Cloud-mobile Assistive Technologies for People with Intellectual Impairments: A Microsoft Azure-based Solution

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ABSTRACT
A cloud-mobile platform under development in the framework of the SMART ANGEL project co-financed by the Italian Liguria Region is presented[1]. The platform is meant to address the needs of people with intellectual disabilities; it is oriented to support and enhance their autonomy and in particular their mobility in urban environments, and can be regarded as an innovative assistive technology. The platform is a concrete instance of how cutting-edge ICT technologies can act as assistive technologies to empower e-inclusion. The potential benefits for the final users (subjects with the Down syndrome and/or similar intellectual disabilities) are outlined as well as those for health professionals and care givers in charge of their assistance.

Categories and Subject Descriptors
K.4.2 [Computers and Society]: Social Issues - *Assistive technologies for persons with disabilities*

General Terms
Performance, Design, Experimentation, Human Factors, Standardization.

Keywords
Cloud computing; mobility; technology enhanced learning; serious games; rehabilitation; intellectual impairments; disability.

1. INTRODUCTION
According to the Disabled World website[2] the "intellectual disabilities", which include Down Syndrome (DS), Traumatic Brain Injury (TBI) and Dementia, together with some other types of impairment, affect in between one and three percent of the world population. Fortunately, more than 90% of this population[3], thanks to the constant and appropriate help of relatives, caregivers and dedicated health professionals, is able to reach some level of autonomous life and thus becomes socially engaged and active: they live on their own, have a job, attend courses, do some form of sport, etc. In order for them to achieve these objectives, the ability to move around town autonomously and safely is fundamental. Nevertheless, the process towards acquiring this ability is not straightforward, mainly because learning per se is a big issue for them and, in particular, they have specific problems in spatial orientation, an ability that is required to move around in urban streets. They also have difficulty in generalization (learning transfer), that is they lack the ability to apply acquired knowledge or skills in different situations or environments. This represents a key problem in all learning contexts, including mobility, where the issue is actually learning how to reach specific (although often well-known) places. Furthermore, individuals with intellectual disabilities tend to learn more slowly and need a lot of field practice. As a consequence, the basic abilities for moving around in urban contexts are traditionally reached after a long training under the guidance of educators. Actually, these people need a long training period, which has necessarily to be carried out with the constant presence of an educator. The SMART ANGEL project (briefly outlined below) aims to use cutting edge ICT, cloud and mobile technologies to support autonomous movements in town of people with mental disabilities. In doing so, it also aims at supporting, making easier and more effective the work of health professionals and caregivers; the final aim is to provide innovative tools allowing time saving, minimizing efforts and guaranteeing increased effectiveness of the training and monitoring actions. The use of cloud technologies is important, in particular due to the huge amount of generated data, needed to improve the system itself and to draw conclusions about each single user's attitudes and performance.

2. THE SMART ANGEL SUPPORT AND MONITORING SYSTEM
SMART ANGEL is oriented to support the inclusion [5] of people with intellectual disabilities in today's society by providing them with accessible software products [1] supporting their daily life, in-house independent living, urban mobility and training. The name SMART ANGEL, instantiates the overall philosophy and rationale behind the project: to offer assiduous

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[1] Project co- financed by Programma Attuativo Regionale 2007-2013 (PAR-FAS)

[2] http://www.disabled-world.com/disability/types/cognitive/

[3] http://www.healthyplace.com/neurodevelopmental-disorders/intellectual-disability/mild-moderate-severe-intellectual-disability-differences/

help and advice in a non-intrusive manner. It recalls the figure of a guardian angel who is at the person's side and provides him with help, if and when needed, without intervening invasively. In the framework of the project, the issue of supporting the urban mobility of intellectually impaired people was felt as key to promote and enhance their full autonomy. Thus, one of the main aims of the project was to enable them to move around in the urban context and reach relevant places (workplace, leisure, sports, home). This was done by relying on last-generation existing technologies.

Actually, the project foresees:

- A training phase in which the users' orientation and mobility skills are stimulated and trained by means of ad hoc developed Serious Games [2] [4], which make use of innovative virtual reality devices such as Oculus Rift [3]. Actually, three serious games have been developed, addressing some of the key skills necessary to create the conditions underpinning urban mobility. One game is oriented to the comprehension of the terms and the concepts of "right" and "left", with the overall goal of helping them to be able to understand and follow simple instructions while moving around town. The second is focused on street dangers: knowing, recognizing and avoiding dangerous situations is a key skill for autonomous mobility. The last one is aimed at exercising "perspective-taking" skills: the ability of identifying the position and the orientation of other people in the space and understanding that their perspective can be different from our own.
- A second phase in which the users start to move around in their town and get confident with places and public transports. Initially they are directly and closely supported and monitored by their educators. As the user's skills grow, the links with the educators get looser until they are allowed to move around in complete autonomy (at least along the established paths) by relying only on the help of mobile devices. Actually, this phase makes in-depth use of both cloud and mobile technologies.

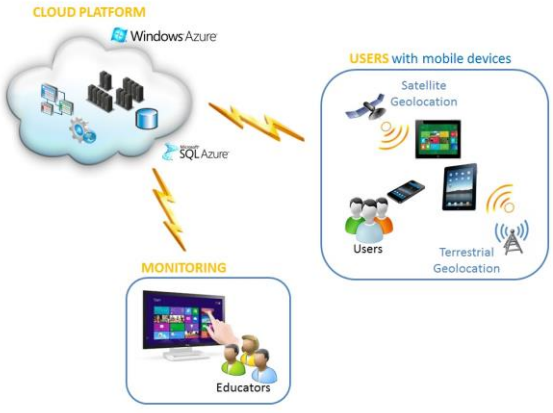

Figure 1. The SMART ANGEL system

Fig. 1 shows the main components of the Smart Angel cloud-based support and monitoring system. A central cloud based platform collects all the users' data and connects the other elements of the system. Each user has his own smartphone, equipped with specific apps, which allows him both to get appropriate support during daily standard activities and to move safely around town. A combination of satellite and ground localization systems is involved to trace the users' movements.

3. CONCLUSIVE REMARKS

Once the SMART ANGEL platform is ready to use, we expect that it may offer significant added value, with respect to the standard traditional approach, based on constant human presence and monitoring. This will be true both for the disabled people and for the health professionals and caregivers.

As to final users, we foresee that:

- They can do more activities and faster.
- Their sense of self-responsibility is increased, still being overall safety guaranteed; they are put in a situation of "supervised autonomy" where they can feel more like being fully independent from other people, although they are still constantly monitored and followed.
- They have an effective dedicated help-online always available in case of need such as exceptional events (e.g. strikes, change of standard paths for public transports, etc...)
- The may access help in areas other than pure mobility, since the system is able to manage also some other aspects (such as time schedule, agenda, reminders).

As to caregivers, we expect that:

- Adopting the system may result in significant time saving for them. The traditional approach, in fact, requires longer training actions and a long-term direct and individual assistance before allowing the user to move around in autonomy.
- Once the final user is definitely allowed to move around town independently, they can anyway remotely follow his/her movements, actual location, visited places, etc.
- Thanks to an accurate analysis of data gathered on final users' behaviour, they can better see the users' strong and weak points, so to enact appropriate remedial/supporting actions.
- Their interchangeability is fostered: one educator/professional can follow more than one user at the same time.
- Through the platform, they have access to a wealth of additional tools oriented preliminary to training and/or reinforcement activities.

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