Personalized Smart Environments to Increase Inclusion of People with Down's Syndrome

Juan Carlos Augusto[1], Terje Grimstad[2], Reiner Wichert[3], Eva Schulze[4], Andreas Braun[3], Gro Marit Rødevand[2], Vanda Ridley[5] *

[1] Middlesex University, School of Science and Technology, London, UK;
[2] Karde AS, Oslo, Norway;
[3] Fraunhofer Institut fr Graphische Datenverarbeitung, Darmstadt, Germany;
[4] Institut fur Sozialforschung, Berlin, Germany;
[5] Down's Syndrome Association, London, UK
j.augusto@mdx.ac.uk;terje.grimstad@karde.no;
reiner.wichert@igd.fraunhofer.de;e.schulze@bis-berlin.de;
andreas.braun@igd.fraunhofer.de;gro.marit.rodevand@karde.no;
vanda.ridley@downs-syndrome.org.uk

Abstract. Most people with Downs Syndrome (DS) experience low integration with society. Recent research and new opportunities for their integration in mainstream education and work provided numerous cases where levels of achievement exceeded the (limiting) expectations. This paper describes a project, POSEIDON, aiming at developing a technological infrastructure which can foster a growing number of services developed to support people with DS. People with DS have their own strengths, preferences and needs so POSEIDON will focus on using their strengths to provide support for their needs whilst allowing each individual to personalize the solution based on their preferences. This project is user-centred from its inception and will give all main stakeholders ample opportunities to shape the output of the project, which will ensure a final outcome which is of practical usefulness and interest to the intended users.

Key words: Down's Syndrome, Inclusion, Activities Supporting Independence and Integration

1 Introduction

We live in a world that generates technical advances and creates innovation at a very fast pace. However neither these advances and innovation reach all, nor

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they reach all in the same way. There are substantial groups of citizens in our society which have not been considered the focus of those developments and as a consequence can benefit only marginally, at the best of cases, from access to the services that most of the society enjoy.

Our project POSEIDON (PersOnalized Smart Environments to increase Inclusion of people with DOwn's syNdrome), focuses on the task of bringing some of the latest technological advances to increase inclusion in our society of a specific group of citizens: people with Down's Syndrome (DS)and tries to answer questions posed in the AAL community before about inclusion and the role of AAL beyond the current focus on supporting independence for the elderly [1, 2].

Common characteristics for people with Down's Syndrome include [3–6]:

- Relative strengths in: some aspects of visual processing, receptive language, and nonverbal social functioning.
- Relative weaknesses in: gross motor skills and expressive language skills
- People with DS sometimes: find transitions difficult, need prompts / reminders as they go about their daily lives, benefit from structure and routine as a way to cope with the complexity of the world, they need a little more time to process information and have difficulties with time because it is quite an abstract concept.

Our solution will aim at giving priority to preferences like these to create technology that is appealing and useful to them. People with DS (along with their relatives and other potential users) will be given the opportunity to co-design a solution along the project and we believe this will increase the chances of producing a solution which is really useful for the intended beneficiaries.

Our project gathers the direct participation of companies, research centres and Down's Syndrome Associations primarily from Germany, Norway and the UK. However the consortium is willing to gather the opinion and attract participation of all EU countries and possibly from other parts of the world as well.

2 The POSEIDON Approach

This overarching goal will be achieved by empowering first and foremost people with DS however this support will also be available to those who interact with them on a daily basis (family, carers, friends, and service providers). Although there are some technological products in the market, these are very limited and specialized on narrow services, without integrating and leveraging all the potential available by todays technology and expertise. Some of the challenges people with Down's Syndrome face:

- Access to education and the support provided is very limited
- Fewer opportunities are given to people with DS to find employment
- Most people with DS find it harder to access and maintain social networks
- Sedentarism can result in health problems for people with DS

– Public information is often in formats that are not easily accessible for people with DS (e.g. bus timetables)
– Reading and writing can be more difficult for people with DS

POSEIDON will aim to provide a technological infrastructure to foster the development of services which can support people with Down's Syndrome and, to some extent, also those who interact with them on a daily basis. The infrastructure will be illustrated with the creation of a system providing services supporting inclusion based on static and mobile smart environments to empower people with DS in different daily life situations. These services will provide evidence and guidance on how technology can help people with DS to be more integrated within their society through education, work, mobility and socialization.

This project cannot eradicate all of the problems that people with DS may experience; however, POSEIDON will provide an added layer of support that will facilitate their immersion in usual daily life activities as most of the population experiences it. The project will create extra support for people with DS. It is not intended that the project leads to a reduction in human contact. Instead, POSEIDON offers information and guidance to encourage decision-making and independence. This is achieved through devices which will provide the infrastructure for a Smart Environment and software which will provide the Ambient Intelligence needed to guide them and support them on interacting with the complex real world. Part of these Smart Environment and Ambient Intelligence is available in the market and part will be created new specifically to support people with Down's Syndrome or those with similar preferences and needs. See figure 1 below. The static devices (Interactive Table and Virtual Reality Set)

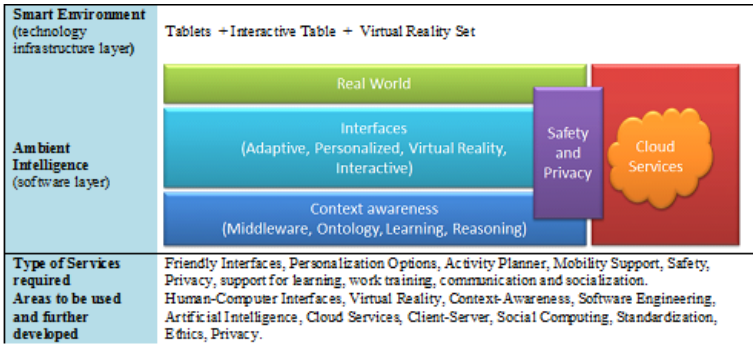

Fig. 1. Summary of infrastructure and its use within POSEIDON.

will be used at specific locations, for example at home, school or work, whilst the users will have access to the inclusion services everywhere and all the time through the tablet. Notice the main users are people with DS but their family, school teachers, employers, bus drivers, and other people interacting with them will also be able to use the static and mobile devices with different interfaces and benefits.

Each individual is different but overall citizens with Down's Syndrome may require some level of extra support in a variety of situations. We cannot address

all possible situations in this project but we aim to consider a few which are related to some of the core challenge areas they face: education, socialization, wellbeing, and mobility. We will use a scenario describing a day out as a guide and inspiration for our project: going from home to school or work, and from there to a place for socialization, e.g., to the cinema or restaurant and then back home (see figure 2 below).

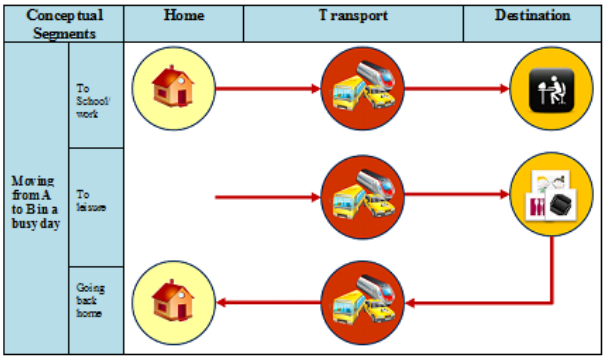

Fig. 2. Supporting mobility in POSEIDON.

Different situations require different levels of support. There is availability of the system at all times (this is indicated in figure 3 in yellow) but in specific, safer and better known contexts that support is specialized and context-aware: safer at home (indicated in green) and not necessarily so safe at other places (indicated in orange). Transitions between environments/situations increase the potential for problems (including safety when travelling from one place to another) so support should be higher (indicated in red) in those situations. The

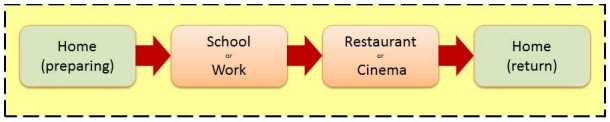

Fig. 3. Scenarios to be considered in POSEIDON.

new inclusion services should not replace humans, the system can be used to empower people with DS and encourage them to make their own decisions in different situations. At different places the person with DS can be with someone else ready to bring support when needed, for example, a travel companion, a tutor, a coach, or a relative, but the inclusion services provided by our project will open new opportunities for a person with DS to choose what to do next and how.

3 Projected Technological Infrastructure

Our system will be supported with a combination of devices and software specifically designed for people with DS and those who interact with them. The technological infrastructure has three main components

1. a display with a computer where Virtual Reality (VR) can be produced;
2. an interactive table which is under development by Fraunhofer and on
3. a tablet PC.

These developments will be based on previous research and innovative solutions created by some of the partners of the POSEIDON consortium [7, 8].

The technology can help to increase participation in education, work, socialization, and greater freedom of mobility. The tablets, VR set and interactive table can provide support for planning tasks and for learning, they are all interconnected maximizing their potential and availability of services. All of these naturally will vary case by case and we will get different degree of success but the project will be the first of this kind and of this scale that we are aware of, and, as such it can produce a tangible product as well as important insights which will nurture future developments.

Different contexts will require different inclusion services dictated by the intended natural preferences of a place: eating, sleeping, playing games at home, learning at school, doing exercise in the gym, etc. The system should be at all times aware of where the person is and what may be useful. We can achieve this level of consciousness and autonomy by the system thanks to the sensors, interfaces, planners and other technologies available. The consortium possess knowledge and experience on developing intelligent and context-aware software but here there are some interesting challenges posed by the characteristics of the main users: Will it be more efficient a system that is self-adapting all the time to make available services according to the context or will the frequent changes of the interface be more confusing than helpful for a person with Down's Syndrome? These and other practical questions and challenges on making sure the platform serves the users properly will be taken into consideration. The POSEIDON system will aim at meeting several desirable features of universal design and inclusion:

- as flexible as possible: it adapts to the user, it learns from its more frequent uses and learns to anticipate needs,
- as clever as possible, to (a) retrieve information which is context-aware and to (b) restructure its look according to the context
- multiregional: language translations for different countries
- across ages: it has to be personalized for children, teens, adults and elderly
- across ability: it has to be tailor-made for the intellectual capability of the user
- across platforms: work in tablets from at least three different providers (e.g. Samsung, Apple and Toshiba), which means the system should be portable across a variety of Operating Systems like Android, IOS and perhaps more

4 Conclusions

We live in an era where old assumptions and stereotypes are increasingly challenged. We are tackling the limitations on inclusion that society impose over people with DS, and we aim at creating technology which can facilitate their development at similar levels than others. POSEIDON gathers the expertise of companies leading technological innovation, academic organizations with deep technical knowledge in the area of assistive technologies and Intelligent Environments as well as on leading organizations to support people with DS.

This consortium is aiming to develop infrastructure to support people with DS, their circle of family and friends, as well as other sectors of our society (educators, job managers, etc.) so that we can create a more inclusive society where we aim to emphasize people's capabilities instead of focusing mostly on the assumed limitations. Each individual is unique and hence our project will aim to gather from the individuals which are their preferences and needs as well as to create a system which can be personalized by the users.

We understand this is the start of a long journey as there has not been comprehensive projects with this focus before and at the same time we know there are difficulties ahead, however we start this journey with the hope at the end of it we would have paved the way for innovative technological developments to support a more inclusive society.

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