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The Use of e-Textbooks on the iPad to Support Students with Disabilities

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Keywords: e-textbooks, iPad, post-secondary, students

1 Introduction

In this day and age, increasing numbers of post-secondary institutions are looking at the use of e-textbooks to include in course materials. The reasons for this are multifaceted and include: a potential cost savings for students and the institution, a reduction in paper use, and the potential that e-textbooks in courses might support Universal Learning Design (ULD). Research is beginning to emerge as to the effectiveness of this digital learning tool for students in their learning. Unfortunately there is limited data available regarding the use of e-textbooks by post-secondary students, and even less information regarding the use of e-textbooks to support the learning of students with learning disabilities. The purpose of this exploratory research was to investigate the affordances and limitations of e-textbooks for post-secondary students with learning disabilities in reading as perceived by the students.

2 Background

When developing courses for instruction, most post-secondary instructors rely on textbooks to provide students with the majority of the course content. As they look for appropriate textbooks for their courses they find that most mainstream textbook publishers now provide a digital version of their textbooks (e-textbooks) either through their own software application or through software from another provider (e.g. CourseSmart), or by simply using the PDF file format. The challenge for post-secondary institutions and instructors is then to determine whether or not to implement the use of the digital textbooks in their courses or to continue using paper based textbooks as been the norm for decades. This can be a difficult decision as very little is known about the impact on the move to digital textbooks on students, and even less is known about the impact on students with disabilities, although there is speculation that digital textbooks may be an excellent learning tool for the implementation of ULD.

The various hardware used for displaying e-books are typically called e-readers. These devices have mostly been monochrome (grayscale) devices that use e-ink displays. The lack of colour and typical small screen size of these devices has made them less suitable for many e-textbooks (as they are currently implemented). However, tablets (iPad, Android tablets like the GalaxyTab) provide much larger, colour screens and a variety of e-textbook apps are now available for these devices. Many of these applications present the text as reproductions of the pages in the hardcopy textbook. This generally necessitates scrolling and zooming to see the contents of the entire page. Changes to the font size and repaging, which would help accommodate different readers, are generally not possible in this set-up (zoom features must be used instead). Annotations (highlights; comments and notes; marks such as stars, boxes, etc.) can sometimes be executed though with some difficulty as compared with paper text. Applications for the iPad and Android tablets may offer a more user friendly platform with free flow text and more intuitive functionality with highlighting and note taking.

There has been some discussion in the literature as to the value of e-textbooks. A number of limitations have been noted regarding the current implementation of e-reader software with respect to textbooks (Danial & Woody 2013), and some studies have indicated that students still seem to prefer reading and studying with print textbooks to e-textbooks (Demski, 2010). On the other hand, increasing numbers of post-secondary students own tablets and increasingly prefer the devices for reading. This is a reversal of previous results where students clearly indicated that they preferred hard text (Desantis, 2012).

Due to the increasing ownership and use of tablets by students the academic community has started to explore the use of tablets to deliver academic content including digital textbooks. There have been several studies in that last 2 years that have looked at the use of digital books and e-readers with varying results. Demski (2010) reported the results of a study with three universities and concluded that the e-readers had limitations that made them inadequate for reading textbooks. On the other hand benefits including a reduction in the amount of paper used and a reduction in textbook costs have been reported (Mang & Warldey, 2012). Martinez-Estrada and Conaway (2012) in a study of the use of Kindle ebooks during a spring course found that the eBook supported student learn and course outcomes. Geist (2011) also explored the use of ebooks on iPads with students and found that students really liked using iBooks for course work and appreciated the convenience it afforded.

Given these developments there is a need to study the use of e-textbooks by post-secondary students, especially those with disabilities. More and more students with learning disabilities with specific difficulties reading and comprehending text are attending post-secondary institutions. The term, learning disabilities, refers to a disorder which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information in individuals with average or above ability. Individuals with learning disabilities may have difficulties with one or more of the following areas: oral language, reading, written language, or mathematics.

The focus of this study was on post-secondary students with learning disabilities who have difficulties in the acquisition and use of reading. Although there are some studies that look at the impact of assistive technology and the supports that it affords students with disabilities, no research was found that specifically addresses digital textbook use to support reading and reading comprehension on tablets by students with learning disabilities. This study will be one of the first explorations of this area.

3 Method

This was a qualitative study with 13 post-secondary students with learning disabilities in reading. The purpose of this exploratory research was to investigate the affordances and limitations of e-textbooks for post-secondary students with learning disabilities in reading as perceived by the students .Each student was asked to read three passages of text from an etextbook on an iPad. One of three, ereader platforms was randomly chosen for the text. The platforms included iBooks, CourseSmart, and the digital textbook app offered by Pearson publishers for their textbooks. Although the platforms were different, the text being read was almost, if not exactly identical between platforms. The researcher provided each student with a demonstration of how to use of the etextbook, on the platform selected, prior to beginning the research. The first passage was presented as plain text, and the participant was asked to just read the passage and answer verbal questions afterwards. The second passage was presented with some of the text already highlighted and annotated by the researcher, and the participant was asked to read the passage then answer verbal questions afterwards. The third passage the students read had no highlights or annotations, and the students were encouraged to use the highlighting and note taking functions in the platform to help them read and remember the information in the passage so that they could answer the verbal questions afterwards. As the students were reading, the researcher observed the students' reading behaviors. Following the reading tasks a semi-structured interview was completed with each student. The interview focused on the student's overall experience using the etextbook, differences between reading on paper and using the platform, and the perceived affordance and limitations of the system. The data was analyzed using a qualitative approach to develop an understanding of the common themes that explain student's experiences with e-textbooks.

4 Results

Seven female students and five male students participated in the research. The ages of the students ranged from 22 to 62, with an average age of 36. The majority of the students were familiar with mobile technologies, but two of the older students had not used an iPad or iPhone previously. All of the students used a desk top computer or laptop for reading and school assignments. Several of the students used assistive technology software programs on the computer for reading support.

All of the students thought that the mobility of the iPad was a huge plus for them. One student commented that she liked "not having the weight of all those books." All of the students also indicated that they liked the ability to change the size of the font and the background while reading on the iPad. Several students commented that the text on the iPad was easy and comfortable to read, and it was almost like reading a book. A definite preference for reading on the iPad versus on a computer was expressed. One student indicated that the computer gives him migraines and that he hoped that being able to adjust the brightness of the iPad screen would help with his reading.

All of the students found it easy to navigate through the text and several reported that the etextbooks were all very user friendly. The two students who had not previous exposure to any mobile technologies found the touch a bit tricky and indicated that they would have to learn how to tap to navigate before they could become proficient users of the features in the e-textbooks.

There were considerable differences reported in the use of highlighting while reading across the 3 etextbook platforms used. Students found the highlighting function in iBooks to be very easy to use and one student indicated that she found it easier to use than the assistive technology Kurzweil program on her computer. This was very different for the students reading in the CourseSmart and the Pearson apps who found the highlighting function to be very awkward to use. One student reported that trying to use the highlighting function in the CourseSmart app took him out of the flow of reading and he continually had to reread the text to find his place. Another student reported that highlighting was too time consuming in the Pearson App and she found the highlighting to not be intuitive.

The students also expressed differences of opinion regarding the note taking function. Several students really liked the note taking function in iBooks. They found it easy to use, and the function made sense to them. Several students commented that they "loved" the compiled list of notes made in the iBooks and found them to be "wonderful." Another student thought that the note taking function would help her to not lose her notes which is a consistent problem for her. Students reading the etextbooks on the other platforms did not like the note taking very much. One student indicated that when he used the note taking function he could not move the note to see text underneath. He thought this would hamper his reading considerably. Another student indicated that when she tried the note taking she had to start the reading again from the beginning. There was also a lack of ability to make notes the way that she was used to. One student expressed concerns about the move to etextbooks in her classes. She felt that she finally had a note taking strategy that worked for her that helped her cope with her disability. If she moved to etextbooks she would have to find another strategy. Several students indicated that they would have to learn how to use the note taking function effectively.

Another feature that the students identified as helpful for reading, was the text-to-speech function in iBooks. Students really liked the ability to have instant access to text-to-speech to help them read words and phrases that they were having difficulty with. They also liked the ability to change the type and speed of the voice, although they found the voice to be a bit unnatural. The fact that they did not have to move to another platform for this function was a feature that the students liked a lot.

Several students reported that the reading guide provided in one of the platforms was very helpful to keep track of where they were reading. Where there was no guide provided several students reported that a guide would help them to stay focused and track where they were in the ready.

5 Conclusion

Overall, the post-secondary students with learning disabilities in reading reported very positive views of their reading of etextbooks on the iPad. One student said, "If this was available when I was younger, I would have gone into law school." Another student reported that she would "rather read textbooks on the iPad rather than the computer." She felt it was easier to work on comprehension, easier to sit longer, and the number of pages that she had to read was not intimidating. Still another student said, "I don't think I would have passed my English course without reading on the iPad." The student with learning disabilities and ADHD reported that the digital text helped to keep his mind more engaged than reading paper, as he could scroll, manipulate text, and the whole experience was more interactive.

Despite the positive comments by the students regarding the reading experience on the iPads, it was clear that not all etextbook platforms are created equal. Many of the students with learning disabilities felt that the highlighting and note taking functions could be very useful supports to them in their reading, but these tools did not function well in some platforms and became a hindrance or deterrent to learning. The iBooks platform received very strong positive comments from the students. The other platforms proved to be less than adequate. In addition, students reported that they felt they needed to learn how to use these functions effectively to help them with reading and learning. In addition, several students commented that they would have to learn a whole new way of studying and learning, as their current strategies all involved paper text.

Around the world, post-secondary institutions are moving to the use of etextbooks in courses in an effort to save money, and certainly the use of etextbooks is becoming more prevalent. There is also thought that the implementation of etextbooks in courses could provide a good ULD strategy for students. Unfortunately, some of the platforms that provide students access to etextbooks have features that are poorly designed and can actually cause students with learning disabilities to experience more difficulties while they are reading. Therefore, it is imperative that effective and well-designed platforms be selected to provide access to etextbooks.

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The Role of Speech and Sign Language in Teaching English as a Foreign Language to Deaf and Hard of Hearing Students

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Keywords: deaf, hard of hearing, foreign language teaching, speech, sign language, beliefs, motivation

Abstract

The aim of the paper is to discuss the role of speech and sign language in teaching English as a foreign language to the D/deaf and hard of hearing students. This paper presents a part of wider research conducted in a group of 146 D/deaf and HOH university students from 11 countries and 14 universities. All of them completed a booklet of questionnaires concerning their motivation to learn a foreign language, beliefs about learning foreign languages, strategies of learning and teaching foreign languages and difficulties in this task.
The results show that the mode of communication does not influence students beliefs on foreign language learning. Both these using speech and sign languages report similar challenges and difficulties.

Introduction

D/deaf and hard of hearing (HOH) persons in the contemporary world are no longer referred to as "people without language". Similarly to the hearing population they live in the contemporary *culture of language* that demands fluency in using not only native (national) but also foreign languages (especially English) in education, culture and entertainment. At the same time, it is language – not speech or voice – that poses the most prominent problem for D/deaf and HOH people. It is sometimes suggested that D/deaf people do not need foreign languages but rather foreign sign languages. However, even their effective usage does not allow D/deaf and HOH free access to the world-wide treasure of knowledge, the key to which is hidden in the ability to use English.

The aim of the paper is to discuss some chosen aspects of the methodology of teaching English as a foreign language to the D/deaf and hard of hearing students, especially in the context of the role of speech and sign language in this process.

1 Deaf and Hard of Hearing Foreign Language Learners

Contemporary language education is accessible to the deaf and hard of hearing thanks to many different methods and services: early diagnosis and speech therapy intervention programmes (e.g. simultaneous-sequential reading method, oral approach, Cued Speech, sign languages or sign-language systems). Communication of D/deaf and HOH persons has been continually supported by the latest technological developments like digital hearing aids, cochlear implants, induction loops or services like *speech to text reporting*. All these result in the D/deaf and HOH people's wider competencies in their native language, but they also open the possibility to teach and learn foreign languages.

In Europe English in many countries is a non-native language and millions of Europeans each year learn it at schools, universities and private tutorials. This is also true for D/deaf and HOH education: during the last decades of the 20th century teaching English as a foreign language to the D/deaf and HOH was recommended as obligatory in many European countries, mainly of Central and Western Europe. Because of a lack of specialized teaching methodology, in each country groups of teachers or even individual teachers tried to work out effective legal solutions, class structures, methods and forms of teaching. Results of this work are described in a latest book by Domagała-Zyśk [1], where experiences from Norway, Italy, Hungary, the Czech Republic and Poland are described. Research of E. Domagała-Zyśk and her 10 year experiences in this field are analyzed in another book in Polish, entitled *Multilingual. Deaf and hard of hearing students in the process of teaching and learning foreign languages* [2].

Motivation to learn a foreign language is thought to be one of the key factors guaranteeing success in acquiring language competencies. Beliefs about language learning (motivation is one of these beliefs) are referred to as general principles possessed by a student on himself as a student, the conditions of the learning process, and the nature of teaching and learning [3]. They are sometimes named as *mini-theories* [4] and they play important role in the process of foreign language learning. Students who have realistic and positive beliefs do better than these whose beliefs are unrealistic or negative. Research conducted in different groups of students show that motivational beliefs are different in different national groups, they differ also as far as age, social status and other individual students' features are concerned.

Taking into account both the contemporary psycholinguistic knowledge and the accounts about successful attempts of teaching foreign languages to the D/deaf and HOH subjects it must be stressed that there are no psychological or methodological obstructions to teaching a foreign language to this population. However, there is little research on D/deaf or HOH students achievements in this field, evaluation of approaches, methods or techniques used or conditions facilitating this process. There has also been no research so far that aimed at analysing the differences between students using speech and/or sign language in the process of foreign language learning and teaching.

2 Methods

This paper presents a part of wider research conducted in a group of 146 D/deaf and HOH university students from 11 countries and 14 universities. Majority of the students came from Poland, then from Italy, France, the USA, the Czech Republic, Hungary, Belgium, the Great Britain, Lithuania, Ireland, Russia and Slovenia. The group consisted of 49 (33,56 %) males and 97 (66,44 %) females. The level of hearing loss in the group was rather deep: majority of the group possessed severe or profound hearing loss which means that audiologically they belong to the group described as deaf persons. This fact is important for the research results analysis, as the findings might have been different in a group with milder hearing loss. The results are presented in tab. 1.

[Tab.1] Participants' level of hearing loss.

Level of hearing loss	**N**	**%**
Mild 21–40 dB	5	4,95
Moderate (41–70 dB)	27	26,73
Severe (71–90 dB)	64	63,36
Profound (more than 91 dB)	49	48,51
Total	146	100

The participants declared that they use different technological means of support: 117 (80 %) use a hearing aid, 18 (12 %) are cochlear implant users and 11 (8 %) persons do not use any of these. The group was differentiated by their modes of communication. The participants could choose more than one mode and a big number of them reported using 2 or 3 modes alternatively. Majority of them – 113 persons (77,39 %) uses speech and lipreading while 77 (52,73 %) persons use sign language or sign-language systems (23 persons, 15,75 %). 22 persons (15,06 %) use Cued Speech. The results confirm that majority of the group might be called bilingual. They are shown in table 2.

[Tab. 2] Modes of communication

Modes of communication	**N**	**%**
Sign language	77	52,73
Sign-language systems (e.g. Signed English, Signed Polish)	23	15,75
Cued Speech	22	15,06
Speech and lipreading	113	77,39

All of the participants reported they learnt or have been learning a foreign language, either in regular groups (29.50 %) or in special groups for the d/Deaf or HOH. The foreign language learnt it was mainly English (129 persons, 88 %), but also German (41 persons, 28 %), French (17 persons, 12 %), Russian (8 %) and Latin (10 persons, 7 %). The students were also asked to declare their level of language. 30 % admitted that it was the lowest level (A1), 20 % suggested it was level A2 and 14 % estimated it as B1.

The refereed research was a part of a wider study with many different research questions. The research problem that is addressed in the present paper is to check the impact of the mode of communication (speech or sign language) on the process of learning a foreign language.

The research method was a paper and pencil booklet of questionnaires. In the present paper some of the results of two of them will be analyzed: results from *Beliefs About Language Learning Inventory* by E. Horwitz [5] and *Foreign Language at my University* by E. Domagala-Zyśk [1]. The analyzed results should help to answer the question of the correlation of the communication mode and motivation to learn a foreign language.

3 Results

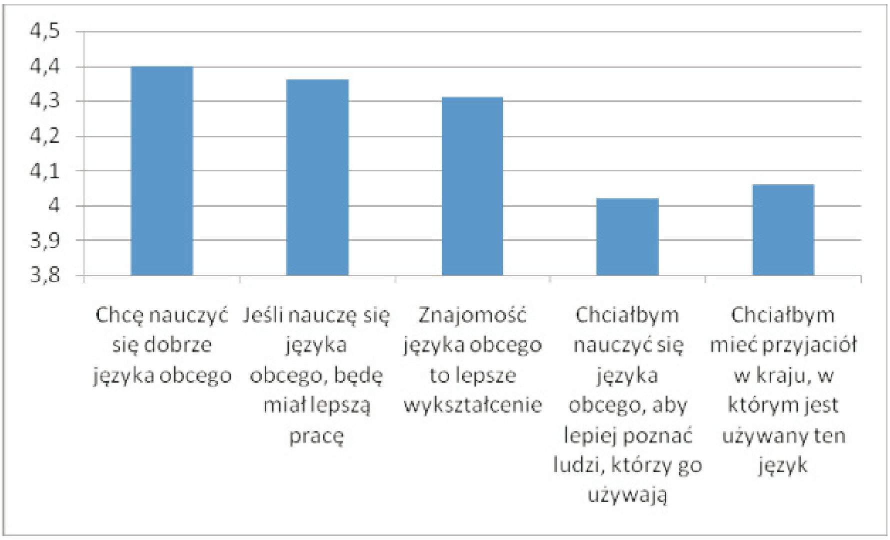
In the first phase of the research on motivation to learn a foreign language D/deaf and HOH students were asked about their general motivation to learn foreign languages. They do it first of all to be able to communicate with people from other countries (26 %), to pass the exam (25 %), or to learn more (19 %). Some of the participants admitted that they learn a foreign language because in a contemporary world it is a must to know foreign languages (16 %), it is advisable to know it at work (11 %), to read foreign literature (3 %) or to use internet (2 %). 8% of the participants admitted that it is a pleasure to learn a foreign language.

The next step was to check the nature of motivation more closely and to correlate it with the students' mode of communication. This was done by analyzing the students answers for 7 questions from the BALLI questionnaire, which formed a category "Motivation and expectations". Students answer the questions choosing one of the 5 numbers, where 5 meant "strongly agree" and 1 – "strongly disagree". Analyzing the results a mean value was counted for each question separately. The questions are enlisted in table 3.

[Tab. 3] Category of "Motivation and expectations" form BALLI questionnaire (Horwitz 1985).

5.	I believe that I will learn to speak a foreign language very well	**1-2-3-4-5**
20.	People from my country feel that it is important to speak a foreign language	**1-2-3-4-5**
24.	I would like to learn a foreign language so that I can get to know better people from the country where it is used	**1-2-3-4-5**
28.	If I learn a foreign language very well, I will have better opportunities for a good job	**1-2-3-4-5**
30.	I want to learn to speak a foreign language well	**1-2-3-4-5**
31.	I would like to have friends from the country where they use the language I learn	**1-2-3-4-5**
34.	It is important for me to study a foreign language in order to be better educated	**1-2-3-4-5**

The results show that the research group is convicted that knowing languages means getting a better education (M = 4,315) and a possibility of a good job (M = 4,363). They want to make friends abroad (M = 4,02; 4,069). They want to learn a foreign language as well as possible (4,404), although they are not so sure if they can achieve it (M = 3,602). The results are shown on figure 1.



[Fig. 1] Motivation and expectations of the students

Statistic analysis (SPSS) of the results showed that none of the independent variables correlates with the students' beliefs about motivation to foreign language learning. However, the detailed analysis of the medium results for each item showed that there is a difference in beliefs between the students concerning their characteristic. Students who represent lower foreign language level (A1) are more optimistic and sure they want to learn a foreign language (M = 4,478) and more confident they will reach this aim (M = 3,717). Students using oral communication were most confident they want to learn a foreign language (M = 4,477) are able to learn a foreign language (M = 3,870). Sign language users were the most willing to initiate a contact with a person from abroad using a foreign language (M = 3,629). These who reported using speech and sign language as their modes of communication are most motivated to learn a foreign language in order to get a better education (M = 4,2) and have bigger chance for a better job (M = 4,261). **The results confirm the thesis that the level of motivation does not directly depend on the students' mode of communication.** Both these students who use oral approach and those who use sign language are equally motivated to acquire competencies in foreign languages, perceiving this a chance for their development, better education and job career choice.

4 The scientific and practical impact or contributions to the field

The research presented has got significant educational implications. It shows a necessity for reformulation of the contemporary aims of D/deaf and HOH students education in such a way as to make their potential visible and used for their personal growth. It shows both strengths and challenges of students using speech or sign language in the process of learning a foreign language. As bilingualism seems to be the most supporting approach it is advisable to promote it as a proper educational approach supporting the student's language education, also in the field of foreign language learning.

5 Conclusion and planned activities

The results show that the mode of communication does not influence students beliefs on foreign language learning. Both these using speech and sign languages report similar level of motivation, report experiencing similar challenges and difficulties.

The postulated further studies should involve research on the methods, forms and strategies of teaching and learning a foreign language to differentiated groups of D/deaf and HOH children, adolescents and adults and also studies on cognitive, emotional, educational, institutional and social conditions of this process.

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A Competence-driven Workflow for Creating an Information Portal Developed by a Diversified Diversity Team

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Abstract

In this paper, we describe a workflow developed by members of a diversified diversity team. The team consists of two groups at two different locations, one working at a support center for visually impaired students and the other one at a support center for hearing impaired students. The members of the groups are persons with and without visual or hearing disability. The common goal was to create an information portal for visually or hearing impaired (prospective) students and job starters with higher education. During the project, we experimented with two different kind of workflows. It turned out that the most efficient workflow allows each person to occupy a position in the team according to her/his specific competence. For instance, the staff with disability ensured that the needs of the target groups were met and specific information for people with disability was provided. Furthermore, the two groups working at the two support centers took care of different tasks. The high number of visitors at the information portal shows the acceptance in the communities. The project also points at the importance that people with and without disability work together in order to create content for people with disability.

1 Introduction

The UN convention on the rights of persons with Disability (UN, 2008) ensures free access to education for all. This includes accessible content on the Internet for people with hearing or visual impairment. However, people with hearing and visual impairment are under-represented in higher education in OECD countries (UN, Disability and Employment, 2007). Moreover, they are more often affected by unemployment than people without disability (UN, Factsheet on Persons with Disabilities, 2010). We assume that one of the reasons is that specific information on how to succeed in higher education is missing. To increase the number of persons with visual or hearing impairment in higher education in Germany, we initiated a project to create an information portal.

2 Our Approach

The described project aims at creating an information portal for (prospective) students and job starters with visual and hearing impairment. The target groups were people with blindness, low vision, hard of hearing or deafness. The main question at the beginning of the project was how to meet the needs of the target groups. Usually people with blindness and deafness does not have very much in common. Direct communication is very hard.

Deaf people are visually oriented and they can hardly imagine a world without colours, pictures, videos and visual language. On the other hand, blind people prefer acoustic information and they hardly understand how people can live in a "silent world". To ensure that the needs of the target groups were met staff with and without visual or hearing impairment was involved in the project. Thus, it was necessary to develop a specific workflow where cooperation between the groups was made possible.

3 Designing the Platform and Content

Accessible content on the Internet in accordance with the WCAG guidelines can be implemented in different ways. Many portals provide information for one group only. Other portals try to provide information for all groups on one webpage according to the principle "one code for all". However, people with blindness or deafness have something in common which is called "print disability" (Kerscher, 1988). Both groups have difficulties in accessing print text and it is helpful to reduce the amount of information for the groups and meet their specific needs as much as possible. Thus, we decided to create three versions of a website: one for people with visual impairment, one for people with hearing impairment who prefer written text and the third one for people with deafness who use sign language. Figure 1 shows the starting point of the website leading to the three versions.

[Fig. 1] Starting point of the website

The three versions differ in appearance, navigational structure and partially in content. For instance, the navigation for people with visual impairment was static whereas for the other two versions the navigation was dynamic. Figure 2 shows the article "general information about exams" in three versions. The three buttons on top of the right hand side of the website allow to switch from one version to another.

It turned out that a lot of the information is shared by all target groups whereas some information is group specific. The amount of overlap depends on the topic. Most information about assistive technology for instance differs from one group to the other whereas laws about disability compensation are the same for all groups. The content is published in form of articles on the website. Thus, the content is split up into common parts and into group specific parts. In the end, each article exists in three versions with common and specific information (a) as a written article for visually impaired people, (b) as a written article with pictures for hearing impaired people and (c) as a video in sign language with subtitles for deaf people.

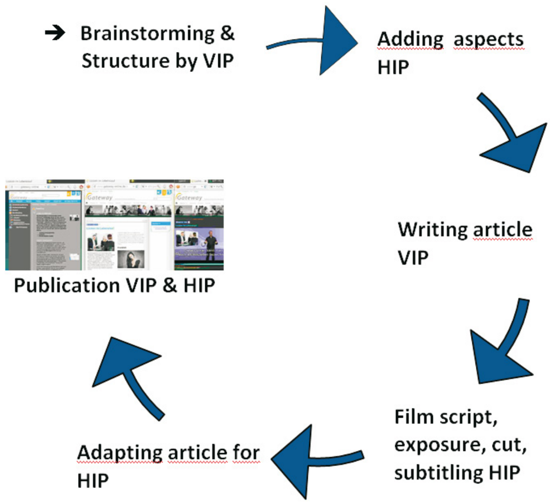
[Fig. 2] Three versions of an article: Version 1 for persons with visual impairment, Version 2 for persons with hardness of hearing, Version 3 for persons with deafness

4 Creating a competence-oriented Workflow

Working in a project with people with and without disability requires a specific workflow. Our first approach was to build mixed groups consisting of one person working at the center for visually impaired students and another one working at the center for hearing impaired students in order to guarantee that both aspects are reflected in the content from the very beginning. It turned out that this strategy was not very efficient. Our final approach was much more effective and reflects the competence of the different groups and group members illustrated by Figure 3. It consisted of the following steps:

1. At the beginning of a new article, the group supporting visually impaired students started with a ten minutes brainstorming session collecting questions which should be answered by the article. A group member who was responsible for writing the article structured the questions.
2. In a second step, disability specific aspects were added to the structured list of central questions and keywords by the group supporting hearing impaired students.
3. Then, the list was sent back to the person responsible for writing the whole article. After two sessions of revising the text it was sent for further processing to the group who supports students with hearing impairment.
4. Those added specific information for people with hearing impairment and finalized the text for the second version.
5. Next, the text was processed didactically for the video shooting in sign language.

6. The video was recorded, cut, pictures and animations were included and subtitles were added.
7. Finally, when all three versions were finished the article was published simultaneously on the website.



[Fig. 3] Newly developed work flow

5 Conclusions

The project shows that an information portal for people with disability profits from a diversified diversity team that comprises persons with and without disability. The developed workflow reflects their specific competence and the communication culture of the groups. We also found that the communities the different groups belong to accepted the different versions shown by the high number of visitors on the website. Further work will aim at developing plugins for a content management system which allows an article to be published in several versions. There, some of the information will be shown in all versions and certain information only in a selected number of versions.

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Tactile Star Wheel for Visually Impaired Observers

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Keywords: Astronomy Education, Blind People, Star Wheel, Tactile Symbol

1 Introduction

A star wheel is a tool whereby observers can view stars and constellations that are in the sky at certain dates and times simply by rotating the wheel against the holder. Star wheels are both inexpensive and simple to use, making them popular as an educational material. The Space Exploration Experience (SEE) Project has made tactile star wheels for blind and visually impaired people [1]. However, the design found on the SEE Web site seems to have a few problems: the stars on the wheel are too big and some of them are too close together to be correctly perceived as the figures of constellations; day lines are too few and not neatly arranged; all Braille labels on the wheel are aligned in the same direction, so some labels appear in the oval window at an awkward angle; and regular (i.e., not Braille) letters are not included, which means that sighted persons cannot understand or explain the wheel to their blind or visually impaired companions.

Therefore, we decided to create a new tactile star wheel specifically geared to the tactile perception of blind persons and the visual appeal for sighted persons.

2 Related Work

Many kinds of tactile astronomy education materials have been created around the world. "Touch the Universe: A NASA Braille Book of Astronomy," "Touch the Sun,"[2] and "Getting a Feel for Lunar Craters" [3] are tactile books which includes embossed or transparent raised planets, stars, and nebulae. 3D planet models have been produced such as "tactile moon"[4]. Recently 3D printers make it easier to produce tactile planet models [4], [5]. Tactile planetariums are large domes or spheres with tactile "stars" on the inside of the domes [6]. Creating tactile planetariums is hard work as they cannot be made automatically. Tactile star charts have many good points of other educational materials: they are handy, easier to produce, and inexpensive as tactile books and interactive as 3D models and tactile planetarium.

3 Tactile Star Wheel

In our proposed tactile star wheel, stars, constellation lines, labels, and markers are made tangible by using microcapsule paper. The wheel is 1.5 times bigger than regular star wheels so as to make the figures of constellations discernible by touch (Fig. 1).

3.1 Stars and Constellation Lines

We found in a former work that a 2-mm difference in diameter makes differently sized circles perfectly distinguishable [7]. Therefore, we express stars with three kinds of dots according to their magnitude: minus to 1 magnitude stars with 4-mm outline circles, 2 magnitude stars with 4-mm black circles, and 3 to 5 magnitude stars with 2-mm circles (Fig. 2).

Tactile symbols smaller than 1 cm are hard to discern [8], so we magnified most of the constellations to larger than 1 cm. This makes our wheel, with a diameter of 459 mm, approximately 1.5 times larger than regular star wheels.

Constellation lines need to be narrow enough to avoid misidentification as dots when they are very short. We set the width of these lines to 0.7 mm.

Too many tangible objects make it hard to distinguish one object from another, so we limited the number of constellations to fifteen of the more famous and popular ones.

3.2 Date and Time Markers

Date and time markers are expressed as tangible lines. To determine the optimum number of tactile date markers for lining up the desired date and time easily, we performed an experiment in which fifteen blindfolded sighted participants were asked to line up the designated date and time with wheels featuring three different tactile date marker conditions: every day, every two days, and every five days [9]. There were three main findings:

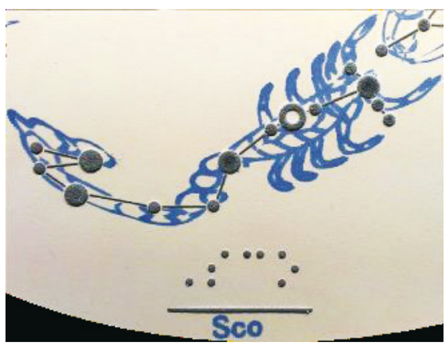
1. Lining up the date and time was faster under the every-two-days and every-five-days marker conditions than under the every-day condition.
2. The dates with tactile markers were lined up faster under the every-five-days marker condition than under the every-two-days condition.
3. Lining up errors were less than one day under all conditions.

Based on these results, we drew the tactile date markers around the wheel every five days (Fig. 3).

3.3 Regular Text and Constellation Art

In general, tactile figures alone are difficult to understand, so for the visually impaired, having a sighted person explain them is vital. To facilitate such explanation, we added regular text and constellation art to the wheel and the holder. These are printed in blue so that they do not rise up when heated.

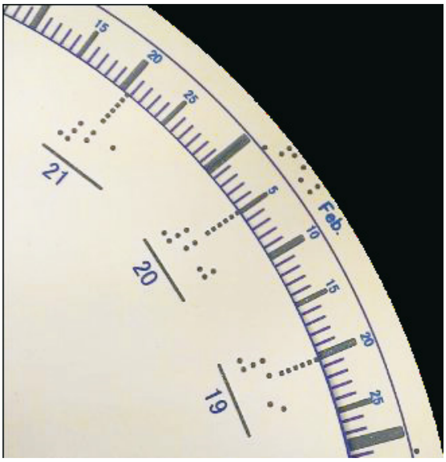
[Fig. 1] Proposed tactile star wheel



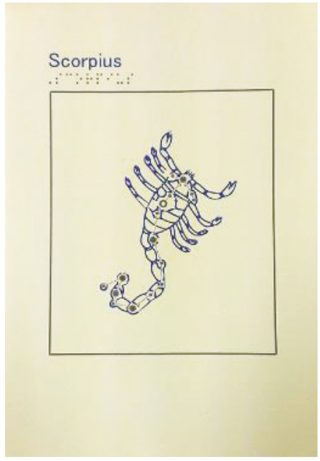
[Fig. 2] Stars and constellation lines

3.4 Tactile Constellation Cards

Larger constellation figures than those in the tactile star wheel help facilitate an understanding of the exact composition of the constellations and stars included in them, so we also prepared tactile constellation cards printed on large (DIN A4 size) sheets (Fig. 4).



[Fig. 3] Date and time markers



[Fig. 4] Tactile constellation card

4 Demonstration and Dissemination

We demonstrated our tactile star wheel at the 2012 and 2013 "Sight World" events for blind and visually impaired persons which gathered about 5,000 people every year. It has also been introduced in lectures at schools for the blind. Up to now, 60 or more tactile star wheels have been presented to blind people and individuals who are engaged in teaching or assisting blind people. They have given us a lot of positive feedback, including:

"We have heard a lot about stars and constellations, but this is the first time to touch them." "I had thought that constellations and stars have certain concrete figures such as a dipper or five-pointed star. For the first time, I realized that all stars are round." "I wish I had had this when I was a student."

5 Future Plans

Microcapsule paper wears down easily and is not suitable for long-term use. We are therefore planning on using a more endurable tactile material such as UV-curable resin. We may also change the way paper is printed at the factory to help increase its durability.

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Computer Games for Diagnosis and Treatment of Elderly People with Dementia-Alzheimer

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Keywords: android application, dementia, Alzheimer disease

Abstract

This paper reports our work in designing and developing an android application ("Fight Alzheimer") to help doctors in diagnosis and developing of dementia and Alzheimer disease (AD). Historically, doctors examine the progress of their patients through games in a paper format. Although there are many such games, there isn't a software application to help doctor in this regard. The application contains different games each of which helps a patient in different section of his mind which tends to be damaged due to the disease. The application can be used to keep the progress of the patient and help therapists to apply these games for his/her treatment.

1 Introduction

The term Dementia (originally meaning "madness") comes from the Latin de meaning "without" + mens from the genitive mentis meaning "mind". Dementia relates to the gradually decline of brain functionalities and it is a syndrome with a set of signs and symptoms rather than a single disease. It is incurable and slowly interferes with an unimpaired person's ability to carry out the normal daily tasks of beyond what might be expected from normal ageing. The affected areas by dementia can be memory, attention, language and problem solving. Normally, symptoms must be present for at least six months to support a diagnosis [1].

Alzheimer's disease (AD) is the most common non-cure form of dementia. It causes problems with memory, thinking and behaviour. It gets worse as it progresses and eventually leads to death. It reduces patients' ability to learn, reason, retain or recall past experience. It also drives to loss of thoughts, feelings and activities. In some cases there are many mental and behavioural problems which influence the quality of patients' life. Alzheimer's disease can be considered as four stages, namely, pre-dementia, early or mild, moderate and advanced (or severe).

2 The Brain Training and studies for the role of Computer Games

Studies show that exercise and other types of physical activity have many benefits because they help our hearts, waistlines, and ability to carry out everyday activities. Also, epidemiological studies and some intervention studies suggest that physical exercise may also play a role in reducing risk for Alzheimer's disease and age-related cognitive decline [2].

Animal studies in older rats and mice show that exercise increases both the number of small blood vessels that supply blood to the brain and the number of connections between nerve cells. Exercise raises the level of a nerve growth factor (a protein key to brain health) in an area of the brain that is important to memory and learning. Also, exercise can stimulate the human brain's ability to maintain old network connections and make new ones that are vital to healthy cognition [2].

Except from exercise and physical activity it is very important for patients with dementia and more specifically for those with Alzheimer's disease to stay cognitively active throughout life via social engagement or intellectual stimulation. Several observational studies show that social engagement through work, volunteering, or living with someone and mentally stimulating activities such as reading books and magazines, going to lectures and playing games keep the mind sharp and are associated with a lower risk of Alzheimer's disease [2].

Researchers believe that computer games and programs aiming at increasing people's mental activity and mental function can be helpful in addition to the medications which are being used with the disease. Playing games can cause the brain to have interaction and get excited with the thought of winning. By concentrating on playing games, their stress can be alleviated and hopefully they can feel much better [3].

People with Alzheimer disease exhibit diminished levels of dopamine, a neurotransmitter. Without dopamine, people aren't able to learn properly. Disturbances in dopamine levels affect behaviour, feelings, appetite and memory. Current research indicates that altering the levels of dopamine in the body may alleviate some of the mood and emotional imbalances associated with Alzheimer's [4]. A number of studies indicate that game-playing triggers the release of dopamine in the brain. In addition to the benefits of dopamine and game-playing, it has been found that a person who stays intellectually active can reduce the risk of Alzheimer's by one-third [4].

Studies have now shown that video games also improve visual skills, attention span and information processing time. One study, by Shawn Green and Daphne Bavelier at the University of Rochester, found that gamers consistently out-performed non-gamers on standard tests that measured these skills [4]. Playing computer games in later life may substantially cut the risk of dementia, according to a new study. Activities which exercise the brain, including reading novels and playing computer games, can have a protective effect on the mind and help prevent memory loss.

Dr. John Harrison, a psychologist in the Department of Medicine at Imperial College, London shared his theories on the topic at the Games for Health Europe conference in Amsterdam, according to Wall Street Journal report [5]. He thinks that using video games can be a very effective tool in helping to treat Alzheimer's and believes that games designed specifically for Alzheimer's patients may hold some promise in either treating the disease or slowing it down. Harrison said that these kinds of games could help in treating five different areas of brain function affected by Alzheimer's and they are: *executive functioning* (the ability to work out a strategy), *working memory* (the ability to use information and skills you have stored), *attention and concentration*, *episodic memory* (the ability to recall an event) and *psychomotor skills* (how quickly you can respond to events) [5].

Games for patients with dementia and Alzheimer's disease must be simple and uncomplicated with few steps. Patients' cognitive abilities may be childlike but we must not treat them like children. Criteria for choosing brain game for patients with dementia and Alzheimer's disease are [6]:

- Games must challenge the major cognitive functions language, memory, attention, visual spatial skills and executive function.
- Games must offer variety and time constraints. They should challenge the patient to perform at his peak at all times, and they should be designed to emulate cogni-tive skills used in the real world. Games must meet patients' demographic.
- Games should be fun in order to enjoy patients and encourage them to continue practice

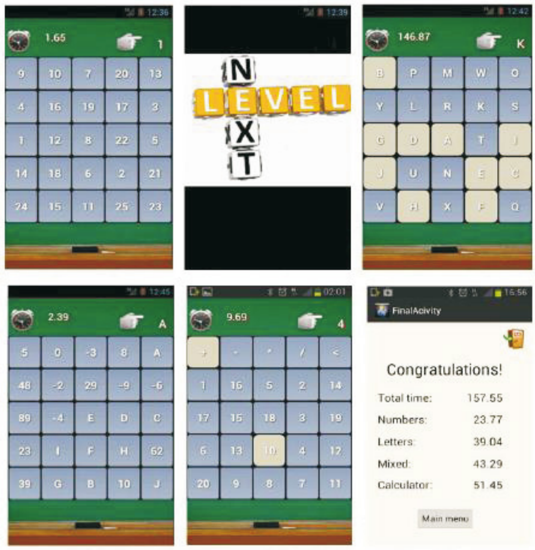
3 "Fight Alzheimer" Application

There are two types of users associated with the application. The first is the doctor who plays the role of the administrator by registering another user (doctor or patient) to the application, managing the profile of his patients and viewing the statistics of patients. The second type of user is an elderly person with or without Alzheimer disease who has the option to view the instructions of each of the developed games, play a game and view his/her statistics.

The design is implemented on a mobile device for the reason of portability. As it mentioned, the role of games is very important as they increase person's mental activity and mental function which can be helpful in addition to the medications which are being used with the disease. For that reason, it is preferable for a patient to play games in mobile devices because he/she can use them anytime and everywhere. In that way he/she has the opportunity to exercise his brain more and daily not only in his doctor's clinic. The only thing that they have to do is to play without filling stress during the testing process. Considering the physical disability that can result from Alzheimer, it is also apparent that a choice of device that requires minimal effort be made. Touch screen devices have been found useful and easy to use by Alzheimer's patients in early stage. The use of keyboard and mouse requires a lot of coordination which might be difficult or even impossible for some patients.

User centred design was used for the development of "Fight Alzheimer" application in order to ensure that the user's needs and requirements are met. It involves an iterative process of going through design, prototyping and evaluation until a satisfactory design has been achieved. One doctor was involved to justify the requirements during the iterations. The final version of prototypes was implemented using Android development environment by using the Java programming language. In "Fight Alzheimer" application four different games were developed. They are described below.

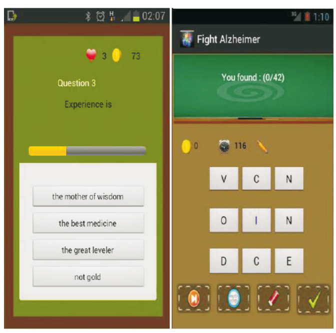
Game1: Sort them (Figure 1) is a game based on speed and observation. The game consists of 4 modes which player has to play consecutively as different levels. Its basic rule is simple: touch the numbers/letters in the appropriate order as fast as you can.



[Fig. 1] *Sort them* game

Game modes: *Numbers* (The player has to touch the numbers from 1–25 as fast as he can), *Letters* (The player has to touch the letters from A–Y as fast as can.), *Mixed* (Firstly the player has to touch the letters (ascending order), secondly the numbers (ascending order) as fast as he can) and *Calculator* (The player has to calculate the number indicated at top right corner (using the numbers and the signs of the board e.g. 20 → 2×10 or 15+5 etc.) If user doesn't know what to touch (in any game level), there is an indicator at top of the board (hand) indicating the appropriate letter/number to touch.

Game2: Word Finder (Figure 2a), the aim of this game is to find as many hidden words as user can within two minutes! The words that user find must consist of at least 4 letters and certainly contain the central character (in any position). For each word which user finds, gets points depending on the size of the word, and wins an additional 15 seconds. If user finds all the words then go to next "puzzle" automatically getting extra points because he/she found them all, plus additional points depending on the seconds left over. If user gets stuck at some "puzzle" he/she has the opportunity to change it and go to another. He can make it up to 4 times. If user has found a 55 % of words in PUZZLE, he can go to the next without any loss.



[Fig. 2] a) *Word Finder* game; b) *Proverbs* game

Game3: Proverbs (Figure 2b), game contains four possible answers. The user has to answer as many questions as he can, and collect as many points as he can. For each question he has 15 sec. The quickest rewarded with more points.

Game4: Photo quiz has the same philosophy as Proverbs game but with images.

The program can be run on android enabled mobile device for the reason of platform independent and portability. It would be overly restrictive if the application can only be run on a single hardware implementation. Motorola, Sony, HTC, Samsung and Toshiba, some of most famous hardware manufacturers are releasing 100's of android devices into the market due to its open source nature. The Android environment provides the opportunity to develop and test an application design on any android device or emulator without restrictions. It is preferable for a patient to play games in mobile devices because he/she can use them at their own convenient time and locations. In that way a patient has the opportunity to exercise his brain more and daily instead of only in his doctor's clinic. Playing at their own convenient time and location can make them without feeling stress during the testing process. Considering the physical disability that can result from Alzheimer, it is also apparent that a choice of device that requires minimal effort be made. Touch screen devices have been found useful and easy to use by Alzheimer's patients in early stage. The use of keyboard and mouse requires a lot of coordination which might be difficult or even impossible for some patients. based tests and "Fight Alzheimer" application coexist for a few years. Also, doctors believe that playing games causes the brain to be interacted and excited with the thought of winning. Patients concentrate on games, and therefore the stress is alleviated and they are expected to feel much better. Finally doctors highlighted that it is very difficult to conclude if "Fight Alzheimer" application could help in treatment of Alzheimer. That needs much more than 6 months in order to be tested with both diagnosed and not diagnosed with Alzheimer's disease groups of people.

A user-based evaluation was also carried out in order to assess the usefulness of the application. Although the doctors who took part in cognitive walkthrough evalua-tion have patients with Alzheimer disease, only three were in the early or mild stage and they didn't accept to take part in user evaluation. For this reason the "Fight Alzheimer" application was evaluated by 15 other elderly people (67–77 years olds) who are not diagnosed Alzheimer disease but with other brain problems. All of these people according to neurologists are in Predementia stage. All participants played the four games of the application. After the evaluation process they were asked to give their comments (describing what they are trying to do, why, what they believe is happening) about the application and answer to a 17-item questionnaire to measure the overall satisfaction. The results are summarized as follows:

- The interface of application is easy and pleasant to use.
- They can find theirs statistics easily.
- They enjoyed playing each of the games and they would like to play again.
- The most difficult game for them was the Word Finder game.
- During the game they did not feel anxious or being tested.
- They prefer playing digital games rather than filling the paper based tests.

4 Evaluation

Two expert-based evaluation techniques and user evaluation were used to evaluate the usability and usefulness of the application. Expert walkthrough is used to identify usability problems before the user evaluation in order to avoid significant bugs. Four HCI colleagues from the Computer Science department at the University of York volunteered to take part in the evaluation. The participants were briefed about the application and they used theirs android tablets to evaluate it. They asked to assess a found problem by giving a grade according to the severity of the problem. Participants were observed as they go about the evaluation. Behaviours and time taken to do some tasks was noted. The participants had a pleasant experience as they enjoyed the games. They found quite easily the navigation into the application and they grasped what was going on within a short period of time. So, they did not require much assistance. At the end of evaluation process each of them made a few observations and they had a discussion about them. The overall feedback was satisfactory. All problems were fixed and ways to improve the application were identified.

For the cognitive walkthrough evaluation three participants were carefully chosen and invited to perform it. All participants were Greek neurologists doctors specialized to Alzheimer disease with many years' experience. Doctors performed the cognitive walkthrough evaluation at different times individually at their own clinics in Greece using theirs Android tablet. Before evaluation started, participants were reminded that the "Fight Alzheimer" application is intended for elderly people without diagnosed Alzheimer's disease and patients at the first stage (Early or Mild) of the disease. The doctors were asked to sign an Informed Consent Agreement. A description of the application was given to evaluators along with some predesigned tasks. All doctors reach the following remarks. "Fight Alzheimer" application is a quite good transformation of paper based games to computer games. Undoubtedly it could be able to contribute to diagnosis of Alzheimer disease and replace the paper based format as it fulfils the brain criteria of good games but it needs time to be achieved. The reason for this is that elderly people, mainly in Greece where the evaluation was done, are not so familiar with this type of technology. So, it would be preferable if paper Project Overview

This project has started out with an overview into autism, which delved into its different categorizations, the non-computer-aided communication tools already in place for dealing with this disorder and finally a thorough critique of already existing applications that address this or similar problems.

It then progressed onto the requirements elicitation process that was achieved by combining what was uncovered in the literature review with discussions with several experts in the field.

A user-centered approach was used throughout the entire project and extreme care was taken whilst designing the application to make sure it complied with the usability needs of autistic children. The design went in fact through two prototyping iterations, which have been discussed and evaluated by experts in the field. The prototype, which was agreed upon, was then enhanced with the functionalities required in order to meet the requirements for this project.

Based on this design, an Android application was then developed. The implementation also went through two iterations. After the first one, a cumulative evaluation by an expert and the mother of an autistic child was carried out and a reviewed implementation was provided in order to address all the problems that had been found in the previous evaluation.

Rigorous testing was conducted in order to make sure it complied with the requirements that had been set out and that it worked according to design.

A user-based evaluation was then conducted by publishing the application on the Google Play. It was awarded 3.5 out of 5 stars and the Google Play statistics showed that 50 % of the people that downloaded the application decided to keep it, meaning that they must have found it useful.

5 Conclusion

Alzheimer's is the most common form of dementia and one of the most disabling afflictions among older people. Although Alzheimer's is detected more often among senior citizens individuals as young as 50 may show signs of Alzheimer's. It holds no boundaries and it is located cross culturally and it is found in both sexes in equal proportions.

This project aims to create an android application with games for both doctors and patients. Its aim was to help in diagnosing and treatment of dementia and more specifically Alzheimer disease keeping the patient enthusiastic without the filling of being tested. The idea of "Fight Alzheimer" application was based on two things. The first was that in medical sector this type of application would be helpful. That's because historically, doctors examine the progress of their patients through games in a paper format and there is no android application to help them in diagnosis and treatment of dementia and Alzheimer disease. This type of application will therefore help them in this regard. The second was to prevent people with dementia and Alzheimer to develop depressive symptoms when realising that they are losing their minds gradually.

In general, the idea of transforming the paper-based tests for diagnosis and treatment of Alzheimer's disease to an android application with games has been realized and evaluated. The application could be used to improve the self-esteem, confidence and social interaction of patients. The demand of the type of applications remains great in order to make other types of disabled individuals benefit from it. We must not forget that Alzheimer and all diseases have no boundaries. All of us are possible pa-tients in the future and all of them were like us someday!

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For a Translating System from Arabic Text to Sign Language

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Keywords: deaf person, communication, translation, Sign Language, Arabic language

Abstract

The World Federation of Deaf (WFD) claims to present 70 millions of deaf people worldwide. Deaf person present a high percentage of the people in the world. This community needs a focus especially on communication that present a vital need.
A sign language is a small subset of possible forms of gesture communication. In which we use the visual channel instead of sound to convey meaning by combining simultaneously hand shapes, orientation and movement of the hands, arms or body, and facial expressions to fluidly express a speaker's thoughts. The sign language remained nevertheless a fully-fledged language, with its own constructional method of the sentences. Furthermore, contrary to popular belief, sign language is not universal. Wherever communities of deaf people exist, sign languages develop, but as with spoken languages, these vary from region to region. Hundreds of sign languages are in use around the world and are at the core of local Deaf cultures. Some sign languages have obtained some form of legal recognition, while others have no status at all [1]. In this context the research laboratory Latice of the university of Tunis has been devoted during several years to develop the project WebSign aiming to translate automatically the written text to sign language. Our future lays down a contribution module for the WebSign project, we are interested in the Arabic language as an input of the system.

1 Introduction

Sign Language introduces the main way of communication between deaf and no-deaf people. It's a visual language that uses a system of manual, facial and body movements as the means of communication. Different Sign Language is used in different countries, such as: French Sign Language (FSL), American Sign Language (ASL), Bitch sign Language (BSL)… These languages are acquired by deaf children in the same timeframe as spoken languages and this acquisition process shows similar patterns and milestones as a spoken language acquisition process. Therefore, to learrn sign language is the only way for communication with deaf people knowing that most of them do not know how to read or to write. For this reason, to have translating tools that can be able to translate a written text to Sign Language is very useful. The translator is a tool that translates one language to another. Many translators exist for many languages, but few of them are focused on sign language as an input or output of their systems.

In this context Latice laboratory devoted many effort to toward building the different modules of the system Websign that take as input a written text and gives the translation in sign language at the real time. The main goal of our project Wesbsign is to develop a Web-based interpreter of Sign Language (SL). This tool would enable people who do not know Sign Language to communicate with deaf individuals [2]. Our work is a contribution for the project WebSign and especially for the input of the system that is the Arabic language. Different systems have been proposed in the literature for many languages as English, French… But not for Arabic Language, that's may be the result of the difficulty of this language and in particular its linguistic treatment.

The rest of this paper is structured as follows. In Section 2, we present an overview of various kind of machine translation for sign language. Section 3 is devoted to present the main problematic of our project and the approach proposed. In this section we will present Arabic language as the input of our system and its particularities. Then a global architecture of our work will be illustrated accompanied with an explication for all the modules.

2 State of art

From the Eighties, researchers begin to analyze and process sign language. Next, they design and develop routines for communication intra-deaf and between hearing and deaf people. Starting from the design of automatic annotation system of the various components of sign language and coming to the 3D synthesis of signs through virtual avatars [3]. In recent years, there was the appearance of the Machine Translation (MT). It's a subfield of natural language processing, which explores the utilization of computer software to translate speech or text from one language to another. Another researcher has defined MT as conventional and standard name for computerized systems that are accountable for production of translations, with or without human assistance [4]. There are many method of MT such as: Statistical MT (SMT), Rule-Based MT (RBMT), Example-Based MT (EBMT), Transfer-Based MT and Hybrid Based MT. Multitude of machine translation exists in the world for many language but few of them are focused in Sign Language as input or output of their systems. In what follows, we present a different translation system existing.

2.1 TESSA

A Speech-To-British Sign Language (BSL) translation system that aims to provide a communication aid between a deaf person and a Post Office clerk. The system uses formulaic grammar approach where a set of pre-defined phrases are stored and translation is done by using a phrase lookup table. However, the use of small set of sentences as templates makes TESSA a very domain specific system. It assumes a very restricted discourse between the participants [5].

2.2 The TEAM project

This project was proposed by Zhao, K. Kipper, W. Schuler, C. Vogler, N. Badler, and M. Palmer [6]. It's a Text-To-ASL translation system where, the STAG (Synchronous Tree Adjoining Grammar) formalism is used to represent source text into ASL syntactic structure. The system maintains a bilingual lexicon to identify the valid word-sign pair. The output of the linguistic module was a written ASL gloss notation. The manual and non-manual information, including the morphological variation, are embedded within the ASL gloss notation. The output of the synthesis module uses animated human models (Avatar).

2.3 ZARDOZ System

The ZARDOZ system is a multilingual sign translation system which is designed to translate spoken language (specifically English text) into a number of different sign language, in particular ISL (Iritch), ASL (American) and JSL (Japanese). ZARDOZ adopt an interlingua approach which places a language independent interface between source and target. Rather than attempting to construct a universal grammar generalizing over the syntactic forms of many languages. ZARDOZ system takes the knowledge based path of modeling sentence meaning in the interlingua. This reflects the origins of ZARDOZ in the TWIG knowledge-acquisition system.

In addition, (Morrissey and Way, 2005, 2006) and (Morrissey et al., 2007) proposed a system using example-based methodologies as part of a data-driven framework. (Stein et al., 2006) has proposed a statistical MT system which uses Hidden Markov Model and IBM models for training the data. (Chiu et al., 2007) also present a Statistical approach for their work with Chinese and Taiwanese Sign Language.

3 Contribution

3.1 Problematic

Deaf people around the world are suffering from hardship of social integration. Sign Language presents the only way of communication between deaf and no deaf person. The Global Horizon for the deaf estimates that around 10 million of deaf people in the Arabic countries. This rate presents 14 % of the deaf people in the world, who needs a lot of attention, with the evolution of technologies and tools of communication in our life. Deaf people have the right to benefit from this progress. In this context, in our wok we try to provide a translating system from Arabic text to Sign language. Therefore, we contribute in reducing the language barrier between deaf and hearing people.

3.2 Approach

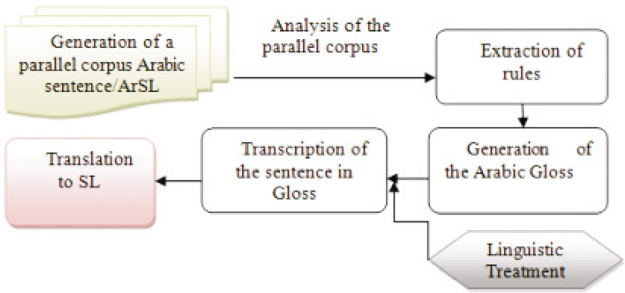
Our Objectives is to contribute in the improvement of project WebSign by widening the set of languages input, that covers. We tend to provide an automatic translation system from Arabic text to sign language with a special focus on syntactic and semantic analysis of the input text in order to extract the maximum of inherent information that can be useful to the translation step. The particularity of our work comes from the particularity of the input language.

3.2.1 Particularity of input language

Arabic is a Semitic language that is written from the right to the left, composed of 28 letters. Most of the expert in NLP (Natural Language Processing) proves the complexity of this language. Arabic is widely considered as one of the most difficult languages to deal with, knowing that in Arabic language we have the presence of diacritical marks that are added above or below the letter, the absence of vowel that causes an ambiguity to identify the right position of the word in the sentence (The word فتح without vowel can be interpreted as فَتْحٌ 'opening', فَتِّحْ 'open', فُتِحَ 'it was opened',...) and the absence of capitalization to differentiate the proper nouns, acronyms and abbreviation,... Arabic language processing requires a lot of information: lexical, grammatical and semantic analysis to translate it then in sign language.

3.2.2 General architecture of our system

Our objective is to develop a translation module from Arabic text to Sign Language to be integrated in the WebSign project. Our system is composed of different module as shown in the following figure.



[Fig. 1] Global architecture of our module

- Generation of parallel corpus Arabic sentence /ArSL

  To develop a translation system from Arabic text or any other language to sign language, requires a construction of parallel corpus. This corpus is composed of Arabic text paired with its translation in Sign Language. This alignment between source and target language needs a collection of a great volume of data. For Arabic text, the collection of data represents a matter. The construction of this corpus is one of the problems encountered during the design of our project. With the lack of necessary data, we already started to contact the experts on ArSL to collaborate for the building of this parallel corpus to be then exploited for the next step of our system.
- Extraction of rules

  This step is the most important one in our system. These rules present the output of the analysis of our parallel corpus. With these rules we can define the Arabic Gloss as an intermediate form between Arabic text and ArSL. The translation of sentence in any other language, are not word by word. There are very important treatments to attain the target sentence as shown in the following figure.
- Generation of the Arabic Gloss

  By analogy to the American Sign Language Gloss for English, the construction of an Arabic Gloss to be used as an intermediate representation of the Arabic sentence to translate needs a lot of processing especially with the absence of existing work dealing with Arabic language. Glosses are not just words in Arabic. It is an alignment model and suppression of some words that cannot be translated [7] (see fig. 2). From the rules extracted in the previous step we can generate the Arabic Gloss as an intermediate form needs for the transcription of the sentence in ArSL.

[Fig. 2] Intermediate phase between Arabic text and ArSL

- Linguistic treatment

The language processing is a very important area to fully exploit the spoken language. The objective is to analyze the written text in order to extract the most relevant information. The language treatment operates this in both linguistic and IT fields in order to extract as much information as possible. The process of language treatment is divided into several stages. First, the original text goes through a morpho-syntactic analysis using a well-specified lexicon, grammatical and morphological rules. The result of this step is a syntactic representation of level 1 that will be analyzed semantically [8], [9] to achieve a representation of level2.

For the linguistic treatment we have used the Stanford Parser which ensures the segmentation of a sentence and returns the set of segmented words with their grammatical category (see fig. 3). This information is important to generate the Arabic Gloss and hence to reduce the error of translation of sentences.

[Fig. 3] Output of Stanford Parser for the sentence "the boy went to the school"

4 Conclusion

In this paper, we gave an overview of our system that presents a translation module from Arabic text to Sign Language. We presented a state of art of the Machine Trans-lation and their different method based. In addition to that, we present the particularity of the source language and the problems encountered related to the choice of this language as an input of our project. We illustrate then the global architecture of our system in which we explain the different steps of our work.

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Accessibility in Virtual Learning Environments: An Experience of Staff Training in Latin-America

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Abstract

E-Learning solutions adopted by several institutions, including Higher Education Institutions (HEIs) are encouraged to validate and promote accessibility in a Virtual Learning Environment (VLE). A large myriad of research related to accessibility in distance education systems is available in literature. In the same way, international initiatives provide guidelines to create accessible web content (e.g. WCAG 2.0), but educational institutions in some countries, especially in Latin-America (LA), are not aware of the VLE barriers that could affect people with disabilities. The initiative presented in this article, promoted by ESVI-AL project, is looking to improve accessibility in virtual higher education in Latin-America through an intensive training workshop oriented to administrators of a virtual campus. A massive staff training experience was implemented in seven countries in Latin-America with more than 180 participants from 52 different HEIs. Results from the experience are presented, showing a growing interest from HEIs in accessibility topics for establishing a Cooperation Network for LA, related to accessibility in virtual education and society.

1 Introduction

Accessibility, adaptability and usability are well known topics tackled by different researches related to Virtual Learning Environments (VLE) [Bühler et al., 2007], [Gay et al., 2009], [Hersh, 2008], [Perakovic, Remenar & Perisa, 2012], [Power et al., 2010]. In terms of Universal Learning Design [Rose, 2001], a VLE implemented in an educational institution should include functionalities to provide different means of representation of learning contents, a solution that works for everyone, a truly flexible approach. In the context of Latin-America (LA), the basic legislation related to Accessibility for All is the Convention on the Rights of Persons with Disabilities (CRPD) [United Nations, 2006], [Kayess & French, 2008] although most of the developing countries in LA [Abou-Zahra & Henry, 2010], [Kelly, Lewthwaite & Sloan, 2010] do not have national laws that enforces accomplishment of CRPD topics, unlike what happens with legislation in developed countries [Hricko, 2003]. The CRPD highlights in Article 9 the production of accessible content in early stages at minimum costs, providing access to Information and Communications Technology (ICT) for People with Disabilities (PWD). The CRPD and the current state of legislation related to accessibility in LA attracted the attention to develop a training workshop about accessibility in VLE for staff involved in the educational process in Higher Education Institutions (HEIs).

This article presents the content used for the training workshop, identified after a state of the art of studies about accessibility, adaptability and usability of the most popular Open source VLEs [Burgstahler, 2002], [Graf & List, 2005], [Iglesias et al., 2011] and the results for a first training experience. The rest of the paper is structured as follows: Section 2 gives an outline of the training workshop proposed by ESVI-AL initiative, and then in Section 3 a brief description of the staff training experience is presented. Finally conclusions and future work are presented in Section 4.

2 Training workshop description

Nowadays more than a hundred standards related to quality, accessibility and adaptability of virtual training [Fabregat et al., 2010], [Amado-Salvatierra, Hernández & Hilera, 2012], [Hilera, Hoya & Vilar, 2011], [Pons, Hilera & Pages, 2011] can be identified, so information must be prepared with implementation experiences and best practices in order to have a useful workshop for staff involved in an e-learning process.

Accessibility evaluation of virtual learning environments aims to check two main elements:

1. The learning management system (LMS), as part of the virtual campus, including accessibility for all collaborative services offered by an institution (e.g. email, forums, chats, wikis, etc.). Also editing services (e.g. WYSIWYG editors, the integrated email message editor, etc.), and complementary services that require additional software activation by the user (e.g. audio players, video, etc.).
2. The educational resources published on the learning platform. If a platform meets the criteria for accessibility (e.g. WCAG 2.0) [ISO, 2012] but educational resources (documents, multimedia presentations, etc.) are not accessible, then the virtual campus is not accessible. It is very important to maintain a continuous process of training for users involved in using virtual campus, to be aware that such content must be accessible.

Based on previous studies on assessments of accessibility, adaptability and usability factors [Burgstahler, 2002], [Graf & List, 2005], [Iglesias et al., 2011], the best evaluated open source LMS platforms are, in descending order: ATutor, Moodle and dotLRN. Moodle is being used for several HEIs in Latin-America, providing better support capacity, greater impact and a minimal learning curve for implementing functionalities of a Virtual Campus accessible platform. For this experience Moodle LMS was selected as the baseline LMS for the training workshop [Amado-Salvatierra, 2013], but contents were defined to be generic so that institutions using other LMS can also use them.

2.1 Training workshop objectives and content

A training workshop for staff involved in virtual learning environment administration was prepared as a blended learning experience with the following objectives:

- Identifying the importance of web accessibility in a virtual campus for people with disabilities.
- Identifying key standards and accessibility standards applicable to a virtual campus.
- Using tools for automatic evaluation of the accessibility of educational content and virtual campus.
- Applying criteria according to a heuristic evaluation of accessibility.
- Getting the basic knowledge to adapt and maintain accessibility in a virtual campus based on Moodle.

Learning units for the training workshop were prepared using the special chapter on accessibility requirements in the ESVI-AL methodology guidelines [Amado-Salvatierra, 2013] (Figure 1 shows the front cover of the guidelines book) and following international standards for web content accessibility and guidelines proposed by the WAI initiative [W3C, 2014].

The learning units are the following:

1. Introduction to web accessibility and related standards.
2. Accessibility requirements for Virtual Learning Environments.
3. Installing, validating and maintaining an accessible Virtual Learning Environment based on Moodle.
4. How to create Accessible Educational Resources.

The course content also included the main techniques that an administrator of a virtual campus should know to make accessible digital educational materials in the most commonly used virtual training formats: text documents, slide presentations, PDF files, videos, audio books or websites with the aim of they will share the experience to teachers in their own academic institution. Creating accessible educational resources [Oton et al., 2013] is also tackled in this approach.

[Fig. 1] Front cover of ESVI-AL book guidelines [Hilera, 2013]

2.2 Teaching methodology implemented

For each of the learning units listed in 2.1 for online sessions, the following methodology is applied to achieve the learning objectives:

- Reading, analyzing and studying educational content: Students must spend time reading and assimilating the contents of the learning unit, which are presented in a sequence of interactive web pages. Following Universal Learning Design guidelines, students also have the opportunity to download the contents of a learning unit in different file formats (a single PDF or word processor files such as DOC, DOCX and ODT). The educational contents of a lesson are available in the learning platform the first day of the week assigned to that learning unit in the academic schedule.
- Self-assessment of knowledge: Through the learning platform, in order to students can check they have properly achieved the learning objectives, a self-assessment test is provided for each learning unit.
- Theoretical knowledge assessment test: The methodology strategy includes different assessment tests as part of the activities of each unit in the course, so that the teacher is able to check the proper assimilation of educational content by the students.
- Participation in discussion forums: Each unit is prepared with different discussion topics related to the content, thereby promoting intervention and socialization of students through the virtual campus.
- Study of solved case studies: Students have several practical cases related to the theoretical content of the learning unit, as well as the solution to that exercise, which enables learning how to solve similar cases, especially technical issues related to web and content accessibility.
- Multimedia content exploration: The students have at least three short videos, prepared following accessibility guidelines (WCAG 2.0) [ISO 40500, 2012] (e.g. closed captions, audio description, alternative content). The proposed short videos follow accessible Massive Open Online Course (MOOC) [Hernández et al., 2013] web practices, which are:
  - A presentation video of the learning unit.
  - An explanation video of a topic to be discussed in forums.
  - An explanation video of a solved practical exercise.
- Conducting practical classroom activities: Each of the sessions has a scheduled face to face meeting to reinforce learned contents, resolve inquiries from students and share practical experiences with a tutor and an invited guest from Latin American Union for the Blind (ULAC) or Disabled Peoples' International organization (DPI) for sensitization activities.

The dedication of the students is intended for five hours a week for online activities and an average of fifteen hours in the face to face meeting session, plus the dedication to a final project work estimated to take five hours. The online content is provided using an accessible virtual campus adaptation based on Moodle LMS, available at http://campus.esvial.org.

As a starting point, a sensitization activity was scheduled in order to the students become aware of the importance of accessibility features for participants with disabilities. To do this, students are provided with different general resources about accessibility: documents, videos and web links. For the same purpose the students are encouraged to install a screen reader (e.g. NVDA) to experience how blind users explore the web. They are also invited to get in the situation of a deaf user, turning off the volume of the computer, and try to play videos available on the web. In the face to face meetings, members of ULAC are invited to share their experiences with the participants. Figure 2, presents an example of the sensitization activities at Universidad Continental in Huancayo, Perú.

[Fig. 2] Sensitization activities for sighted people at Universidad Continental, Perú

2.3 Dissemination approach

The staff training approach is an initiative of ESVI-AL project [ESVIAL, 2011] (www.esvial.org) "Educación Superior Virtual Inclusiva – América Latina" (Accessible and Inclusive Virtual Higher Education in Latin-America), an initiative partially supported by the European Commission through the ALFA III programme. Fourteen organizations are involved in the project, including 10 universities from Latin-America (LA) and Europe (EU): Universidad Técnica Particular de Loja, Ecuador; Universidad Continental, Perú; Universidad Católica del Norte, Colombia; Universidad Politécnica de El Salvador, El Salvador; Universidad de la República, Uruguay; Universidad Nacional de Asunción, Paraguay; Universidad de Lisboa, Portugal; Helsinki University of Applied Sciences, Finlandia; Universidad Galileo, Guatemala and Universidad de Alcalá (Spain) (coordinator). The project is supported by the following international associates: the Disabled Peoples' International organization (DPI), Latin American Union for the Blind (ULAC), International Social Security Association (AISS) and Virtual Educa (VE). The first experiences were scheduled in the seven countries with partners in LA, inviting staff from all the HEIs in the region and future editions will be provided online as a MOOC prepared by the ESVI-AL Cooperation Network about Accessibility in Virtual Education and Society.

3 Staff training experience

The staff training workshop on accessibility was implemented in seven countries (El Salvador, Uruguay, Colombia, Paraguay, Ecuador, Peru and Guatemala), having a total of 182 participants (60 women and 122 men). Table 1 presents participants distribution in each edition of the training experience. From the total of participants, 140 participated in the complete blended learning experience and 43 participated only in the virtual session. A total of 52 different educational institutions were represented in the experience. Figure 3 presents a group of participants at Universidad Galileo, Guatemala, Figure 4 presents a group of participants in Universidad Nacional de Asunción (UNA), Paraguay.

[Fig. 3] Staff participants of the training experience at Universidad Galileo, Guatemala

[Table 1] Total participants for each edition of the staff training experience in year 2013

Country	Institution	Dates	Number of participants
El Salvador	Universidad Politécnica de El Salvador	August 26–29	17
Guatemala	Universidad Galileo	September 2–6	17
Paraguay	Universidad Nacional de Asunción	September 10–13	28
Peru	Universidad Continental	October 3–4	31
Ecuador	Universidad Técnica Particular de Loja	October 7–10	18
Colombia	Universidad Católica del Norte	November 12–15	31
Uruguay	Universidad de la República	November 25–28	40

Participants were invited to evaluate the training experience and a total of 107 participants (59 %) completed the evaluation. The results are presented in Table 2 with a 4-point Likert scale. Constructors for the evaluation metrics present an average grade for tutors (A1–A6) 90.69 %, and for the content (B1–B4) 89.81 %.

[Table 2] Overall evaluation of the staff training experience (metric items)

Id	Evaluation metric	Average results (over 100 %)
A1	Tutor's mastery of course topics or curricular activity	94.16
A2	Clear and correct answer to question	91.12
A3	Order, consistency and clarity in the presentation of topics	89.85
A4	Was the methodology proposed in the course successful?	86.92
A5	How was the quality and relevance of the content?	90.65
A6	Consistency between assessment exercises and course contents	91.36
B1	Achievement of the objectives formulated in the course	87.15
B2	Convenience of the amount of activities/material for each unit	85.75
B3	Quality and relevance of the course content	91.36
B4	Importance and application of knowledge acquired in the institution virtual campus	91.82

[Fig. 4] Participants of the training experience at UNA, Asunción, Paraguay.

4 Conclusions and Future work

The proposed staff training workshop implemented in seven countries (El Salvador, Uruguay, Colombia, Paraguay, Ecuador, Peru and Guatemala) had a good initial acceptance in Latin-America. Dissemination of accessibility guidelines was considered as a successful experience, where a total of 52 different institutions were represented in the training approach. A new edition of the staff training workshop will be prepared as a MOOC to reach a broader audience.

After the course, participants were asked to complete a workshop evaluation survey for quality measures. An evaluation with eleven items was prepared with a 4-point Likert scale. In total, for the seven editions of the workshop, 107 people agreed to participate in the anonymous evaluation with the following main results: Training tutors scale was 90.69 over 100 and Training contents scale was 89.8 over 100.

The ESVI-AL initiative has created and will maintain a Cooperation Network and Observatory about Accessibility in Virtual Education and Society, with all the publications of the project available in electronic format. Any HEI, company or academic institution interested in the topics related to inclusion of people with disabilities in virtual education will be admitted as a partner of the Network to exchange best practices and experiences.

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HaptOSM – A System Creating Tactile Maps for the Blind and Visually Impared

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Keywords: tactile map, blind, individual, OpenStreetMap, XML, G-Code, CNC, Braille paper

1 Motivation

Being able to move freely in public spaces should be a matter of course for everybody in today's society. Nevertheless, there is little opportunity, especially for the blind and visually impaired, to orientate themselves in advance before visiting a new town. A sighted person may just pull out an old map before visiting. But traditional maps are usually printed in colour on paper and are of little use to blind and visually impaired people. For those, information needs to be tactile, so that the fingers are able to "see" something. Of course, there are already commercial solutions for tactile maps available today. Those commercial maps are designed and created manually by trained specialists. In general those people take "normal" maps at a scale about 1:1000 (1 meter in reality is 1 millimetre on paper) and glue the tactile elements – often made out of cork – on the map. Then with the technique of thermoforming, a thin plastic foil is heated and sucked to the map so it takes form of the cork. One can easily see that this is a very complex and expensive process, and therefore not possible to produce for a single person. Due to that high effort needed to create such a map, these are rarely re-created and therefore often out of date. Taking for instance the city map of Marburg, a city with many blind residents: It costs € 99, and with a size of 40×40 cm, it is fairly impractical and dates from the year 1985 (cf. (Stehlik, 2008, S. 21)). For sighted people a 29 years old map – or an even older one – may not represent a problem. Naturally, he/she can see, whether and which places have changed. For a blind or visually impaired person it can, in certain circumstances, be essential for survival to know, whether a pedestrian crossing was moved or even abandoned. This project has the ambition to make it a bit easier for the blind and visually impaired to navigate and orientate in public spaces.

2 Idea

First of all there is the need for data, that contains special information for the blind and visually impaired. And furthermore this data has to be affordable. Because if the data is too expensive in the first place, we won't be able to create affordable maps in the end. Luckily current map data is by now available for almost all parts of the world under a free license on the OpenStreetMap-Project (OSM).[1] Besides the information on roads and frontiers, the OSM also contains information about side-walks and cycle ways. For a few years information for blind and visually impaired people is explicitly included in the OSM-Data:

1 http://www.openstreetmap.org

In the case of many communities, the OSM has already included information on existing support systems for the blind and visually impaired, such as tactile pavement surfaces, pedestrian crossings and pedestrian sound signals. The basic idea of the HaptOSM-project is to make the free map data more easily available for blind and visually impaired people.

A new method that makes the data palpable has been developed. When desired individual tactile paper maps can now be easily produced. The concept includes the development as well as the construction of the necessary hardware and in particular the implementation of the necessary software, which converts the OSM-data into the required format for the embossing machine. The requirements for the maps to be produced can be summarized as follows:

- embossing time < 1h
- translation from text in Braille according to DIN 32976
- height of the embossed elements > 0,5mm
- embossing on DIN A4 paper

Those items were chosen carefully maintaining a course that produces high quality at lowest cost possible.

3 State of the art

Experiments to produce tactile maps have already been made with swell paper, 3D printers, lasers and copper etchings. The HaptoRender Wiki-page[2] renders a schematic description of these results. Until now these projects were not able to be used commercially, in terms of price and the production time required, and have therefore hardly been followed up. The laser treatment of Finnboard for example requires a special CNC laser, which costs, even used, about € 20.000[3]. Another problem is the enormous amount of time: For example a test with a DIN A5 Finnboard took about 40 minutes and had to be constantly monitored since Finnboard is ammable[4]. Another example is the first tactile map ever made of OSM-Data, which is etched in copper. Pretty remarkable as a proof of concept it was complex in manufacturing and with its sharp edges and its possible adverse health effects, not really suited for everyday use. In July 2014 a variant with a 3D printer will probably be presented at the MakerFair in Hannover. However, it is debatable whether affordable maps could be produced with this method, since it is expensive and time-consuming. For instance, a base plate must always be printed before the actual map can be printed. One could use a base plate already produced but it is difficult to make the printed plastics stick to the base plate. The project has been discussed with the author – Christian Schuhmann – and he said that the printing of a test map only 10 by 10 centimetres took about 20 minutes.

2 http://wiki.openstreetmap.org/wiki/HaptoRender

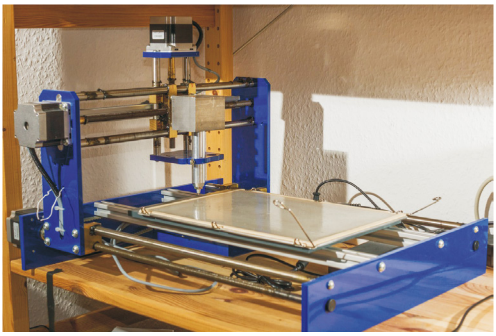
3 https://www.cameo-laser.de/nc/material/shop/vorfuehrgeraet-lasergraviersystem-cameo-elite-6030/gebrauchtgeraete.html

4 https://wiki.openstreetmap.org/wiki/User:Head/HaptoRender#Laser_cutting

4 Methodology used, R&D work

4.1 Hardware

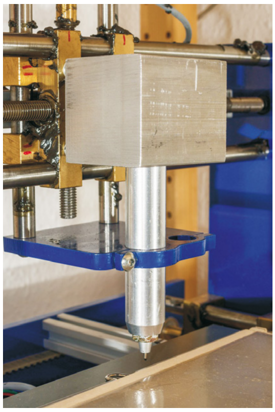
Instead of exploring completely new ways regarding the support material, HaptOSM uses normal Braille paper. This paper is for example used in the production of books in Braille and is therefore ideal for embossing. The next challenge was finding a cost effective method of embossing information on streets, areas and Braille according to need. The first try was posed in the effort to convert a dot matrix printer in such a way that the roller could be replaced by a soft rubber, in order to enable the pins to emboss the paper. Two major diculties, however, made the use of the dot matrix printer impossible: On the one hand, the rubber, which replaced the hard pinch roller, provided too little friction. The consequence: The paper could not be pushed forward in a smooth motion. On the other hand, although the pins penetrated deep enough, they did not return back fast enough. The pins repeatedly got stuck in the paper and thus rendered the embossing unsuitable. To make a long story short – it didn't produce the desired effects.



[Fig. 1] prototype of embossing machine (2012)

The second idea, which ultimately led to success, was the use of a portal CNC machine from the hobby range (Figure 1) with appropriate modifications. In this case the CNC machine provides three degrees of freedom (translation in X, Y, Z direction) and can move a special embossing pencil (Figure 3) anywhere on the Braille paper and emboss it. The Braille paper is placed on a specially made paper holder (Figure 2), which consists also of a soft silicone plate. A special weight is on top of the described pencil allowing constantly the same embossing depth. The combination of the special pencil and the soft surface allows the CNC machine to emboss the paper at any point now. The embossing of streets, areas and Braille is now possible without problems.

[Fig. 2] paper holder first attempt (2012)



[Fig. 3] special CNC pencil

To emboss on "the right place" the origin (X0 Y0 Z0) of the paper has to be known. As shown in the Video (see Section 7) this task was a bit tricky: The tip of the pencil has to be positioned directly on the lower left corner barley touching the paper. Fortunately it was possible to automate the process. For further details see section "Conclusion and planned activities" (Section 7).

4.2 Software

In addition to the hardware a software is required, which translates the map data into a CNC compatible format (G-code), is required. As already mentioned the map data is provided from the OSM and is available, among others, in a certain XML-format.

The most challenging task was the implementation of the software prototype. Although algorithms, which could be used in the conversion of OSM-data to G-code, are already available, these have mainly been written for pixel based images. The machine is, however, directed by means of coordinates and vectors. Therefore, the algorithms have been adapted. For example, for filling areas with appropriate shapes, the scan-line-algorithm has been converted to vector graphics (cf. (Sprengel, 2012, Chapter 16)). For another problem a new algorithm had to be developed from scratch: To prevent the pencil of the CNC machine from exceeding the edge of the paper and thus causing damage to the paper and/or the pencil, roads and tracks must be "cut off" to fit.

One basic principle the whole software development has been based on is stated by T. C. Edman in her Book "Tactile Graphics": "Keep it simple" (cf. (Edman, 1992, S.197)). Meaning that every information put on the map has to be a surplus. The resolution of the fingertips is considerably lower than that of the eyes. Therefore too much information can confuse the reader to the point of not understanding anything. Because of that the first prototype of the software only covers:

- distinction of streets and footways
- Braille labels for streetnames
- two different area types – forest & cemetery

Constructing an algorithm for placing the Braille labels was a problem, that was still not resolved up to this point of development. An entirely new solution had to be found. Due to size and the defined orientation, it cannot follow the course of the road – like the ettering of ordinary maps does. Braille has to be embossed “in a row” so the reading experience is already familiar and has not to be learned from scratch.

The particular challenge was to realize an optimal readability as well as a clear assignment of street names to the corresponding street. So there are some basic rules so that one can be sure which label belongs to which street:

- crossings must not be covered by a label
- a street runs always through the centre of a label
- if – because of too much information – a label covers another label, the label with the shorter street on the map pane is removed

This simple rules made up a good start and were sufficient for the prototype. Currently a new, more sophisticated algorithm is in progress to fix some minor disadvantages this one still has.

4.3 Elements of the tactile map

Following Poly K. Edman and her main question on tactile graphics “Is this information neccessary?” the decision was made to keep the number of different elements on the tactile map to a manageable count – at the prototype state. Two different types of ways can be distinguished at the moment: Footways (only those not shared with horses or bikes) are rendered as dashed line. So if there is such a line on the map the viewer can be sure not to be surprised by any vehicle. Every other road is rendered as continuous line. The OpenStreetMap offers eight “standard” types of streets and due to the extensible format a numerous of other types are also in use. The software of HaptOSM is very modular and so chaining the rendering style is done very quick if needed. Also adding new types of renderings are easy to implement.

In addition to streets and ways, HaptOSM offers the embossing of areas with corresponding symbols. The prototype can handle two different types of areas at the moment. The first one is forest. On commercial tactile maps forest feels often like the surface of a children’s toy off a famous Danish manufacturer. But for HaptOSM another way has been taken because those large dots take long to emboss with a pencil. Also the paper tends to tear while embossing surfaces. Forest is rendered using little triangles pointing upward. The reason is that those triangles are not likely to be confused with other elements on the map and still could be recognized as forest even if you don’t know. The second area type is cemetery. Cemetery is obviously rendered as small crosses.

Those two were chosen because they are easy to distinguish from each other and other elements of the map and be still easy enough to implement for a working prototype. Still adding further elements is a very easy task. The software just needs text-files describing the lines or dots the symbols should be made out of. These files are then dynamically loaded during execution. No further programming is necessary.

While placing Braille labels one more important thing should be mentioned: Braille is read only good if nothing interferes with the dots. Therefore another algorithm was implemented “clearing” all the lines off the map where there should be a Braille label placed.

5 Test & Results

5.1 Internal tests

The internal test were aimed at checking weather the technical specication are met. First of all: The machine is actually able to produce a map in about 15 minutes average – mostly depending on how many elements have to be embossed. Embossing Braille takes usually most of the time, because the pencil has to move up and down for every dot. And must furthermore make a small circle cause the tip of the pencil does not match the precise size needed. Those 15 minutes in average include downloading the data from the OSM-Server, processing this data to g-code, preparing the paper on the CNC machine and finally embossing the paper. Figure 5 shows the first test map meeting the technical specifications.

Second: The Braille letters are 100% standard, according to the DIN 32976, that species the distance between the dots and also the height of at least 0.5 mm. The Braille dots on the tactile map of HaptOSM are 0.6 mm. They could be embossed deeper, but while embossing lines, the paper is likely to tear.

5.2 External tests

In order to learn how the map proves themselves under real conditions, close contact with the Association of the blind and visually impaired people of Lower Saxony (german: Blinden- und Sehbehindertenverband Niedersachsen e.V. – short: BVN) has been made. There, a test map covering the area of the BVN was subjected to two experts. A great amount of time was spent on putting the map to the test. The map was embossed on nine sheets of A4 paper covering a three by three matrix. Due to the high accurate Braille letters, discovering the "up-right" of the map was very easy for the experts.

Fortunately two testers with two different backgrounds were available: One was blind at birth, the other one lost his eye-sight later his life. Both had no problem in recognizing streets and footways, assigning Braille script to the according street and discovering little triangles as woods. Despite these features they were also happy with the following:

- the readability of the elements,
- the density of the information (not too much and not too little),
- the Braille script conforming to standards,
- the clear distinction being made between streets, sidewalks and foot paths,
- the use of paper for the maps as a carrier medium.

The preliminary considerations were therefore leading in the right direction, and the choice of the carrier medium proved to be a success. Particularly the high accuracy of the map was emphasized: In schools for the blind and visually impaired, maps are usually created by "connecting" building blocks of the previously mentioned Danish toy manufacturer.

This method merely enables right angles. The HaptOSM-map, however, depicts roads as they exist in reality.

6 Scientic and practical impact

The “right to inclusion” has recently been introduced in Germany. This means, among other things, that pupils with special needs have to be taught in regular schools. To visually impaired students, for example in geography lessons, HaptOSM can offer a map, which can be understood by them. Another scope is the indoor navigation. Stations, cultural and leisure facilities, hotels, shopping malls, public departments and authorities can provide HaptOSM-indoor maps to visitors, enabling the blind and visually impaired people to explore new places independently. Of course the software is build modularly All in all a new kind of mobility and thus a more independent and self-evident participation in public life is achieved.

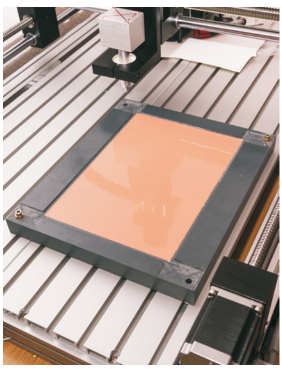
7 Conclusion and planned activities

This paper describes briefly the development of hardware and software for the affordable production of individual tactile maps for blind and visually impaired people. With the presented method it is possible to convert OSM-data of any map section automatically in G-code, in order to produce a tactile map on standard Braille paper in a short time.

To make the process of embossing an easier task, a new paper-holder has been designed (Figure 4). It took some time, but nally a piece of PE[5] has been milled according to the design. Also the new machine is able to nd the origin of the paper itself. Manual adjustments are no longer needed, making it conceivable that the machine could be available at school s or associations in the future.

A web-service were one can order the HaptOSM-map is planned to be launched within the month of April. Customers will be able to fill in a small form and the finished map will be sent by mail a few days later.

As stated earlier: The algorithm positioning the names of streets in Braille script is not without flaws. Currently a bachelor student at the University of applied science and arts of Hannover is working on a more sophisticated algorithm. Depending on the progress of the thesis, some of that work might be presented at the ICCHP in July.



[Fig. 4] new paper holder made of PE

A video, demonstrating the process of embossing a new map can be found here: http://www.youtube.com/watch?v=j4JVMZRfkEw. It is showing the state of 2012.

5 Polyethylene – a common plastic polymer

The new machine as shown with the new paper holder in Figure 4 is a lot more faster and more reliable. Also it could produce maps up to DIN A3 if needed.

[Fig. 5] first test map meeting the specications

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Tools for Working in Sign Language and for Editing Bilingual Documents

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Keywords: Sign Language

1 Introduction

Currently, in many countries, the sign languages (SL) are recognized, in attitudes or officially. But even when they are recognized by the law, they are still not used in the public domain. However, for the deaf, accessibility to SL in all areas of everyday life is an important criterion of accessibility.

Deaf have the right to work, to receive the informations or to learn in SL. First, because it is their language. Being able to practice an activity in SL guarantees efficiency, accuracy, but also comfort and pleasure. But also because the other language, French[1], is a second language that is accessible only in written form and is more or less understood, often poorly, as shown in the high rate of illiteracy among deaf.

This right must be applicable in all areas, but particularly in training because shortcomings in this area have repercussions in the social and professional integration and in the personal development of the deaf people.

2 Problematic

However, the use of the SL as a working language or as a learning language introduces difficulties. The main difficulty is that the SL have no written forms commonly used. We therefore use the video. It is already used to store or broadcast the utterances in SL. And there are easy to use tools for capturing and editing. But this is insufficient. A SL-video document can be accessed only linearly[2]. Thus, reading is long and daunting therefore inefficient. It is therefore necessary to be able to produce structured documents, to have direct access to components and to allow a non-linear path.

On the other hand, needs are not confined to build or to read documents. For example, in education, we must also build exercises, correct the homeworks (their form and their content) and allow students to share. In teaching the sign language, teachers need to show and to explain how sign language works, mainly its specificities like the use of the space, the exploitation of iconicity in grammatical structures (taking roles), the simultaneous use of different body parts (torso movements, facial expressions, gaze direction, head movement, configurations and movements of hands, etc.). They need more elaborate tools than basic video to show how this works.

1 The examples concern the French Sign Language and the French Language but apply to most Sign Languages and vocal languages of the same countries.

2 We can structure a video into chapters, but reading requires the use of the French language. The other media (DVD) are complex to manufacture and therefore do not meet our goals.

3 Goals

To allow work in SL and in particular to easily produce structured documents in SL and access appropriately (nonlinearly), we need a set of tools giving to the video a status equivalent to that of a written for vocal languages. To be actually used, these tools must meet some constraints :

- Ease of use, both to produce these documents, to disseminate them and to use them.
- Their implementation should therefore not require greater expertise than that required to use a word processor and should not cause a time overhead due to the use of the tool.
- Finally, this production must be incremental and the documents should be changed.

4 State of the art

The first and most common applications provide bilingual lexicons or dictionaries, French-sign language, on the web[3].

Currently new online services are created: teaching of sign language or training services in sign language services. But these achievements are beyond the scope of our work. What interests us is what form these sites provide users with documents sign language, how these users keep track of their participation and how can users interact with each other.

Some services offer content in sign language. Technologies have been developed for the simultaneous display of sign language video and written text (eg. Videotext.web)[4]. More ambitious systems seek to provide the concept of hypertext documents, in sign language (AILB project) [1].

SignLink studio [2] is the more advanced system. One of its strengths is the proposal of a development environment. Among the applications we propose, the concept of "hypersigne" [3] has similar goals with different technologies.

5 Tools for working in SL or for producing and using bilingual documents

A document in sign language is necessarily a video. To produce such a document, it is sufficient to record a sequence of sign language and there are now cheap and practical tools to do so, both hardware (webcam, camcorder) and software (editing software, such as iMovie or Windows Movie Maker, or conversion and compression, as Handbrake or Miro Video Converter). But this type of document, a video of a few minutes, has several drawbacks:

- It is not structured; all informations are at the same level. And one doesn't have global visibility on its content.
- It requires a linear reading of the entire document to access the content.
- Beyond a few minutes, its reading is often tedious.
- The video is the format of the SL documents.

3 Wikisign: http://lsf.wikisign.org, Elix: http://www.elix-lsf.fr, Culinan: http://www.culinan.net/

4 See for example: http://archiv.oegsbarrierefrei.at/videotext.asp?cid=48&vid=376

But to produce documents that are rich, informative and truly accessible, one must enable it to play a role equivalent to that of writing for vocal languages. One must be able to segment the video into chapters or paragraphs, with titles, associate tables of contents and indexes, enrich the document with annotations, equivalent to footnotes, allow a partial reading, surf following links, etc.

We have developed several functions for generating these components. However the result is no longer a simple video but a set of grouped data in a folder. To allow distribution and to make it easy to read, we give it the form of a web document, that is to say a document readable with a simple browser.

5.1 Lexique

This is the most basic form of structuring a video document: the user provides his document into multiple videos, similar to paragraphs. To identify these components, he provides an image for each video. This image can be extracted from the video, or can be an image-sign[5], a symbol or any visual depiction that suggests the content of the video.

The software formats the videos (size reduction and put to mp4 and webm formats to be readable by all browsers), it formats the images (size reduction and put to png format) and asks the user to specify the display order of the images and the text to be displayed under each image. On the display, the document looks like Figure 1. The image list acts as a table of contents. When the user clicks on an image, the corresponding video is played in the main window. There is no limit on the number of items. Originally planned to edit lexicons or small glossaries, this software can be used to produce account course summaries, records of meetings, reports, resumes etc. (Figure 2).

[Fig. 1] Lexique

5.2 AnImaS

Animas is a variant of Lexique: the user provides an image to be annotated and the video annotations and the software requests it to indicate graphically the location of annotations in the form of active regions in the image.

5 An image-sign is a representation of a sign as a single image obtained by superimposing several keyframes of the sign and by indicating the movement by arrows. This is a process used since a long time to produce books of bilingual lexicons.

[Fig. 2] Lexique

When the user browses over the image, the cursor changes shape when passing over an active zone. A click then causes the display of the video in the main window. (Figure 3) AnImaS has been used to teach technical vocabularies (components of a plane or a computer), or the name of items with spatial caracteristics (map monuments of a city).

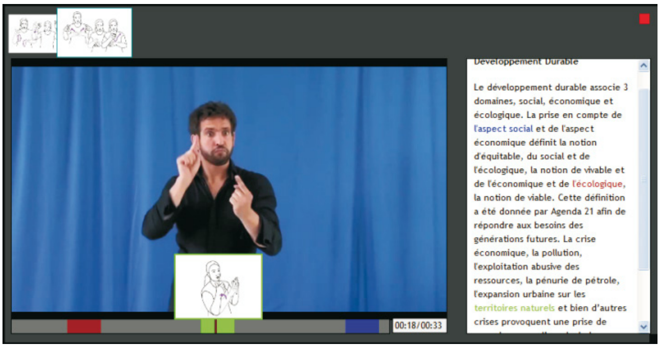
[Fig. 3] AnImaS

5.3 HyperSigne

Hypersigne introduces the concept of hypertext document in sign language (Figure 4). The document has a tree structure, each node representing a concept or a term. The user traverses the tree by following links.

The browser displays the video of the current term in a main area. Below this zone, a time line contains the links. When the cursor passes over a link, a thumbnail appears which indicates the meaning of the target. There are 3 types of target: pictures (illustrations), hypersignes and web pages. If the user clicks on the thumbnail, the current video is replaced by the target. A history appears at the top of the window as a thumbnail sequence to return to the original video. Finally on the right side, a window displays a text corresponding to the translation of the video if the user has provided it.

Hypersigne allows the manufacture of rich documents, structured on several levels and accessible nonlinearly.



[Fig. 4] hypersigne

5.4 Glossigne

Using hypersigne, one can build rich glossaries represented by a tree hierarchy, classifying concepts from more generic to more specialized; each concept is explained by a hypersigne.

Glossigne has been used to build a bilingual glossary of sustainable development (Figure 5).

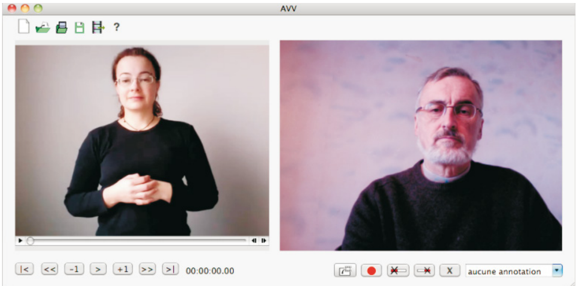
[Fig. 5] Glossigne

5.5 AVV

AVV means Annotation of Video with Video. It allows to annotate a video document in sign language, ie to generate the equivalent of footnotes.

The user browses the video to annotate. At the desired locations, it stops the video and recorded his annotation (Figure 6a). At the end of the reading, the software creates a new video where all annotations are inserted as thumbnails adjustable size at the bottom left of the video (Figure 6b).

Beyond this function of building footnotes, AVV can be used to correct a duty in sign language. It can also be used to subtitle a video in sign language.

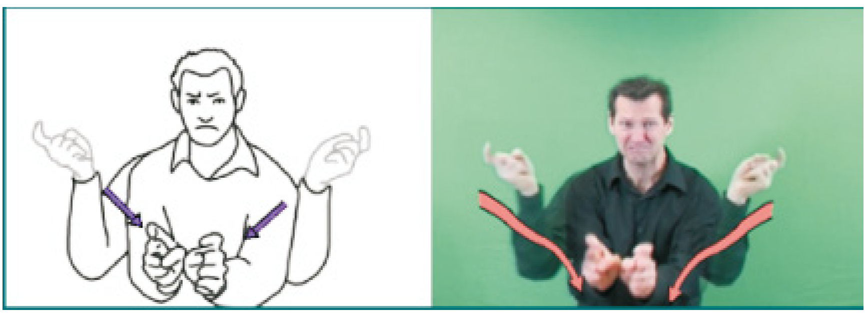


[Fig. 6a] AVV

[Fig. 6b] AVV: result

5.6 Photosigne

Photosigne is used to produce the image of a sign, by combining multiple key pictures selected by the user, hiding unnecessary parts, and automatically tracing arrows indicating the movement of hands. It allows to represent entries in a table of contents or of a lexicon.



[Fig. 7] Photosigne

6 Conclusion

Most of the functionality of a text editor were thus transposed to video LSF. We can structure a document into paragraphs or chapters, complete an existing document, create a table of contents, include comments or footnotes page, use the links in the document to provide a non-linear navigation. Two functions are still missing, search by content and automatic construction of index. They need progress in automatic sign language analysis, mainly in temporal segmentation of continous sign utterances, to isolate the signs, and in their recognition [4], [5], [6].

All documents produced by Lexique, Glossigne, HyperSigne and Animas are transferable on the web with a simple FTP transfer and are therefore exploitable locally or on Internet via a browser.

For now, these tools are mainly used in the field of education (bilingual education, university courses, continuing education, training LSF) and bilingual edition. Several courses teach how to use these tools (DU IELS) and a website provides tutorials and downloading applications (PRESTO).

These tools are already contributing to fill the deficit of documents available in SL for the deaf audience and to give trainers including deaf educators new opportunities to teach effectively.

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EduCards – Virtual reality and Universal Learning Design Application

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Keywords: virtual reality, augmented reality, glyphs, Universal Learning design, preschoolers

Abstract

Literacy is one of the basic human rights, therefore we have worked on developing a state of the art application that will, by using a universal learning design and virtual reality break the barriers and make learning letters and numbers fun and accessible, without making it unattractive and expensive for regular preschoolers.

Hypothesis

Can blind children be integrated into society by enabling them to participate equally in the process of regular classes?

Analysis of the situation / problem description

Literacy is a basic human right, included in the right for education. It is recognized as one of the human rights in a number of international conventions and included in the texts of key international declarations. The Universal Declaration of Human Rights from 1948 recognized the right for education, and thus the right to literacy. They went even further: in the Declaration of Persepolis (1975) where it is written that: "Literacy is not an end in itself, it is a fundamental human right", and the Hamburg Declaration (1997). Emphasizing that literacy, which in a broader sense includes the knowledge and skills that are needed by all in a rapidly changing world, is a basic human right. Literacy is recognized not only as a right in itself, but as a tool for the implementation of other human rights. However, it carries with it a number of other advantages: it benefits the individual, affecting self-esteem, empowering them for social involvement in society, unleashing their creativity and enabling them a critical reflection of reality. Also, the means of political and cultural uses and benefits in areas such as education, health preservation, reproduction and gender equality are related to raising the level of literacy, and determine the relationship between literacy and economic growth.

The association HUPRT conducts education of literacy in terms of typing, using voice applications to work on the computer, but also teaching blind people the Braille alphabet so that they have the ability to use various devices as information input and output.

The educational program performed better when it was supported by using computers. For learning the Braille alphabet on the market currently there is no free software that allows blind individuals to acquire knowledge of the Braille alphabet. In particular, this problem is conspicuous when users are blind children preparing for school and the first years of primary education when they need to master the skills of reading and writing. Given the availability of educational tools for younger students, it is important to allow children who are blind interesting ways of learning. For this purpose, we have designed a learning Braille alphabet software with the help of computers throughout the game and virtual reality.

Methodology

The association HUPRT conducted a survey among visually impaired users about its educational programs. Evaluation of research results demonstrates the need to simplify the learning of Braille for adults and especially for children. That is why we decided to created the presented application solution to facilitate and make the process of mastering the Braille alphabet for blind people more interesting.

Program Description

The application for learning numbers and letters using universal learning design.

This is an application designed for preschool children and first-graders to master reading and writing numbers and letters. The application uses virtual reality (augmented reality) with the glyph (cards with symbolic images on which one letter of the alphabet is inscribed – the Latin alphabet and Braille symbol done with Braille printer) to establish communication between children and computers. The application applies universal design, and so the card can be printed in Braille, software accompanied by sound, and hearing impaired persons in sign language. Learning letters and numbers takes place through a series of exercises and games to make it a more interesting way to present the material to children. Since the application was made using Microsoft technologies, especially for the Windows 8 system, it is therefore suitable for PCs, laptops, and Tablet PCs with a camera. The application is designed so that all children will use it without barriers, and without missing out on fun. It is aimed that the application be used at home but also in kindergarten for groups where blind or hearing impaired children are integrated. This application promotes integration of children with disabilities in the regular school's process.

Application Mode

The child takes a card with a letter printed in Latin and in Braille and a symbolic image, lifts the card in front of the camera to the computer; then the computer recognizes the symbol and pronounces the character and image (e.g., P as a Plane). Special cards are used for some games, like card Left, card Right etc.

Users

The past 20 years has seen an increasing number of people with a loss of vision as a result of other diseases, with a large number of young children. Due to the lack of modern aids and applicable technology, blind children in Croatia today learn Braille as well as they did 50 years ago using mechanical methods.

Results

The result is an application with a set of glyphs (cards with a symbolic figures and letters) for teaching braille, letters, numbers and sign language designed primarily for children. In addition, we expect the result is an easier learning process and training of Braille but also a way to introduce Braille and sign language to all children from an early age, which will lead to less discrimination in the future.

Applicability in the real environment

The implementation of the activities of this project will result in higher quality inclusion of children with visual impairment in community life and regular teaching process. In addition, a sense of belonging to a group is very important, allowing children to be integrated into regular school programs and the possibility of equal participation in games and exercises that will encourage the development of a sense of equal value and raise their self-esteem in visually impaired children. We emphasize the usefulness of the program for teachers, assistants and parents involved in the educational process of visually impaired children as they will be able to devote more time to other things because they will not have to adapt and vividly explain these games and exercises to the blind children with whom they work.

ICT Supported Therapeutic Practice for People with Speech and Language Disorders

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Keywords: ICT, People with Speech and Language Disorders, Stuttering, DAF, FAF

Abstract

In Slovenia, inclusion is often linked with people with special needs. According to the Slovenian Placement of Children with Special Needs Act, the children with special needs require adjustments in physical school space, part of which is also adjusted ICT. Results from the research we conducted in 2013 showed that the majority of headmasters do not use adjusted ICT for pupils with special needs. In the last years, speech and language disorders are being recognized more often among pre-school and school age children. We are introducing the case study about the use of ICT in treatment of people with speech and language disorders, specifically, the use of altered auditory feedback in stuttering therapy. The case study from 2013 was conducted among 11 persons who stutter. We analysed the user experience of two types of AAF. Our results confirm that in some cases it can be a useful tool for persons who stutter.

1 Introduction

Inclusive education supports different needs of pupils and accepts the variety of their special features (different nationality, language, individual imperfections, difficulties, disorders, illnesses, etc.). It must enable the inclusion of all pupils into formal and non-formal education, regardless of their individual characteristics, special features, needs and interests. The interest in ICT supported inclusion research has grown recently, which was confirmed by the analysis of the articles, published in seven educational technology journals [1]. In Slovenia, inclusion is often linked with people with special needs. According to the Slovenian Placement of Children with Special Needs Act [2], the children with special needs require adjustments in physical school space, part of which is also adjusted ICT.

In 2013, we conducted a research among the entire population of Slovenian primary school headmasters in order to establish which groups of pupils they have at their primary schools and how they have adjusted the school environment for these groups of children in order to enable inclusive education. Out of 150 headmasters, who filled in the online questionnaire, only 8 have specified that they had adjusted ICT for the blind and the partially sighted and only 2 primary school headmasters had adjusted ICT for the physically impaired pupils. None of the 150 headmasters had specified any other adjusted ICT for other groups of pupils. Because "principals are not only the educational leaders of their schools but managers who are responsible for financing, personnel, and the results of their institutions" [3] the results are not encouraging. On the other hand similar studies throughout Europe have proven the affinity of headmasters with ICT supported learning environment. However, this is not evident in the educational practice, since headmasters do not make the decisions that would affect the availability of an ICT supported learning environment [4].

In the last years, speech and language disorders are being recognized more often among pre-school and school age children. Stuttering is one of the communication disorders. "Stuttering is a diagnostic label referring to a clinical syndrome characterized most frequently by abnormal and persistent dysfluencies in speech accompanied by characteristic affective, behavioral and cognitive patterns" [5].

We do not have data on the prevalence of stuttering in the Slovenian population. Data of studies conducted abroad currently indicates that the 0,72 % life-span prevalence is a reasonable estimate [6].

Altered Auditory Feedback (AAF) can be used in treatment of stuttering disorder. AAF alters the speech signal and the speaker hears his/her voice differently. There are three main forms of AAF used in stuttering treatment: masked auditory feedback (MAF), delayed auditory feedback (DAF) and frequency shifted auditory feedback (FAF) [7].

Early studies of AAF revealed a number of limitation associated with the use of AAF such as unnatural sounding speech resulting from long delays, size of the devices, individual variability, lack of sustained improvements etc. [8], [9].

Only recently some researchers investigated the use of shorter delays (20, 50 and 75 ms) and found that slowing the speech rate is not a necessary condition for achieving a reduction in stuttering frequency [10], [11]. Delays of 50 and 75 ms were the most effective; the results indicated that 50 ms appears to be the shortest delay producing the maximum reduction in stuttering frequency [11].

With the advances of technology today's devices for AAF are smaller and more accessible. The market offers several electronic devices (which can be small, even in the size of a hearing aid), programs and applications (which are downloaded and installed on computers, tablets, smart phones), which enable AAF. Such an electronic device is e.g. SpeechEasy. Some of the apps for iPad, iPod Touch, Android, iPhone and other smart phones are DAF Professional, Easy AAF, DAF Assistant, Speech4Good etc, while for computers you can use the following software: Speech Monitor, Fluency Coach, Speech Gym, ArtefactSoft, etc.

There was a lot of interest regarding the individual differences in the degree of stuttering reduction with AAF. Researchers discovered differences in the degree to which FAF reduced stuttering in individual and individual differences in terms of the most efficient combination of FAF. Antilopova and colleagues conducted a study in which they examined eight conditions (non- altered auditory feedback and 7 different combinations of DAF and FAF effects) and concluded that "experimental condition producing maximal reduction in stuttering frequency was not consistent across the participants or testing sessions" [7]. Recent findings suggest that the variability is caused by multi-causality of the disorder and the existence of stuttering subtypes [12]. Findings from researches suggest that persons with different subtypes of stuttering respond differently when exposed to AAF effects [13].

Studies that investigated which AAF effect is more effective in reducing stuttering concluded that DAF and FAF is more effective that masking [14]. Consequently, interest in masking as a tool for stuttering reduce decreased. The positive effects of DAF on people who stutter have been known for a long time (since 1950). With DAF, the speaker hears his/her own voice with a delay. This delay can be set individually. Delays typically range from 50 milliseconds (ms) up to approximately 250 ms [7]. The positive effect of FAF was found a few decades later. When using FAF, the speaker hears his/her own voice at an altered pitch. Some researchers investigated the effect on stuttering reduction when using a combination of DAF and FAF. Results did not prove an intensified reduction of stuttering when using DAF and FAF simultaneously [7].

Researchers have investigated the effect of AAF on the speech of persons who stutter (mostly on reading and monologue) and proved its efficiency in stuttering reductions. The use of AAF was found to be effective during reading and spontaneous speech as well as speaking in situations that are difficult for most speakers (talking by phone, speaking in public [15], [16]. The focus of the case study we are introducing was to explore the conditions for the use of FAF technology for people with stuttering in Slovenia. We were particularly interested in the perspective of people who stutter and their feedback about improvement achieved through the use of this technology. We investigated the experience of 11 people who stutter with the use of DAF and FAF effects.

The aim of the research is to contribute to a better treatment of school aged children and adults who stutter. Until now, only little research was done on the use of ICT supported teaching for pupils with speech and language disorders in regular schools and inclusive classrooms [1].

2 Method

2.1 Participants

The case study from 2013 was conducted among 11 persons who stutter (4 pupils and 3 adults), who attended therapy at the Center for the Correction of Hearing and Speech Portorož in 2013. All participants were diagnosed with stuttering disorder. The stuttering severity was measured using the Stuttering Severity Instrument for Children and Adults [16]. The sample is nonprobabilistic, convenience [17] and is described in Table 1.

[Table 1] Description of the sample

Participant	Age	Gender	Stuttering Severity (Total Overall Score SSI-3)
1	9	M	Severe
2	9	F	Mild
3	11	F	Mild
4	13	M	Moderate
5	13	M	Moderate

6	13	M	Moderate
7	14	M	Very severe
8	22	M	Moderate
9	25	M	Mild
10	37	M	Moderate
11	45	F	Severe

As can be seen in Table 1, our sample included persons with stuttering disorder who differed in age. 5 persons (4 males and 1 female) were teenagers aged between 11 and 14 years, representing a majority of the sample. 4 participants were adults, aged from 22 to 45 years. The remaining were 2 children, aged 9 years. Our sample consisted of more man (N = 8) than woman (N = 3). Stuttering in late childhood and adulthood is characterized by an uneven sex ratio, with male to male ratio of 3:1–5:1 [19].

2.2 Devices

We used a software application DAF Professional for iPad in iPhone. The software was chosen because in Slovenia electronic devices are not available. DAF Professional is relatively low-cost, has a free trial version and it is available as application for iPhone and iPad. Versions for android system were in the phase of development at time the study was taking place.

IPad and iPhone are portable devices and can be used outside the clinic, in everyday situations. The number of persons owning iPad or iPhone is growing.

2.3 Procedure

DAF and FAF effects were tested during speech therapy for all the participants. Participants first familiarized with the program. Their speech-language pathologist monitored the speech fluency of the participant by recording the percentage of dysfluent syllables spoken and through conversations identified the impact on the individual. First DAF effect was tested, followed by FAF effect.

Users tested AAF during 3 session of speech therapy. Their experiences were recorded. After 3 treatments a person chose whether they want to use FAF effect in everyday situations.

3 Results

7 out of 11 persons found that they can benefit from using AAF effects. 3 persons found FAF effect disturbing and preferred the use of DAF.

Not all persons with positive experience have chosen to use AAF in everyday life. Only 4 people used AAF in everyday situations. All of them were males and used applications for iPhone. Given the fact there were only 3 female participants, however, this is not necessarily a rule. As shown in Table 2 almost all younger participants chose to use AAF in everyday situations (with the exception of one, the youngest). All teenagers who have had benefit from AAF have decided to use it outside clinic. In contrast, in adult population, we observed that despite the effectiveness of AAF most participants have not chosen to use it in everyday life (with the exception of one adult).

Persons who did benefit from AAF and chose not to use it outside clinic stated that the reason was discomfort. They did not feel comfortable in carrying the device while communicating with other persons.

[Table 2] Users experience of DAF/FAF effect at the fluency clinic of the Hearing and Speech Correction Centre in Portorož in 2013

Participants	Efficiency of using DAF/FAF		Use of DAF/FAF	
	YES	NO	Only in clinic/home	Outside clinic
Pupils who stutter	4	3	1	3
Adults who stutter	3	1	2	1
All participants	7	4	3	4

4 Discussion

We note that in Slovenia electronic devices that allow the use of AAF effects are not available. Several types of electronic devices that are small and discrete can be purchased in foreign markets. With the purchase of the device often comes a free training (therapeutic use of the device), which the Slovenian users in this case cannot attend. Some device providers even stress that the desired results can only be achieved with the correct use of the device together with therapy and advise against purchasing the device for home use only (without consulting a speech therapist or a qualified professional). The programmes and applications have become a lot more accessible lately; only the price remains relatively high. Slovenian persons who stutter can use programs for computers and applications for smart phones and tablet computers that allow the use of AAF effects. Given that the majority of people as reason for not using AAF in everyday situations indicated discomfort we believe that smaller devices would be better accepted and, consequently, could be used more widely.

Our study confirmed findings from other studies that the AAF effect varies between different individuals who stutter.

The results of the present study confirmed that in many cases the use of technology, which allows DAF and FAF effects can improve communication of persons with stuttering. We consider AAF as an additional option which can be useful in everyday situations. For persons who stutter the use of speech techniques learned in speech therapy is easiest in usual, released situations. In the speech situations they find difficult, they cannot always use the technique effectively. AAF can be used periodically, in situations that are difficult for them or during speech therapy until the transfer to outside situation is not yet possible. Some persons with stuttering can also chose to use AAF regularly in certain situations (e.g. when using phone).

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Legislation and Standards of Accessibility versus Intelligent Design

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Keywords: Convention on the Rights of People with Disabilities, CRPD, Accessibility for Ontarians with Disabilities Act, AODA, Integrated Accessibility Standards Regulations, IASR, PDF/UA, ICT, Information Communication Technology, standards, legislation, intelligent design

Abstract

Standards for document formats have emerged over the past ten years as have international, federal and state/provincial pieces of legislation attempting to define and implement the inclusion of people with disabilities. However, most of the standards live in isolation of each other and many of the pieces of legislation do not consider existing or evolving standards. As illustrated in the case of Section 508 in the United States, the process to revise existing legislation can take many years and "freeze" the inclusion of people with disabilities at a point in time far behind the current technological capabilities.

This paper explores the relationship between legislation, standards and intelligent design and the current disconnect between these components of inclusive design. The over-arching Convention on the Rights of People with Disabilities is used for this topic as the basis for goals and objectives of inclusion.

Inclusion versus Self-identification

One of the problems with current legislation is that often the person with a disability must identify themselves as having a disability and actively request either an accessible version of the same format or an alternate format of the same content. There are those who support the detection of adaptive technology by a user-interface which would then "seamlessly assign" a way of interacting with content. Neither can be considered "intelligent" design.

As we are striving for an inclusive community, people with disabilities should not have to identify themselves as having a disability or using a specific technology to access content. Any user profile should not be based on disability to access specific tools. The interaction between content and the end-user must be seamless.

If content is designed to be inclusive, there is no need for profiling or auto-detection of adaptive technology. The control of the content is in the hands of the end-user whether they have a disability or not. If content is designed using principles of universal design, inclusion and intelligence, content is accessible to everyone. Unfortunately the current environment is one of "inclusion to legislation" or "inclusion to standard" with little attention paid to intelligent design.

The Convention on the Rights of people with Disabilities

The over-arching international treaty containing the goals of inclusion and what those items mean for people with disabilities, is the United Nations Convention on the Rights of People with Disabilities[1] or CRPD. Eventually the CRPD may assist in creating more globally applied legislation so that the interaction between the end-user and the content is seamless no matter the geographic region. Content would be designed intelligently ensuring localization was also seamless.

Article 9, 2(a) of the CRPD identifies the mandate to: "develop, promulgate and monitor the implementation of minimum standards and guidelines for the accessibility of facilities and services open or provided to the public;[2]"

Normative text in the CRPD identifies the primary duty of states parties as being inclusion as opposed to Accommodation. The place for reasonable accommodation is for situations where an inclusive environment still contains a barrier to the person with a disability. As in the case of the Accessibility for Ontarians with Disabilities Act (AODA), Integrated Accessibility Standards (IASR) for Information Communications Technology (ICT) and Employment, accommodation for instead of inclusion of people with disabilities is still the "standard[3]". Unlike the Incheon Strategy,[4] there are no core or supplemental indicators that will provide data on the success of the IASR ICT or Employment Standards. There is no mechanism for knowing when we've achieved inclusion and can then expand our understanding and implementation of an inclusive community to the next level.

The Role of Standards in Inclusion

The current global environment toward inclusion is a variety of "standards" that include actual ISO standards, guidelines and best practices. Depending on what an organization wants to accomplish, any of these can be used in any combination to meet minimum "legislative standards."

Most countries and organisations use the Web Content Authoring Guidelines or WCAG 2.0 (now an ISO standard) as the definitive "proof of accessibility." As with the original Section 508 legislation in the United States which pointed to WCAG 1.0 as a definition of accessibility, the WCAG checkpoints are for web content or HTML documents. The checkpoints for WCAG 1.0 were immediately mapped to other file formats such as PDF and word processed documents. Countries and organisations wanted to comply with legislation and the WCAG web content guidelines became a "one-size fits all" approach to inclusive design. This is often still the case.

1 United Nations Enable, Convention on the Rights of People with Disabilities: http://www.un.org/disabilities/default.asp?id=259

2 United Nations Enable, Convention on the Rights of People with Disabilities, Article 9: http://www.un.org/disabilities/default.asp?id=269

3 Accessibility for Ontarians with Disabilities Act, Integrated Accessibility Standards Regulations, employment Standards: http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_110191_e.htm

4 Incheon Strategy to Make the Right Real for Persons with Disabilities in Asia and the Pacific, Goal 1: http://freeget.net/contents/download.asp?ctg=outlist&file=Incheon-Strategy(3).pdf

If we examine the role of standards in the case of one file format, that of PDF accessibility, we find immediate evidence of confusion.

Although the WCAG 2.0 are HTML based, the Word Wide Web Consortium (W3C) has developed a document of techniques for accessible PDF documents based on WCAG 2.0[5]. Many countries and organisations have adopted this as a "standard" for measuring the accessibility of PDF documents, including the federal government of Canada.[6]

Meanwhile, on the other side of the virtual room, the ISO and the PDF Association have been working on an international standard for accessible PDF. This work includes the initial ISO standard ISO 14289-1:2012 (now in a working draft for version 2.0), an implementation guide for developers,[7] a document called the Matterhorn Protocol that explains the standard in plain language,[8] and a document on "Achieving WCAG 2.0 with PDF/UA.[9]

Additionally, there is the PAC or PDF Accessibility Checker[10] which checks a tagged PDF document against PDF/UA using the Matterhorn Protocol, and the adobe Acrobat Accessibility Full Check which currently does not.

There is confusion about which standard to use, where to find the standard to use, what a standard is and what is a best practice or guideline and which tool to use to perform a mechanical validation of the document. (There must always be a manual validation or quality assurance check of a document before it is published.)

The Role of Legislation in Inclusion

One might think that legislation would be able to assist in sorting out the standards from the best practices and guidelines and provide some organisational protocols for when to use each.

This is not, however, true. For example, those working in the area of disability rights are on one side of the virtual room (again) and those working on document and content standards are on the other. Although the PDF/UA standard is relatively new, it was surprising to find, in a webinar on the CRPD, that when it comes to "document accessibility" many people creating legislation and international treaties are only vaguely aware of WCAG. Of them, most cannot identify the current version while others believe that it can be applied to any format.

This situation is reflected at the state party level. In Canada each province has its own provincial Human Rights Code that further defines the Federal Charter of Rights and Freedoms (federal Human Rights Laws). Within the provinces of Ontario and Manito-

5 W3C, PDF Techniques for Web Content Accessibility Guidelines 1.0 and 2.0: http://www.w3.org/WAI/GL/WCAG-PDF-TECHS-20010913/

6 Treasury Board of Canada, Assessment Methodology: http://www.tbs-sct.gc.ca/ws-nw/wa-aw/wa-aw-assess-methd-eng.asp

7 AIIM, Technical Implementation Guide,: http://www.aiim.org/Research-and-Publications/standards/committees/PDFUA/Technical-Implementation-Guide

8 PDF Association, The Matterhorn Protocol: http://www.pdfa.org/wp-content/uploads/2013/08/MatterhornProtocol_1-0.pdf

9 AIIM, Achieving WCAG2.0 with PDF/UA: http://www.aiim.org/Research-and-Publications/standards/committees/PDFUA/WCAG20-Mapping

10 X-media, PAC PDF Accessibility Checker: http://www.access-for-all.ch/en.html

ba there are now the Accessibility for Ontarians with Disabilities Act and the Accessibility for Manitobans with Disabilities Act respectively. These additional laws identify standards to be achieved through the provincial and federal human rights laws…and the CRPD.

The Canadian government states, through the Treasury Board, that PDF documents must "comply" with WCAG 2.0 AA checkpoints and the PDF Techniques for the Web Content Accessibility Guidelines 1.0 and 2.0. The IASR for the province of Ontario states that "content must comply with the WCAG 2.0 AA checklist. There is no reference to the W3C PDF Techniques document or PDF/UA.

Additionally, the IASR states that even if a document is accessible, a person can request "differently accessible" versions of the document. This barrier to accessibility is echoed in Provision (A) of Section 508[11] and the draft refresh of Section 508 (2011).[12]

Continuing to mandate the provision of alternate format for accessible content moves the goal of access to ICT to access based on preference rather than on accessibility of the content/documents. It creates confusion for the private and public sector organisations that must comply with legislation.

This mandate leads to the misconception that if one version of content is accessible, for example a word processed document, then other versions, for example PDF, do not have to be. This is based on the misconception that one only has to provide an accessible format to comply with legislation and the organization can choose which format to make accessible.

This is contrasted with the goals of the Incheon Strategy which put the focus on standards for accessible ICT in the hands of the International Standards Organization (ISO) standards for specific documents. Goal 3 of the Incheon Strategy which includes ICT states that the level of accessibility of ICT must adhere to the: "Availability of mandatory technical standards for barrier-free access that govern the approval of all ICT-related services, such as websites for the public, taking into consideration internationally recognized standards, such as those of the ISO."[13]

The language used in legislation is often confusing to those attempting to implement it. For example, in the original draft refresh of Section 508 in 2010, reference to word processed, spreadsheet and presentation "documents" were referred to as "web pages" which does not accurately represent the content format.

The draft refresh of Section 508 was put out for initial comments more than four years ago and is an example of how legislation can stagnate rather than promote technological development or inclusion.

Although legislation is not "written in stone "those who implement the legislation often only want to know "what do I have to do?" If the legislation states that content or formats "are not accessible now so forget about them" a clear message of exclusion is sent to those developing content and digital tools.

11 1194.22 Web-based intranet and internet information and applications, Provision K, Section 508.gov: http://www.section508.gov/section-508-standards-guide#Web

12 Draft refresh of Section 508, 602.3.2, Access Board: http://www.access-board.gov/guidelines-and-standards/communications-and-it/about-the-ict-refresh/draft-rule-2011

13 Incheon Strategy to Make the Right Real in Asia and the Pacific, goal 3.9.

The Role of Intelligent Content Design in Inclusion

Intelligent content design inherently must be defined as not being "intelligent commercial design or author centric design." If the focus of designing content is on marketing rather than getting a message out or providing content in the most expansive way possible, then there is a lack of "intelligence" in the design process.

Intelligent design of content must align itself with emerging and evolving standards that go beyond the current legislative standards. Standards should be, by their very nature, fluid and open to new technology.

The creation of content to be inclusive must balance the limits of the standards that are available, the limits of the legislation that is in place, and the ability of the content developer to see beyond the content, standards and legislation to the intended consumption of the content.

Standards and legislation should provide minimal content accessibility guidelines for content creators. Those developing content must begin to use their creativity to expand the design of their content to be inclusive. Inclusive intelligent design must rapidly evolve into something that people want to do as opposed to something people are "forced" to do. This has been a theme among inclusive content designers for several years. Unfortunately, due to the nature of legislation, this philosophy has only evolved through content developers who understand the future of content and the need for seamless inclusion.

Summary

The current atmosphere regarding standards, legislation, intelligent design and accessibility tends to view each component as a separate entity with no collaboration or communication between them.

There is a focus on the minimum amount that must be done under legislation, the lack of knowledge of existing or emerging standards for digital content, tools and viewers; and what appears to be an unconscious avoidance of inclusive design. In short, after ten years or more, we are still trying to convince developers and content creators that accessibility of product and content is just good design and good business.

Exacerbating this atmosphere is the lack of collaboration between those who are advocating and creating international treaties and human rights laws, those creating the regional legislation and those developing international standards for specific tools and content types.

In this respect, legislation and standards become a barrier to accessibility. There is no holistic framework from which to work or evolve the concept of inclusion.

If those of us with disabilities are to be included in the global community or our local community, treaties, legislation, standards and intelligent design must be synonymous.

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(There is a complete list of bibliographic references at http://www.karlencommunications.com.CRPD.html)

UDLnet: A Framework for Addressing Learner Variability

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Abstract

Article 24 of the UN Convention on the Rights of Persons with Disabilities states that persons with disabilities should be guaranteed the right to inclusive education at all levels, regardless of age, without discrimination and on the basis of equal opportunity. State Parties should ensure that children with disabilities are not excluded from free and compulsory primary education, or from secondary education. Still, there is a long way ahead before reaching a society where equal opportunities are guaranteed for all. Inclusive and quality education is a key means to achieve this goal. In many special, as well as mainstream schools, however, there is still much uncertainty and a lack of knowledge. Grounded on new research in neuroscience and the Design for All principles, Universal Design for Learning constitutes an educational approach that promotes access, participation and progress in the general curriculum for all learners. UDL recognizes the need to create opportunities for the inclusion of diverse learners through providing curricula and instructional activities that allow for multiple means of representation, expression, and engagement. Yet, these developments do not necessarily result in significant, widespread changes in practice – that is, in how schools actually organise and provide learning experiences for pupils. The difficulty is in all cases translating these policies into practice. Though the policy context supports a shift to inclusion, professionals need more support to develop their practice. In order to bridge the gap between policy and practice the UDLnet network aspires to address this necessity collecting and creating best practices under the framework of Universal Design for Learning. UDLnet is a European network that aims to contribute to the improvement of teachers' practice in all areas of their work, combining ICT skills with UDL-based innovations in pedagogy, curriculum, and institutional organization. This paper presents the UDLnet project, its aims, the methodological framework, as well as the envisaged themes.

1 Introduction

Following the European Year for Combating Poverty and Social Inclusion (2010), the adoption of a headline target under the Europe 2020 Strategy (Europe 2020, 2010) on the reduction of early school leaving and the 2010 Council conclusions on the education of migrants and on the social dimension of education and training, social inclusion is promoted through education. For the school sector particularly, the issues of early school leaving and special needs are particularly important. European legislation addresses disability in a broad range of areas: Treaty of Amsterdam (Article 13, 1997) on discrimination against disabled citizens; Article 26, EU Charter of Fundamental Rights on 'the right of persons with disabilities to benefit from measures designed to ensure their independence/social and occupational integration/participation in the life of the community.' Mainstreaming accessibility in EU policies is part of the Commission's wider drive to facilitate people with disabilities to play their full part in society. Disability is also at the core of the UN Convention on the Rights of People with Disabilities, to which the European Community is a signatory. The EU's Europe 2020 strategy has, as a priority, accessibility and economic/social participation of people with disabilities through the elimination of existing barriers. According to the EU Commission Staff Working Document Analysis and mapping of innovative teaching and learning for all through new Technologies and Open Educational Resources in Europe Accompanying document Communication 'Opening Up Education' (2013), the wider use of new technology and open educational resources can contribute to alleviating costs for educational institutions and for students, especially among disadvantaged groups. This equity impact requires, however, sustained investment in educational infrastructures and human resources

The right to inclusive and quality education for all, has come a long way over the last decades. Since the UNESCO Salamanca Statement of 1994, there is a political will within the 27 EU Member States to carry out the necessary changes in the field of legislation and school organisation. Both on European and national levels, authorities worked on the realisation of legal frameworks facilitating inclusive education for all within the framework of their competence. These declarations and policy documents clearly state that all children and adults have the same right to high quality and appropriate education. While there have been numerous successful efforts to reduce barriers to access, participation, and progress within the general education curriculum, students with disabilities still experience significant difficulty obtaining accessible and usable educational resources in a timely manner. As a result, students with disabilities are chronically at high risk for school failure and under-performance (Blackorby & Wagner, 2004; Frieden, 2004).

There is a long way ahead before reaching a society where equal opportunities are guaranteed for all. Inclusive and quality education is a key means to achieve this goal. In many special, as well as mainstream schools, however, there is still much uncertainty and a lack of knowledge. Strong legacies of institutionalization, charitable special provision and segregated systems exert a powerful negative influence on expectations and assumptions. Though the policy context supports a shift to inclusion, professionals need more support to develop their practice. Over the last twenty years, educators have been searching for ideas and techniques to address access and equity issues that create barriers to effective learning for a variety of students. In Ireland, the critical importance of the *Report of the Commission on the Status of People with Disabilities* in 1996 was underlined by a significant wave of legislative and administrative measures tied in to acceptance of the social model of disability, the mainstreaming of services and significant new legislation. While linkage to other areas of social discrimination and human rights was not consistent, the importance of the Equality Act 2004 cannot be overestimated in promoting a legal basis for inclusion for the pursuance of anti-discrimination actions.

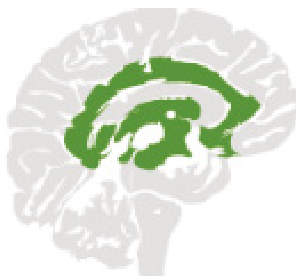
Educators recognise that every child has unique strengths and needs not served well by a traditional, standardized instructional approach. The challenge, according to Universal Design for Learning (UDL) is not to change the students, but rather to redesign, adapt and personalize curricula and instructional methods and create a learning environment that helps each student develop his or her full potential. Thus, Designing for All (D4All) and promoting inclusion benefits all children and not only those with disabilities. "Universal Design for Learning is a "research-based set of principles that forms a practical framework for using technology to maximize learning opportunities for every student (Rose, et al. 2002)". UDL along with the associated Guidelines is grounded on the D4All principles and constitutes a quite generic framework that has not significantly been introduced in Europe.

2 State of the art

2.1 What is Universal Design for Learning?

Grounded on new research in neuroscience (Hall, Meyer & Rose, 2012) and the Design for All (D4All) principles (Stephanidis, 1999), Universal Design for Learning (UDL) constitutes an educational approach that promotes access, participation and progress in the general curriculum for all learners (CAST, 2014). Individuals bring a huge variety of skills, needs, and interests to learning. Neuroscience reveals that these differences are as varied and unique as our DNA or fingerprints. Three primary brain networks come into play: (Meyer & Rose, 2000, Rose& Meyer, 2002; 2006):

[Table 1] Brain networks and Universal Design for Learning

Recognition Networks	**Strategic Networks**	**Affective Networks**
The "what" of learning	*The "how" of learning*	*The "why" of learning*
		
How we gather facts and categorize what we see, hear, and read. Identifying letters, words, or an author's style are recognition tasks.	Planning and performing tasks. How we organize and express our ideas. Writing an essay or solving a math problem are strategic tasks.	How learners get engaged and stay motivated. How they are challenged, excited, or interested. These are affective dimensions.
Present information and content in different ways	Differentiate the ways that students can express what they know	Stimulate interest and motivation for learning

UDL recognises the need to create opportunities for the inclusion of diverse learners through providing curricula and instructional activities that allow for multiple means of representation, expression, and engagement (King-Sears, 2009).

2.2 The Three Principles

Three primary principles, based on neuroscience research, guide UDL and provide the underlying framework for the Guidelines:

- **Principle I: Provide Multiple Means of Representation** (the "what" of learning). Learners differ in the ways that they perceive and comprehend information that is presented to them. For example, those with sensory disabilities (e.g., blindness or deafness); learning disabilities (e.g., dyslexia); language or cultural differences, and so forth may all require different ways of approaching content. Others may simply grasp information quicker or more efficiently through visual or auditory means rather than printed text. Also, learning and transfer of learning occur when multiple representations are used, because it allows students to make connections within, as well as between, concepts.
- **Principle II: Provide Multiple Means of Action and Expression** (the "how" of learning). Learners differ in the ways that they can navigate a learning environment and express what they know. For example, individuals with significant movement impairments (e.g., cerebral palsy), those who struggle with strategic and organizational abilities (executive function disorders), those who have language barriers, and so forth approach learning tasks very differently. Some may be able to express themselves well in writing text, but not speech, and vice versa. It should also be recognized that action and expression require a great deal of strategy, practice, and organization, and this is another area in which learners can differ.
- **Principle III: Provide Multiple Means of Engagement** (the "why" of learning). Affect represents a crucial element to learning. Learners differ markedly in the ways in which they can be engaged or motivated to learn. There are a variety of sources that can influence individual variation in affect including neurology, culture, personal relevance, subjectivity, and background knowledge, along with other factors presented in these guidelines. Some learners are highly engaged by spontaneity and novelty. Others are disengaged, even frightened, by those aspects, preferring strict routine. Some learners might like to work alone, while others prefer to work with their peers.

In fact, two aspects in UDL can be identified: a) a conceptual model from which a set of principles (see above) and practices are derived and b) a set of specific practices and guidelines by which universal design is actually accomplished. In the first decade of its development, the emphasis in the domain of UDL was on the use of technology to inclusive education and accessibility for the disabled. Rose and Meyer (2002) proposed that UDL is a research-based set of principles that forms a practical framework for using technology to maximize learning opportunities for every student.

The UDL Guidelines are organized according to the three main principles of UDL (representation, action and expression, and engagement). These are arranged differently depending on the purpose of the representation, but the content is consistent. To provide more detail, the principles are broken down into Guidelines, which each have supporting checkpoints.

[Table 2] Universal Design for Learning Guidelines & Checkpoints (CAST, 2011)

I. Provide Multiple Means of Representation	**II. Provide Multiple Means of Action and Expression**	**III. Provide Multiple Means of Engagement**
1. Provide options for perception	4. Provide options for physical action	7. Provide options for recruiting interest
1.1 Offer ways of customizing the display of information 1.2 Offer alternatives for auditory information 1.3 Offer alternatives for visual information	4.1 Vary the methods for response and navigation 4.2 Optimize access to tools and assistive technologies	7.1 Optimize individual choice and autonomy 7.2 Optimize relevance, value, and authenticity 7.3 Minimize threats and distractions
2. Provide options for language and symbols	5. Provide options for expression and communication	8. Provide options for sustaining effort and persistence
2.1 Clarify vocabulary and symbols 2.2 Clarify syntax and structure 2.3 Support decoding of text, mathematical notation, and symbols 2.4 Promote understanding across languages 2.5 Illustrate through multiple media	5.1 Use multiple media for communication 5.2 Use multiple tools for construction and composition 5.3 Build fluencies with graduated levels of support for practice and performance	8.1 Heighten salience of goals and objectives 8.2 Vary demands and resources to optimize challenge 8.3 Foster collaboration and community 8.4 Increase mastery-oriented feedback
3. Provide options for comprehension	6. Provide options for executive functions	9. Provide options for self-regulation
3.1 Activate or supply background knowledge 3.2. Highlight patterns, critical features, big ideas, and relationships 3.3 Guide information processing, visualization, and manipulation 3.4 Maximize transfer and generalization	6.1 Guide appropriate goal-setting 6.2 Support planning and strategy development 6.3 Facilitate managing information and resources 6.4 Enhance capacity for monitoring progress	9.1 Promote expectations and beliefs that optimize motivation 9.2 Facilitate personal coping skills and strategies 9.3 Develop self-assessment and reflection

2.3 Needs being addressed by the UDL

When educators hear the term UDL, most associate it with technology (Zascavage & Winterman, 2009). However, UDL is not solely about the use of technology in education. It is also about the pedagogy, or instructional practices, used for students with and without disabilities (King-Sears, 2009). New developments on the theory and practice of UDL that have emerged underline the importance of instructional pedagogies that facilitate accessibility for diverse learners (Burgstahler, 2009). Recent research findings have proved that UDL can support access, participation and progress for all learners (Jimenez, Graf, & Rose, 2007; King-Sears, 2009; Kortering, 2008; Meo, 2012). However, few have provided a comprehensive framework to put the UDL pieces together, in a practical, research grounded and efficient way (Katz, 2013). UDL is much more complex than we originally thought (Edyburn, 2010).

Understanding the potential of UDL is seductively easy. Its exponential growth indicates that it may be the right idea at the right time. However, it has proven far easier to help the various stakeholders understand the potential of UDL than it has been to implement UDL on a large scale. Now that more people are "doing UDL," it is not clear what the outcomes are. Udvari-Solner et al. (2005) illustrate ways to apply UDL principles to provide all students with multiple means of representation, multiple means of engagement, and multiple means of expression. To initiate a universal design approach, they advise secondary educators to think about three distinct curriculum access points: content, process, and product. UDL requires collaborative planning amongst teachers with different curriculum knowledge and skills (Nevin et al, 2004). Complaints that are often raised include lack of time to co-plan and lack of resources to teach a differentiated curriculum. With the term Web 2.0 we describe a broad spectrum of digital tools to create, edit, share, discuss, engage, collaborate, and communicate in online media sharing spaces (Solomon & Schrum, 2007). These tools are used to edit, mix, remix, record, and publish content. Web 2.0 tools are interactive and multisensory. These technologies, therefore, are ideal for teachers wishing to apply UDL, i.e. craft flexible, scalable, differentiated activities that are accessible and engaging for reluctant and eager learners alike (Kingsley & Brinkerhoff, 2011). The Open Discovery Space portal (2013) is a repository, harvester, a place to search and build resources, lesson plans and learning scenarios collaboratively among teachers' networks with the use of the ODS Authoring tool. CAST UDL Exchange (2014) is a Web 2.0 base place to browse and build resources, lessons and collections. These materials can be used and shared to support instruction guided by the UDL principles. UDL Exchange facilitates the power of networking to create, remix, and share UDL-informed lessons and activities. According to Edyburn (2010) "as we head into the second decade of doing UDL, it is time for a new generation of thinking about UDL. We need to clarify the core stakeholders (developers or teachers) who will be trained to create UDL products. We need to understand what it means to implement UDL. We need to understand how to measure the outcomes of UDL. Finally, we need to renew our commitment to equitably serving all students in the event that our UDL efforts fall short".

While UDL emerged in the context of disability, disability (and the associated services provided for people with disabilities) has come to be viewed in the context of a wider rights and equality agenda. This agenda addresses the whole range of exclusionary and discriminatory practices that marginalize other kinds of groups. Disability has much to learn from locating itself in this wider context of social exclusion. This applies both to the understanding of social injustice and differential access in Europe and to the creation of innovative methods to combat discrimination.

3 The UDLnet network

In order to bridge the gap between policies and practice in applying UDL and to face the associated obstacles identified above, we present here the design and development of the UDL Network (UDLnet). UDLnet aspires to address the necessity of collecting and creating best practices under the framework of UDL from a wide range (generic guidelines down to more specific ones) of four envisaged themes: inclusive learning environments, accessible resources, teachers' and school leaders' competences, examination of barriers and identification of opportunities. Moreover, it investigates current needs related to the use of mobile devices in UDL practice. Furthermore, accessibility options emended in the mobile devices under the D4All approach is explored along with the application of the UDL framework in real inclusive educational practices. UDLnet targets 3,500 users in seven countries across Europe (Greece, Ireland, Cyprus, Finland, Netherlands, Germany, Spain) and in six languages.

In general, UDLnet aims to improve teachers' practice in all areas of their work, combining ICT skills with UDL-based innovations in pedagogy, curriculum, and institutional organization. It is also aimed at in-service and pre-service teachers' use of ICT skills and resources to improve their teaching, to collaborate with colleagues, and perhaps ultimately to become innovation leaders in their institutions. In addition, it aims to train school leaders and other school staff about the ways they can adapt, personalize and select some of the existing, easy-to-use, and free-of-cost software tools that various organizations around Europe offer. The purpose of this is to set up tailor-made learning tools and lesson designs (at their institutional or regional level) and to interconnect these with existing infrastructures. The overall objective is not only to improve classroom practice, but also to raise awareness of the European educational community on the need for UDL based teaching and learning practices. The innovation of UDLnet lies within the connection of best practices from various European countries on school/university education and training, open to wide teacher and student communities who will then effectively provide UDL in education.

3.1 UDLnet Methodology

The envisaged procedure of UDLnet Network consists of the following basic phases:

- **Good Practice Thematic Search and Organization:** good practices shall be collected from partner countries, as well as from affiliated institutions in the areas of inclusive education all over Europe with emphasis in UDL, through focus groups, as well as through the practice exchange forum. A set of guidelines and criteria will be set and followed in order to ensure the quality of these practices.
- **Implementation:** a number of events shall be organised for the exchange, validation and evaluation of the collected UDL best practices: such as training sessions, contests, summer schools, webinars, as well as workshops organized in local and

European level. The specially developed web-based inventory that will allow all interested parties to access ideas and best practices on effective use of accessible eLearning resources will contribute to this. All these actions aim to create a European network of teachers discussing, testing, implementing and eventually even developing inclusive practices.

- **Valorisation:** The formation of a set of recommendations to policy makers and regional authorities shall indicate ways European policy makers can use the UDLnet Inventory and UDL good practices to support the inclusive education and training of their citizens. Moreover, a concrete guide of good practices for teachers (Pathway to Universal Design for Learning) will be disseminated through teacher communities across Europe.

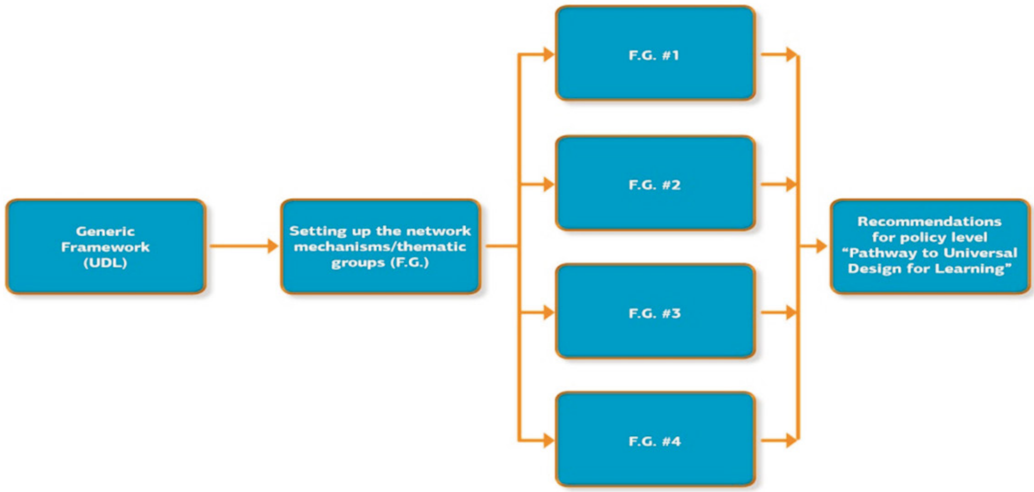
The UDLnet approach includes:

- Development of a detailed and systematic methodology to define the criteria for identifying best UDL practices and then operate as the frame for collection and formation of exceptional UDL based teaching and learning approaches.
- Design and development of a Web 2.0 inventory, with a collection and categorization of UDL best practices that can support a learning community where users will be able to find, exchange and adapt inclusive teaching and learning practices and exchange ideas and best practices.
- Establishment of a constantly-expanding network of educational communities informed on the necessity of UDL based innovative teaching and learning practices and trained accordingly. This network will operate in an independent way, with teachers supplying the educational material and ultimately being responsible for the preservation and further enhancement of the inventory and through Web 2.0-based approaches and tools.
- Collection and development of innovative, relevant and multilingual content that will support the UDL approach, which is described and stored (in the form of learning objects) in the Inventory's repository of content.
- Development of teachers, school leaders, school staff skills and attitudes to ensure the access to and use of UDL based teaching and learning practices under the umbrella of community building. Community building is critical component that enables their success in learning programs by reducing isolation, mentoring success, transforming experiences of exclusion to ones of inclusion, offering encouragement and hope, and fostering group dialogue and peer learning.

3.2 Themes addressed by UDLnet

Methodologically, UDLnet addresses the following four main themes (Figure 1):

1. UDL-based learning environments,
2. UDL resources,
3. Teachers' and school leaders' competences,
4. Examination of barriers and identification of opportunities.



[Fig. 1] Methodology/themes addressed by UDLnet network

3.3 UDLnet evaluation methodology framework

An evaluation methodological approach will be set in order to assess the impact of the major intervention designed and implemented in the context of UDLnet, on the participating school communities and identify barriers to adoption. Evaluation will have both a formative and summative nature. The formative evaluation component will be related to the monitoring activities of the project. Summative evaluation will focus on assessing the impact of the project activities. UDLnet is going to achieve the objectives addressed by the following coordinated actions:

- By contributing to the openness and inclusiveness of education in Europe;
- By letting teachers and students acquire Competences;
- By stimulating the demand for accessible eLearning resources, designed based on the UDL approach.

In order to measure the impact of using eLearning resources in aspects that need to be addressed, UDLnet will measure impact on the three axes: on students – teachers; on school level (mainstream and special); on educational systems.

The means of achieving this will be:

- an Evaluation and Quality Assurance Plan, the methodological guide for all evaluation activities that will take place taking into account all foundation work in the areas of educational design, technological specifications, implementation scenarios, and the emergent development of Communities.
- Evaluation instruments: necessary instruments in order to evaluate the network outcomes and process, including questionnaires, surveys, and interview guides.

4 Conclusion and further work

It has proven far easier to help the various stakeholders understand the potential of UDL than it has been to implement UDL on a large scale. UDL requires collaborative planning amongst teachers with different curriculum knowledge and skills. The methodological approach of UDLnet has been presented. UDLnet is in the process of collecting practices of universal design for learning with focus groups where stakeholders and experts might attend and contribute and we hope that the recommended approach will contribute towards creating and sharing inclusive open educational resources. An implementation/training period will follow, as well as annual reports documenting the findings. Further work remains the presentation of outcomes, as well as the design of the web inventory with the UDL practices according with the UDL Guidelines and Checkpoints (CAST, 2014).

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Prototyping Software for Presenting Programing Lecture Materials for Screen Reader Users

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1 Introduction

Recent computers have developed in visual clarity and ease of operation, and as a result those which enable intuitive operations have become popularized. However for visually impaired students, because of a design which attaches greater importance to the visual, such computers are instead hard to use and cause difficulties and lead to a digital divide.

Therefore, to apply IT technologies for the student who has a visual impairment, the following measures are generally taken. In the case of the information on the screen which is hard to read, this is compensated for by enlarging the screen and/or adjusting the color tone. In the case of information which cannot be obtained through vision, it is compensated for by using sensory substitution measures such as audibility and tactile sense while utilizing the screen reader and/or the tactile sense display. When viewing the official guidelines for teaching for special support schools, it is stipulated that "an instruction method should be devised that considers the status of visual impairment of students, and which enables students to easily collect and process information by using such materials as tactile sense teaching materials, large print teaching materials, and voice teaching materials as well as using information devices such as optical aids and the computer." Therefore, for the education of visually impaired students, instruction that doesn't depend specifically on vision will become indispensable and the mastering of special education techniques will become necessary for the teacher.

For the education of the student who has visual impairment, in general assuring the following items is thought to be essential:

1. To improve the ability to understand the lesson, focusing on the voice.
2. A process of visualizing and or verbalization based on tactile impressions, and adequate time allowed for learning.
3. Understanding of the difficulty in understanding the whole picture, and the consideration needed.
4. Instruction for reading and writing in all school subjects.

Here, when focusing attention on aspects of education for the visual impaired student, the first item is especially regarded as of major importance. Because the student who has visual impairment cannot use visual communication tools such as the blackboard and/or visual teaching materials, a lecture which focuses on voice teaching is needed. However, since a voice comes and goes, to accurately listen it requires considerable persistence of concentration, logical listening, and a technique to construct the whole picture; in addition, a quiet environment is desirable. For that reason, the teacher must have a logical way of speaking to make it easy to understand the whole structure, and the technique to explain graphical expressions using language. In addition the teacher cannot have a lecture style that heavily uses demonstratives such as “this” and “here”, while indicating a blackboard and/or documents. This is the cruel reality for the collection of information depending only on the voice [1], [2].

On the other hand, by taking advantage of IT technologies, various methods have been created that compensate for difficulties in getting information through vision. For example, by making the most of support equipment such as the voice reader and the pin display, computers have come to be able to be operated without relying on screen and mouse operation. In recent years, these developments in equipment seem to have been increasing the amount of obtainable information even further.

With such a background, various methods to help visually impaired students such as the development of teaching materials and Web based learning systems utilizing these advanced IT technologies are proposed and researched [3], [4]. These methods can be said to be very effective measures to carry out in an independent way activities such as social participation, expression of intention, and effective collection of information. However, in the communication between a teacher and a student, there are occasions in which a student cannot proceed independently. For example, in such occasions as the interpretation of source code in a programing class, where the student needs to listen the explanation by the teacher and to access the materials at the same time; for the student who has a visual impairment, it is difficult to understand the lecture by listening only to a narrative from the teacher. When explaining the program source code, it is important to make students understand and focus on the position of the source code being explained in the document; but it is hard to confirm whether the student can access without problem the place where the teacher is explaining the information. In addition, the teacher must explain in detail instructions about the place explained, and in that way the information that is conveyed by voice becomes more and more verbose. As well as that, the teacher needs to use expressions to avoid using demonstratives, and so the teacher requires a special technique of narrating.

Therefore with the goal of solving these problems, this paper explains the prototyping of lecture material support software enabling the teacher to communicate with students in real time by controlling the lecture materials.

This software can distribute text-based lecture materials to the client software installed on the student computer in real time, and can show such information on the screen. It also introduces a feature which allows the teacher to indicate with a pointer the element to focus on in the presentation document and has a feature enabling students to record notes themselves. Using this software makes it possible to immediately show the part indicated by the teacher on the student computer screen in enlarged display as well as audio representation, and to show that part on the braille display; which makes it possible for the teacher to explain using the demonstrative.

2 Development of System of showing the Lecture Materials

2.1 System Configuration

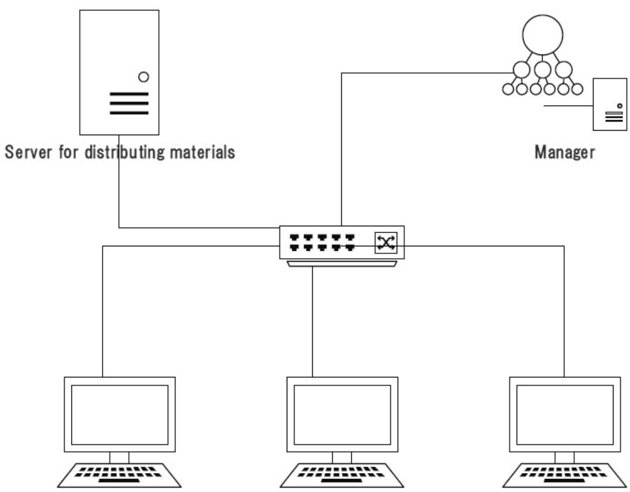
The system configuration of the software prototyped is shown on Figure 1. This software consists of the management software used by the teacher, the client software for the student which displays the lecture materials, and the distribution service server which is the intermediary connection of the network between the management software and the client software. Using the management software installed in the instructor`s administrative computer, the teacher can use it as follows: to load the lecture materials that the teacher wants to distribute; to indicate the points within the lecture materials where attention should be paid; to instructs the clearance of the lecture materials, etc. The student client performs the following: receiving and displaying the lecture materials distributed from the teacher`s administrative computer; enlargement, audio reading, and Braille display of the important points within the lecture material data, which is instructed from the teacher`s administrative computer. The distribution service server plays a role of relaying network communication between the instructor`s administrative computer and the student clients and is able to receive the connection of up to 100 student computers.

2.2 The management software for the teacher

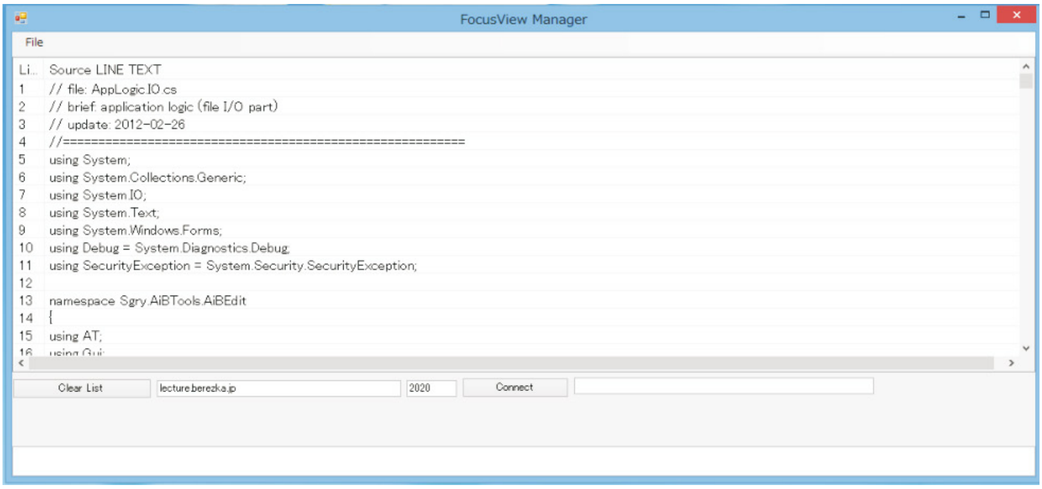
The screen layout of the management software for the teacher is shown on Figure 2. The features of the management software for the teacher are shown as below.

Loading from a file menu the text-based lecture material data desired for distribution, it displays the loaded materials in a list display as well as distributing data to the student client via the network.

Clicking with the mouse pointer on the line to be explained in class shows the instructed text information in enlarged display as well as playing the audio reading and displaying the braille characters in real time.



[Fig. 1] Entire picture of system configuration



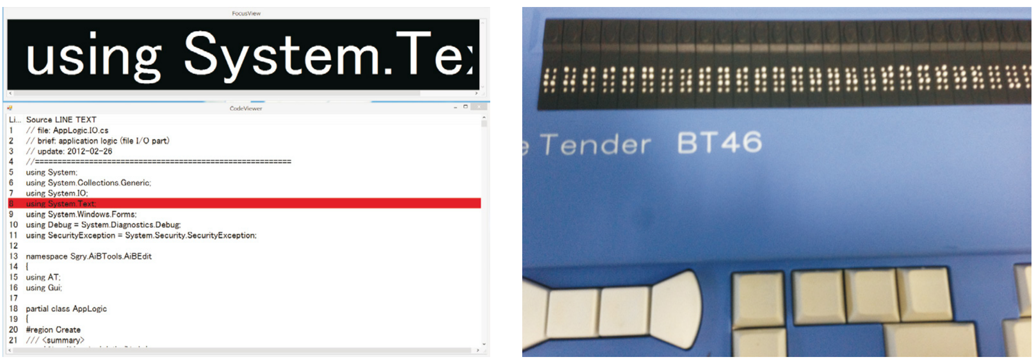
[Fig. 2] Management software Screen for the teacher

2.3 The student client software

The screen layout of the student client software is shown in Figure 3. The operations of the student client software are shown as below.

- It shows in a list display the lecture material data distributed from the instructor management software.
- It shows in a list display, the voice reading and braille display of the line of attention, as instructed by the teacher, as well as marking with a red mark the corresponding line within the list display .
- Memo recording feature
- Feature to save the showed materials/notes

Figure 3 shows both the situation when in the display of data, distributed by the teacher; line 8 is instructed as the point needed for attention, as well as the display situation of the braille display. Also, if needed by the students, the line of attention can be changed by using the up and down cursor keys and each piece of information can be confirmed.



[Fig. 3] Student client software

2.4 *The distribution service server software*

The distribution service server software has a feature to relay communication between the instructor management software and the student client software. The communication protocol uses TCP protocol, and the prototype software establishes connection using port 2020. This software simply carries out the action to broadcast the data distributed by the instructor management software to all student clients simultaneously.

2.5 *Overview of the communication protocol*

The communication of the software uses simple TCP message communication. And as for the data distribution and the distribution of various instructions from the teacher management software, the protocol was implemented on the application layer.

Header
New Line Code (CR+LF)
Message payload

[Fig. 4] Protocol format

The overview of the protocol format is shown in Figure 4. The data format that carries out the communication between the teacher and the students is divided into 3 blocks and the following 3 types of header parts were set out.

1. Lecture material distribution: [LIST]
2. Clear order of the distributed data: [CLEAR]
3. Instruction for the line needing attention: [NUM]

As for the message body, the following data will be input.

1. In the case of lecture material distribution: text data of the lecture materials
2. In the case of clear order for the distributed data: null data
3. In the case of instruction of the line needed for attention: the number of the line needed for attention

This protocol makes it possible to arbitrarily expand, so when the user wants to use the feature it makes it possible to add the changes to the header.

3 Trial use under a programing lecture with visually impaired students

We used our developed software in the network programing lecture in order to show C Sharp source code to students. This class has 8 students which visual statuses are shown in Table 1. The results of using the developed prototype software during actual explanation of programming source code are stated below. Using the developed software, it was possible to directly distribute and display the source code which was distributed in advance, without the necessity for the students to access the computer. Also, in the explanation time, because it was possible to enlarge and display in braille in real time as well as performing voice reading, the students were able to access the information along with the teacher's explanation without any delay; by indicating through the software the part needed for attention, the teacher was able to convey the information using the demonstrative.

When asking the students about their anecdotal experiences, it was indicated that due to the heavy burden to access the source code distributed, it was significantly hard to focus on and to listen to the teacher's explanation. However using this software reduced the huge burden, and linking both the information of the lecture materials and the teacher's explanation made it possible to understand the explanation – so it had a significant positive effect. Also, some students noted that it was easier for them to concentrate on the lecture and they felt as if the lecture hour had been shorter than the actual time.

For the teachers, when explaining it creates a sense of security if they can ensure that they can convey the information they want the students to pay attention to; and they were able to solve the problem that it is hard to confirm whether the students can access the necessary information without difficulty when the access is left up to the student as in the conventional situation. Also, since this software makes it possible to convey information with the demonstratives, there is the possibility that a teacher without any special skills can effectively give a lecture to a student who has visual impairment.

[Table 1] Visual status for each student for trail use of our software in the lecture.

Students	Visual status
A	Blind
B	Blind
C	Readable point size : 18pt.
D	Readable point size : 12pt.
E	Readable point size : 14pt.
F	Blind
G	Blind
H	Blind

4 Conclusion

In this paper, we proposed the prototyping of software for the screen reader user, which shows the lecture materials for a programming class. We found out that, when delivering a lecture linked to the materials, using this software enables the students to more easily understand and to be able to pay more concentrated attention in class. Also for the teacher, because it reduces the necessity of special explanation at the time of instruction for accessing the lecture materials, it can be considered to become a support tool enabling even teachers who are not accustomed to teaching visually impaired students to give an effective lecture. For the future, we plan to examine student opinions etc. in detail using questionnaires and so on, as well as to investigating the possibility of including sufficient features needed for a lecture support tool.

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Recommendations for the Development of Information and Communication Services for Increasing Mobility of Visually Impaired Persons

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Keywords: traffic network, communication system traffic control, assistive technology, adaptive technology

1 Introduction

In designing the interfaces of mobile terminal devices available for the visually impaired persons it is important to satisfy everything to the aspect of accessibility "Design for Usability". Mobile terminal devices depend on their characteristics, and therefore it is possible in case of iPhone device to use the recommendations of research about the touch screen functionalities [1]. The methodology of Touch screen functionality has been analysed according to the users' needs, where as concluding observations the most frequently used movements of single users are defined [2]. In order to improve the basic functionalities for the movement by mobile terminal devices the system programmers have to have satisfied user-experience-enhancing requirements [3]. The persons with damaged vision often use screen readers as aids for using mobile terminal devices and therefore it is important to adjust the content to the readers. The non-availability of contents fails to provide the visually impaired person with full information which is also indicated by the research about the analysis of the information availability [4].

Designing of services for mobile terminal devices with the aim of providing information and guiding of the blind or visually impaired persons has been dealt with in several scientific and professional papers. The methods of collecting, processing and presenting the data about the users' requirements have to be performed in a systemic manner [5], thus enabling higher quality design of applications and services for mobile terminal devices and the contents availability. Precise information that creates the contents of user information about their location for mobile terminal devices (Android) is enabled by the application of TTS technology, GPS maps and navigation applications [6]. In case of the mentioned solution the voice support has been successfully tested, allowing information and navigation of the users.

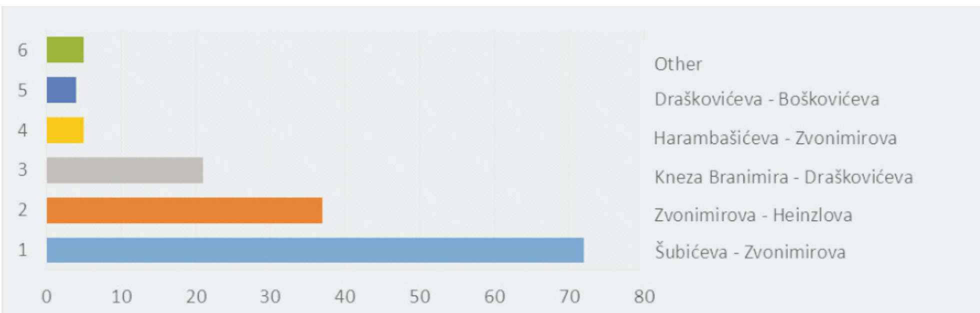
The problem of the precise location and all the relevant data necessary to increase the level of users' safety have not been observed in any of the mentioned papers. In designing ICT solutions and services for safe movement of persons with reduced and difficult mobility in the traffic network of the city of Zagreb the current situation needs to be analysed. The analysis will encompass the users' satisfaction parameters (assessment of the availability of the current technology and parameters that affect the perception of safety), and the analysis of technical and technological characteristics of the applicable user equipment and available applicative solutions taking into consideration the diversity of the user platforms MTU (Android, Windows and iOS).

2 State of the Art

To collect the data (users' opinions and attitudes) the method of interviewing was applied among people who reside in the City of Zagreb. The survey was planned to be applied on a sample of 175 users, who move and live in the City of Zagreb. The survey involved 144 users, which is 82 % of the total figure. The representative sample was defined according to the Croatian Blind Union and the Zagreb Association of the Blind Persons according to the number, which is 171, of Blind and Visually Impaired (significant amblyopia) people employed in the City of Zagreb. The poll involved 101 users who are employed, which makes 59 % of the total number of employees, so this sample is considered to be representative. This sample had been selected because these customers move around the city of Zagreb daily. The users participated independently in the survey via online form, and via phone in the form of interviews.

In analysing the assessment of traffic elements while moving along the traffic network the users assessed the current traffic signalisation intended for the persons of impaired vision in the City of Zagreb, adjustment and accessibility at the traffic intersections for the blind and the visually impaired persons and which intersection they find the least safe in their movements. In the City of Zagreb, as of 31 October 2012, there were 76 traffic intersections equipped with audio signalizers and a total of 698 signalizers. The defined traffic intersections were selected by the users who participated in the survey and they were used in testing the efficiency of the model.

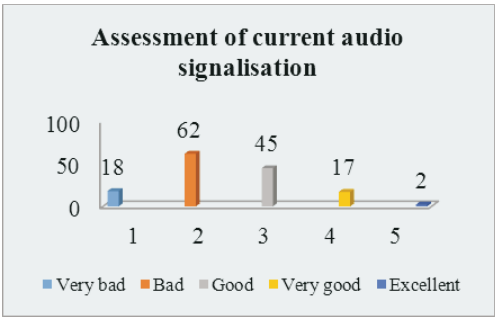
In selecting the traffic intersections, five traffic intersections most frequently used in the movement of the blind and visually impaired persons were offered. These are the intersections that are in the zone of the movement of the blind and visually impaired persons. These were used to test the applications for guidance and navigation of the users, and for performing the analysis of availability of ICT technologies and services. Figure 1 shows the assessment of the users regarding the safety level of the proposed intersections.

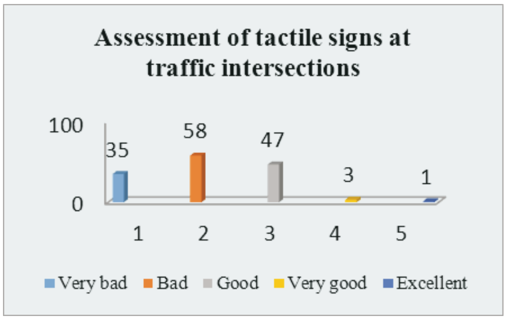


[Fig. 1] Traffic intersection of reduced feeling of safety

As a traffic intersection with the lowest level of safety (some users claimed that they could never cross it on their own) is the intersection of the Šubićeva Street and Zvonimirova Street, 72 users. The traffic intersection with the lowest level of safety is considered to be the intersection where the user while moving along it, feels the least safe, i.e. where they have reduced possibility of defining the configuration of the traffic intersection and the elements that surround them.

The assessment of the audio signalisation is presented in Figure 2a, which shows the users' dissatisfaction with the current audio signalisation on the routes along which they move. The assessment of tactile signs that are currently found at the traffic intersections is shown in Figure 2b. Thirty-five users assessed the current tactile signs set at the traffic intersections as very poorly designed, fifty-eight found them poorly designed, the situation was assessed as good by forty-seven users, four users found that the tactile signs have been designed very well, and one user considers the design as excellent.



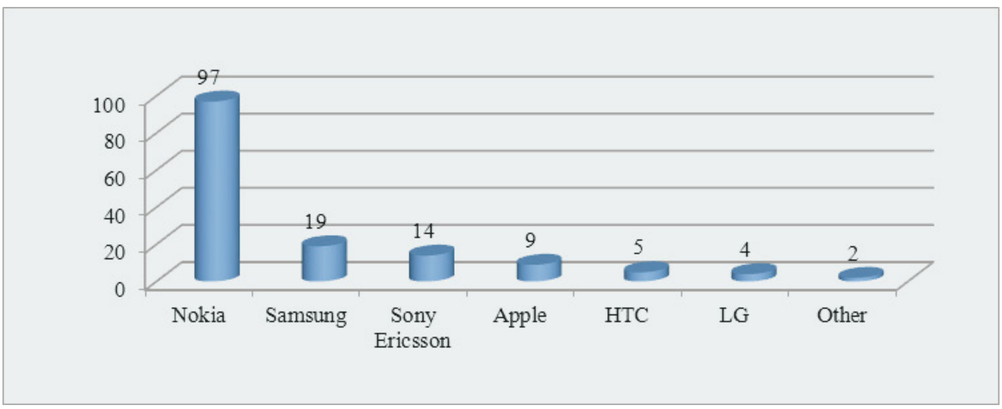


[Fig. 2a, 2b] Users' satisfaction with audio (2a) and tactile signs (2b)

The proposal of the development of new services in the zone of safe movement of persons with impaired vision is based on the application of new information and communication solutions. For this purpose the presence of mobile terminal devices and their functionalities have been analysed. Ninety-four percent of users use computer technologies which is very important in designing new services and solutions.

3 Assessment of Functionality of Mobile Terminal Devices

The surveyed users have assessed the availability of hardware characteristics of single devices, which refer to the significance of the availability of major functionalities. The major functionalities refer to the methods of usage when defining the trip plan, information methods, checks of information precision, data input methods and others. The users were interviewed at the defined intersection using the most represented manufacturers of mobile terminal devices as shown in Figure 3.



[Fig. 3] Most represented manufacturers of mobile terminal devices

The mentioned figure shows the most represented manufacturers whose mobile terminal devices are used by the interviewed persons. The devices and components that were used for the assessment of information and communication technologies are presented in table 3.1.

[Table 3.1] Overview of analysed characteristics of mobile terminal device components

Model	Operation system	Application	GPS Receiver	Input units	Output units
Nokia E51	Symbian OS 9.2	Loadstone	A-GPS out – Iblue 737A	Key-board	Talks
Nokia 6220 Classic	Symbian OS 9.2	Loadstone Nokia maps	BT-Q818XT 66- channels	Key-board	Talks
HTC Mozart	Microsoft Windows Phone 7	Outdoor navigation	Integrated, A-GPS	Touch screen	Voice navigation
Sony Ericsson Xperia mini pro	Android OS, v4	Intersection Navigation WalkyTalky	BT-Q818XT 66- channels	Touch screen	Talk-Back
Nokia C7	Nokia Belle OS	Nokia maps	Integrated, A-GPS	Touch screen	Mobile speak
HTC Vario 4	Windows Mobile 6.5	MobileGeo	Prestigio Bluetooth GPS	Com-bined	Mobile speak

The users evaluated the devices that they use by the significance grade 1 (unimportant) to 5 (extremely important). According to the analysed data, the users found in the hardware part of the equipment as the most important parameter the existence of a keyboard as the input unit. As output units (voice) the most frequently used are TTS applications such as: Mobile Speak, TalkBack, Talks and those that are integrated into the operating system. The operating systems that have been analysed are important from the aspect of designing the accessibility of applications used by the users.

The applications have been analysed according to the parameters indicated in Table 3.2. The users assessed with grades of importance (1 – not important, 5 – very important) single functionalities.

[Table 3.2] Overview of analyzed functionalities of navigation applications and their accessibility

	Loadstone GPS	Outdoor Navigation	Mobile GEO	Intersection Explorer	Nokia Maps	Walky-talky
Language support – CRO	Yes	No	No	No	Yes	No
Mode (offline/ online)	Yes	Yes	Yes	No	Yes	No
Map type	Google maps	Bing maps OpenStreet-Maps OpenCy-cleMaps	Tom-Tom	Google maps	Nokia maps	Google maps
Automatic detection of use (pedestrian / vehicle)	No	No	No	No	No	No
Voice control	No	No	No	No	Yes	No
Points of Interest entry (POI)	Yes	Yes	Yes	No	Yes	No
Starting method	Slow due to extern GPS-a	Fast	Slow	Slow due to extern GPS-a	Fast	Fast
Multitasking	Yes	Yes	Yes	Yes	Yes	Yes
Method of creating movement routes	Extern (via computer)	Yes	Yes	No	No	No
Ability to automatically create return routes	No	No	No	No	No	No

As the result of analysed functionalities of single applications the most common application is Loadstone GPS, which is also the most accessible to the users. The application operates with Symbian platform of series 60 and it can be connected with various GPS modules either external ones or those already installed in the mobile device. Loadstone does not use ready-made maps for movement and navigation, but the users need to define the maps and movement routes themselves, and after defining them the users can send them to the Loadstone central server so that other users may make use of the developed maps or routes. The application can run both offline and online which requires connection to the Internet, and the decision on the usage is to be made by the end-user. The advantage of this application is language support (Croatian) and running with Symbian screen readers which include Talks and Mobile Speak [7]. The drawback of this application is the impossibility of integration on newer operating systems, but due to its open source code many users have already started to adapt this solution to the Android system.

4 Recommendations for Design of Information and Navigation Services of Users

The proposal of developing new services in the field of safer movement of the visually impaired persons is based on the application of new information and communication solutions. For this purpose the presence of mobile terminal devices as well as their functionalities have been analyzed. There are 94 % of users who use computer technologies which is extremely important when designing new services and solutions.

Recommendations for the design of services for mobile terminal devices are based on the results performed in this research, and all this with the purpose of accurate navigation and information of the users about the environment. The recommendations for the design of services for the guidance and navigation can be classified according to users' requirements which have to be met. The information that needs to be provided to the user by the system includes:

- Information about location;
- Information about guidance and navigation;
- Information about objects surrounding the user;
- Information of audio character;
- Information of descending and ascending curb;
- Information about traffic intersection;
- Information about the traffic control method (tactile lines, traffic light system or something else);
- Information about the proper moment to cross the street;
- Information about the system operation (failure of the system or upgrade), and
- Information about arrival to the destination.

The service of informing and navigating the users from the starting to the desired point has to provide accurate information about the user's location and environment and all the relevant information for guidance. Therefore, the user's mobile terminal device should be equipped with the application that satisfies all the standards of universal design. It is recommended that the application features the offline/online operating mode, mostly because of the economic aspect.

According to the elements of universal design the application has to be available for all groups of users, which means that its design and possibilities should not deviate from the standard solutions. The design has to be equally adapted for the left-handed and for the right-handed persons. The flexibility of usage is important when satisfying the users' requirements and for this purpose it is recommended, during the user installation, to define the user profile in order to provide the user always with the requested information. The management elements then need to provide logic structure of information, more accessible according to the most frequently used information. The information structure needs to be divided according to the following categories:

- Basic information about the user;
- Information about the route of movement (where all the above mentioned pieces of information need to be provided);

- Public urban transport services;
- Possibility of defining the information for real-time information, and
- Accompanying facilities surrounding the user.

Because of the possibility of connecting the application with the web interface the mobile and web application need to have satisfied standards in selecting the colours for the visually impaired persons, as well as the possibility of increasing or reducing the font size [8].

The contents of application have to provide clear and understandable information, mostly because of the compatibility with screen readers. When defining the basic information about the user it is important to make it possible for the user to define their own level of impairment so that the information can be adapted.

By defining the level of the user's impairment better accessibility to the requested information is provided and it can be adapted to the users' requirements. Image information need to be accompanied by description, and the information needs to be understandable, regardless of the user experience, knowledge, language skills or current level of concentration. The information provided by the application also needs to have language support for the majority of world languages.

The application design must be such as to reduce the threats to a minimum, and to prevent the consequences of random or unintentional action. The information management elements should be set in such a way as to reduce to the minimal measure the threats and errors due to the application running: the most used elements; the most accessible ones; eliminated dangerous elements, isolated or covered. The warnings of danger or possible errors should be enabled. Protective elements should be enabled. Unconscious actions in creating information that require full user's concentration should be disabled. Working with the application should not inflict any physical or mental effort, such effort should be reduced to a minimum.

For the running of application that features the service of informing the users about all the relevant traffic information that surround them, information should be also provided about the public urban transport. This information would provide the user with a higher quality access to public urban transport, which is reflected through:

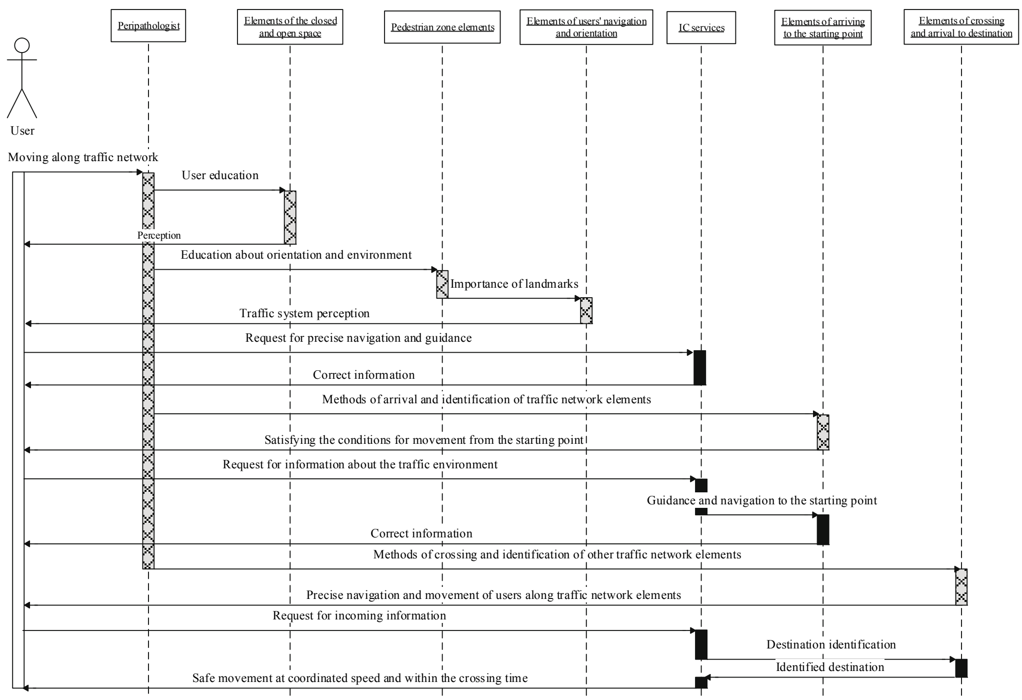
- better information about the time of arrival of tram or bus;
- monitoring the work of application if the user is changing the transport mode;
- information of users about the environment in the vehicle during the ride;
- information of users about the environment at the station, and
- possibilities of arranging special transport services.

Real-time information of passengers, the service which informs the user with sound or voice information about the changes on their route of movement. Example: if there are works on the pedestrian crossing and it is impossible to use it, the user gets the information about this, and suggestions of alternative routes for safe moving. Two-way information, data and voice communication with the user is important before moving along the traffic network. The users have the possibility of creating their own route within the application, data that have not been input the users can enter themselves during their movement. For safety reasons the information can be very important, for instance if there are works blocking the direction of the user's movement or the information found at the intersection are not correct.

The supporting facilities that surround the user can be defined within the application as points of interest (POI). The possibility of such information can be used if the user wants to receive information about the supporting facilities such as cafés, restaurants, museums, shopping centres, hospitals, etc.

Because of the possibility of connecting with web applications it is necessary to ensure compatibility of devices. The current data about the number of represented devices are in favour of the devices that have a keyboard, whereas the devices with touch screen as input unit are used to a lesser extent. Because of its input unit the iPhone device provides a keyboard as an additional component which is also used by some of the interviewed users.

The recommendations for the development of new services are based on the application of key relevant parameters whose purpose is the creation of the user knowledge base. The interconnection of the parameters into one whole (base) and their sequence is important because it is set on the basis of the learned basic methods on orientation and movement of the blind and visually impaired persons. The user learning processes while moving along the traffic network are shown in Figure 4. An important segment in this presentation is the peripatologist or instructor of orientation and movement whose task is to implement the program with the blind and visually impaired persons in order to facilitate their movement along the traffic network. Based on the obtained information (based on ICT technologies) the user is provided with coordinated movement along the traffic network thus regulating their speed, and thus also the time of movement.



[Fig. 4] Generalised overview of creating the user knowledge base

The implementation of new information and communication technologies (information and communication parameters) in the function of the users' mobility along the traffic network allows better information of the users. The information of the users is considered from the aspect of the user's surroundings and exact information about the navigation and guidance of the user to their destination, which affects directly the speed and time of movement. The exact information about the users' surrounding and their guidance contribute to raising the level of safe movement along the traffic network.

5 Conclusion

This research gives recommendations for the development and design of new services based on the most common mobile terminal devices and technologies. The prevalence of the devices is based on the previously performed analysis in the target group of users. The users tested the currently common applications for guidance and navigation at the traffic intersection where their level of safety is the lowest. This meant defining of all the relevant information necessary for better and more efficient movement of the users. The drawbacks of the current applications have been used as the basis in defining the recommendations for the development of future applications, all this with the aim of increasing the users' safety.

New services as the basis of the decision-making process use the generalized presentation of the user knowledge base, and all this with the aim of increasing the level of the quality of living of the visually impaired persons in the city of Zagreb. In the Republic of Croatia 66 % of the surveyed users pass the training of orientation and movement and therefore the peripatologists have to have education about new ICT solutions and services. The mentioned services would then become a component of every user training who wants to move independently along the traffic network.

The design and development of mobile applications in the function of guiding and navigating the visually impaired persons along the traffic network need to be developed according to recommendations and standards. Therefore, for this purpose it is necessary to satisfy the mentioned criteria in research. The more precise location of the users is possible with the application of additional technologies such as RFID, NFC or WiFi thus directly combining information about the user environment.

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