language and therefore their ability to use SMS as a communication tool in emergency situations is limited [1], some EU countries have used communication services with predefined SMS messages containing the event location using GPS [1]. As another option, specialized video relay services support the communication between a hearing impaired person and normal hearing person through an intermediate operator who translates from and to the sign language.

This study undertakes the development and evaluation of a system aiming to meet the communication needs of hearing impaired citizens in cases of emergency. The system consists of (i) a mobile application which records and sends the details of an emergency event, and (ii) a central management system that handles these calls from the end of the emergency services (https://youtu.be/28fGVy41dFY). The implementation was completed in four cycles, for the development of applications and the overall evaluation.

2 Methodology

The present study was completed in cycles of design, development and evaluation with the involvement of 74 hearing impaired users and three officers from the Cyprus Police (Emergency Response Unit). Data was collected in each cycle and findings lead to improvements of the system, which was subject to investigation in the next cycle, until all requirements were met in a total in four cycles.

2.1 Participants

The study involved a total of 74 participants, partially 35 men (47.3%), 61 deaf (82.4%) and 13 (17.6%) hard of hearing. Other participants were three officers from the Cyprus Police - Emergency Response Unit (CP-ERU).

2.2 Procedures

Cycle 1. This cycle involved face-to-face meetings with the deaf participants (N=74) where data was collected via questionnaires and focus groups. Also, data was collected via interviews with the three officers of CP-ERU. The data collected led us to the

identification of requirements, the preparation of the specification and design of a functional prototype of the system.

Cycle 2. This cycle involved a subgroup of 15 deaf participants with range of ages from 21 to 64. The prototype system was examined by each of them completing four scenarios, aiming to present any weaknesses or problems encountered. The scenarios included: (S1) There is an accident on the motorway (police call); (S2) There is a fainted boy (ambulance call); (S3) There is a fire in a rural area (fire call); (S4) You came home and you realize that it has been burgled and your mobile does not have GPS (police call without GPS). Evaluation data fed into the second version of the system that included all the changes proposed, both by users and CP-ERU officers.

Cycle 3. In this cycle a new subgroup of 20 deaf users (ages 24- 61) participated in the evaluation of the application using the same scenarios and data collection procedures as in cycle 2. Another meeting was also held with the CP-ERU officers. The final version of the system is presented in the next session.

Cycle 4. A final round of evaluation was conducted in cycle 4 with 36 deaf participants (ages 22 - 68) for whom the system was new. Five usability-type measures were gathered: (1) time for completing four scenarios (same scenarios used in cycles 2 and 3; (2) user errors; (3) errors repeated more than once; (4) number of unsuccessful attempts to reach the emergency services, (5) number of unsuccessful attempts to reach the emergency services. Moreover, the participants completed a usability questionnaire and qualitative data was collected via focus groups at the end of the experience. Last, three CP-ERU officers were observed using the system (responding to the 4 scenarios) from the end of the CP emergency services.

3 System

The system is composed of two parts. First, the system includes a mobile application for deaf users that collects the event data, creates an XML file containing the information and sends it to a specific address on the server. Second, the system includes a data management application at the end of the CP-ERU, recording events into a database (MySQL).

The mobile application was developed using android studio considering the large market share for Android OS. The main screen of the application contains three predefined function buttons for emergency calls: (1) police, (2) ambulance, (3) the fire department, using GPS for tracking the location of the incident. By pressing one of them the application creates an XML that contains all the elements of the event and sends to a specific address. A fourth button was added for emergency calls without GPS, in case the device does not have GPS or the user is located in a space where communication with satellites is not possible (Fig. 1). In this case, the application requires the "Message" field to be completed by the user to record his position.

The data management application makes use of JavaScript for retrieving and displaying data and PHP for XML management and data recording in the database. The application allows for incident data viewing and sending messages to the users. The application checks for new records (every 10 sec.) and displays the cumulative number of events, listed in three categories: all events, outstanding and resolved.

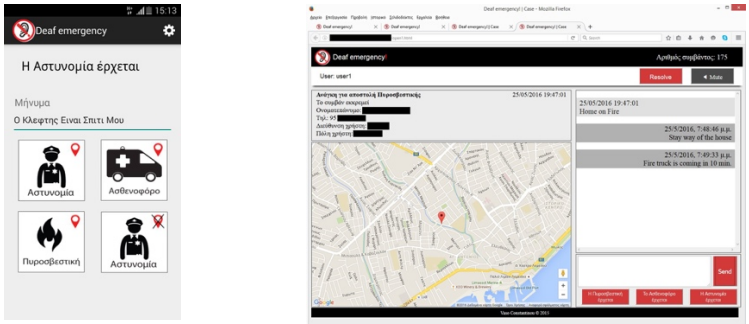

Fig. 1. Application screenshots: mobile application (left), data management application (right)

4 Analysis and Results

Results from the final round of evaluation demonstrated how the system can provide easy and direct access to emergency services, without the need of any intermediate, enabling the inclusion of these citizens in a critical process such as the response to an emergency. A detailed presentation of the results is beyond the scope of this demo paper and is presented elsewhere (please check research at http://cyprusinteractionlab.com/).

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