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INFOMAT-E – public information system for people with sight and hearing dysfunctions

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Abstract*—The article features the results of two initial stages of the Infomat-E project. The project is to provide access to information to people with sight and hearing dysfunctions through a hardware-software solution. So far, a number of analyses have been conducted within the project with respect to the method in which the contents of information is presented as well as interaction with the devices that present this information. These included the analysis of suitable colours, font sizes, ergonomic layout of screen menu bars, and ergonomic keyboards – to make them most convenient for people with sight and hearing dysfunctions. There were also analyses conducted how written texts are understood, especially in the case of the deaf. The project assumes integration of elements which were results of separate research projects. Within the project, the following will be used: speech synthesis, speech analysis, presentation of ideas with the use of the sign language. The project will result in the Infomat-E system which will present information in kiosks specially designed to suit the needs of people with sight and hearing dysfunctions. The article features the results of the conducted analytical works which lay at the basis of the technical concept of the system. This concept is presented in the article too.

I. Introduction

MODERN public administration requires that the customers should have more and more knowledge, especially in the field of administration issues. It is necessary to know regulations, administrative procedures, to be familiar with one's own rights and duties resulting from the national and local laws. To meet the clients' expectations in this field, administration offices provide information in different ways. There are guidebooks, web sites, public information newsletters, information kiosks, and other methods to provide assistance in everyday contacts between citizens and public administration.

Among people who use public administration services there are handicapped people whose dysfunctions cause not only health problems but also communication problems. Among the handicapped, 30% are people with sight dysfunctions, while about 14% – with hearing dysfunctions [1]. As there are about 5.5 million handicapped people in Poland[1], the group of people with sight or hearing dysfunctions is considerably large, and this group is particularly affected by communication problems as far as the access to information or information exchange are concerned. Many institutions lack solutions that would allow the blind and the deaf to deal with administration issues easily and, what is even more important, by themselves. In the case of blind people, there is no information that would contain, for example, a set of guidelines how to move inside a building in order to get to the place where a given issue is dealt with.

While the problems of blind people seem to be regarded as evident, it is often understood that written information is an alternative for the deaf. However, deafness significantly affects the way a deaf person functions in a society, causing difficulties in understanding both written and spoken information and in expressing oneself. This affects particularly those who have been deaf from birth as the Polish language is a foreign one to them – their mother tongue is the sign language which has totally different syntax and grammar regulations and whose terms have different semantic ranges than those characteristic of Polish [2]. Vocabularies are significantly different too as far as the number of words is concerned. Generally speaking, sign languages used in Poland have only several thousand signs each. Information provided by different institutions, not only administration offices, is often too complicated (due to such reasons as: too sophisticated words, too long sentences, the use of compound-complex sentences). Such statements are too difficult to understand not only by a deaf person but also by an average citizen.

As a result of all these factors, people with hearing and sight dysfunctions have become socially excluded as far as the contacts with public administration are concerned.

Currently available devices that support the deaf and the blind in their everyday living are separate for each of these two groups. There are no integrated and, at the same time, publicly available solutions that would support people with each type of dysfunction, not only individual users.

II. Infomat-E project

The researchers of EMAG had recognized the numerous, varied and yet unsolved issues and launched a project aimed

The presented results are the results of the project No N R02 0059 06/2009

[1]National Census 2002.

at solving at least a part of problems of the handicapped. Within the project No N R02 0059 06/2009 EMAG began the development of an integrated set of hardware and software components which will allow efficient information transfer to people with sight and hearing dysfunctions. The objective of the project is to develop a prototype which will make it easier to deal with widely understood public issues. The solution will be based on providing information with the use of specially designed information kiosks. This article aims at presenting the results of analytical works related to the project along with the concept of the Infomat-E system development.

III. Analyses results

The Infomat-E project is developed in co-operation with two groups of handicapped people, according to the project assumptions. All analyses presented here, along with proposed technical solutions, were consulted with potential future users of the system, i.e. blind, poorly sighted, deaf, and hard-of-hearing people.

A. Requirements about appearance of the device

The Infomat-E project is based, to a large extent, on presenting information to the user. The information is presented in kiosks and the objective of the project is, among others, to make the presentation method and navigation through the system as easy as possible for people with sight and hearing dysfunctions. For this clearly defined objective there were requirements identified and analyzed within the project. The article features a part of these requirements with comments. For blind people it is important that the information should be property voiced and that an ergonomic control method should be applied (voice, well adapted keyboard). For poorly sighted people it is important that the information should be well visible. These issues are contained in WCAG (Web Content Accessibility Guidelines) [3]. This specification refers, largely, to the issues of web site content presentation. An information kiosk is a kind of a specific web site, thus the guidelines included in WCAG were a starting point for writing down the guidelines on how to present information in the kiosk. The layout of information sites was prepared. Then the sites were evaluated by poorly sighted people from the Polish Association of the Blind (PZN). It turned out that some WCAG guidelines were too lenient with respect to the colours or contrast applied in the presentation. A large part of screen layouts of the future Infomat-E presented to the poorly sighted were questioned due to poor readability, though all proposals complied with the WCAG requirements.

As a result of discussions between the project developers and PZN, some additional requirements, supplementary to those of WCAG, were prepared. The requirements about colours and general appearance of the site must help poorly sighted people pay attention to the most important information.

The sites should have high contrast applied to such elements as the text and diagrams. The background of the site should be uniform so as not to distract the poorly sighted person's attention. The site should be visible for the poorly sighted but, at the same time, should have an esthetic appearance for able-bodied people who will use it as well. Due to contrastive colours the site lacks esthetic qualities and, therefore, does not look professional. As a result of analytical works and consultations with the poorly sighted, it was decided that the best colours would be different shades of grey. Such a set of colours (Fig. 1) meets the requirements both about high contrast and esthetic requirements.

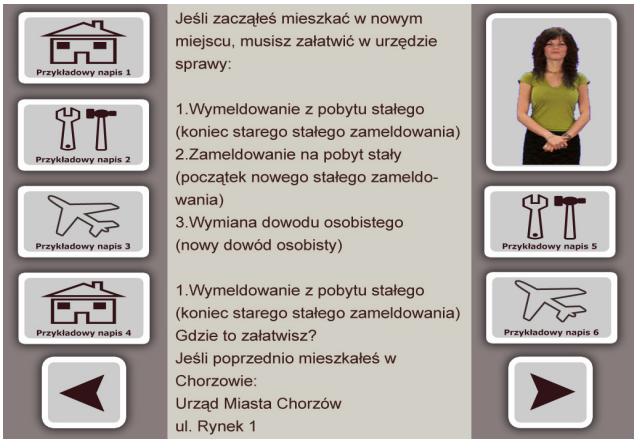

Fig 1. Standard layout of a touch screen [source: own]

The site of the information kiosk should present the content with a contrast ratio of 7:1, according to the pattern described in WCAG, while the font size should be at least 20px[2] , which means that on 96dpi monitors the text will have a minimum height of 6 mm. After the analyses, the minimum recommended height was increased to 10 mm. As far as navigation buttons are concerned, they should be well visible against the background. This can be achieved by contrasting frames. The buttons should be placed in regular distances from one another, in flat rows. It is possible to use shadows around buttons, however each shadow should be symmetrically placed around the button.

In order that the function of the button could be better understood, it is possible to place an icon on it. The icon is also helpful for the deaf as it helps to understand the use of the given option – it creates certain associations. The icon on a button has to be in proper distance from the caption. The icon has to be outlined. Filling of the outlines should be avoided as this way the whole picture would be blurred and the pictogram would be seen as a shapeless blotch. Thus the used icons were quite big while the captions on buttons relatively small. There are certain arguments for such a choice. If big-size fonts were used – readable for poorly sighted people – the place in which to place the pictogram would be much smaller. It is possible to increase the size of buttons but this would cause problems with distributing larger num-

[2]px stands for screen pixel. All calculations of quantities referring to font sizes or other displayed elements have to take into account the real resolution of the monitor. It is necessary to remember that these could be different values for the X and Y axes. In this article the resolution of 96dpi was applied in calculations.

ber of buttons which give access to information contained in the Infomat-E system. Another argument to diminish the size of captions is the fact that one's associations are better developed on the basis of pictures rather than texts. Additionally, smaller captions on buttons will be readable for users who do not belong to two basic groups selected for the project. No matter whether the graphic layout is readable to the poorly sighted or not, those users will have additional support from those functions of Infomat-E which were designed for the blind. The whole of the system will be voice-enabled, including buttons.

B. Guidelines about text presentation

The method of text display in the kiosk should be compliant with a number of requirements. The text should be written in a sans-serif font, aligned to the left and should not contain words in italics. The recommendation to use a sans-serif font is the result of discussions with PZN and is different from the recommendations stipulated by WCAG. Sans-serif fonts are particularly clearly seen on raster scan displays, such as a computer monitor. Serif fonts and italics, well readable on printouts, are not displayed well on screens. The displayed text should contain enough blank space (line spacing, inter-paragraph spacing) to distinguish between particular information units. It is necessary to have two spaces after each sentence and a single line of the text should have no more than 80 characters. Interlinear spaces should have at least 2 px, while inter-paragraph spaces should be 1.5 times bigger. All texts displayed in the kiosk should have a uniform appearance, without unnecessary text formatting. The only exception are words that have to be specially distinguished, for example links to other sites. The letters in the words should not be placed too narrowly since they might merge into one another.

C. Understanding the texts

Understanding the texts is another important element which affects the kiosk accessibility by the handicapped. In this case the key factor is how information is understood by people who are deaf from birth because they particularly face difficulties while reading standard texts.

The deaf use the sign language every day. This language has a different structure and logic than the Polish language because the latter is based on linear language structures. Each sentence in Polish is a series of successive elements coming in a certain order which cannot appear all at the same time. In the sign language it is possible to use non-linear mechanisms, thus one can say a few things at the same time [2]. It happens so due to communication transferred along three channels at the same time (body language, voice-sound, words). As the deaf lack one of these channels, they reinforce other, i.e. the body language channel. Using body language is a natural thing here because this channel is responsible for the majority of communicated messages. Still, looking at the words transferring channel, in the case of the sign language, in long sentences the SVO[3] order dominates (the subject is before the verb and the object comes as the last one) while in short sentences – the SOV[4] order (the subject is before the object and the verb is the last element).

Another problem is the vocabulary range of the sign language. Currently in Poland the sign language contains, officially, about 2,500 words [4]. This concerns the documented and analyzed version of the sign language used in Poland, i.e. the Sign and Language System (SJM). A larger vocabulary range is the one of the Polish Sign Language (mother tongue of the deaf). However, this range is not contained in any dictionary and there are differences between regions where it is used. Independently on the version of the sign language, its vocabulary is much smaller than that of the Polish language. Therefore, if a text is to be understood by the deaf, it has to be simplified, to make a kind of translation, which is a very difficult task if one takes into account numerous differences in the vocabulary ranges between Polish and the sign language. It is important to note that many hearing people who use the Polish language every day have problems in understanding complicated texts, e.g. official texts, legal texts [5] [6]. Additionally, when official texts are simplified, it is forbidden, due to formal reasons, to translate certain precise expressions and the representatives of public administration are reluctant to allow such translations as some elements, such as the names of documents or departments, should not be modified.

Having in mind these two groups of people and other formal requirement, some recommendations were worked out on which the descriptions displayed in information kiosks should be based:

- The text should not contain long and complex sentences.
- Each sentence should have only one verb in second person singular and the SVO order which is the basic syntactical order of the Polish language and understood by the deaf.
- Passive voice must not be used.
- The texts should contain words only from the set of vocabulary of the sign language. If it is necessary to have in the description an expression incomprehensible to the deaf, the expression should be described by means of basic words.
- It is recommended to use expressions which show how a given activity should be performed with the use of concrete everyday things, e.g. the sentence "Submit an e-form" can be replaced by: "Save your data in the computer on the web site of our office".

D. Navigation

For blind people it is particularly important to have proper navigation guidelines which enable them to get to the desired place. After consultations with the blind it was decided that navigation guidelines should contain orientation points, such as: stairs, door, lift. One should not forget about putting a starting point into the guidelines either. It is not necessary to say how long the distance is, it is enough to describe the way and give the destination point or places where direc-

[3]SVO - Subject Verb Object

[4]SOV - Subject Object Verb

tions change. Navigation guidelines should not contain too many details as this can make it difficult for a blind person to remember or comprehend the description. Other users can make use of basic information about the place where a given issue is dealt with, i.e. room number and floor. Additionally, it is planned to have an interactive map that will picture the location of selected places in the building and how to get there.

IV. Concept of the solution

As a device, a multi-media kiosk is a specially prepared computer equipped with a touch screen, keyboard, camera and microphone.

As far as its application is concerned, the kiosk can be defined as a place where it is possible to get context information about things related to the institution in which the kiosk has been installed (office, shop, exhibition, museum, etc.).

People with different dysfunctions will have different problems when contacted with a typical information kiosk. The poorly sighted (or the blind) have problems with using touch screens. Sometimes there are keyboards on touch screens which make the latter useless for the blind. In the case of mechanical keyboards, there are often untypical keyboards used. The keyboard buttons have small key travel (weak tactile feel).

The kiosks also lack screen voicing in the form of the screen content being read aloud. It is possible to use the so called screen reader but, as the interaction with the kiosk is different than with the computer (no mouse), it is necessary to employ extra mechanisms. Using a speaker in the kiosks makes the users feel they have no privacy. People with hearing dysfunctions and deaf usually have difficulties in understanding written texts (the written language is, in fact, a foreign language to them). The best solution would be to present the content with the use of the sign language. Obviously, hard-of-hearing people find it difficult to hear sounds too, particularly when standard speakers are used.

To sum up, the requirements for the Infomat-E system, from the point of view of an information kiosk, are the following: proper voicing (both speech synthesis and analysis), presenting the content in the sign language, providing ergonomic operation of the device (proper receiver, keyboard). Other requirements regarding the information display are the following: suitable layout and content (avoiding too much information), simple texts (comprehensible texts), proper colours and sizes (contrast, brightness, colours).

While the technical concept of the solution was worked out, it was assumed that the solution should enable easy adaption of the existing kiosks. The kiosk structure should not divide the users into groups. There should be a common interface provided that would meet the requirements of all users. These objectives will be achieved through the use of proper software and a dedicated device – a manipulator.

The software will include several components which will facilitate access to particular pieces of information linked with one another so that their co-operation could bring a desirable effect.

The voicing will be achieved by providing speech synthesis in such a way to enable ergonomic listening (possibility of repeating already heard messages, reading sentences, reading words, explaining difficult words). Additionally, voice control will be available as a supplementary function to keyboard and touch screen based control.

To facilitate the system operation by the deaf, there will be an avatar presenting the information content in the sign language. This solution is developed in co-operation with the Silesian Technical University and the Progress company [7] [8]. It is composed of two elements: a module which is responsible for controlling the avatar's movements and a mechanism which translates sentences into the sign language (necessary simplifications, change of word order, etc.). This way it will be possible to present the content in the sign language automatically.

Apart from the software that will support handicapped users, there will be software to support the administration of the whole system. It will comprise; a tool supporting the verification of the content complexity (checking the words used in descriptions so that they should fall within a certain range, e.g. the range of the sign language), a tool verifying the used colours (measuring contrast according to the standards given by WCAG so that the colours should be suitable for the poorly sighted), an administration panel to manage the content and interactions with the kiosk.

Apart from the software, it is expected to have a special device added to the system – a manipulator (Fig. 2).

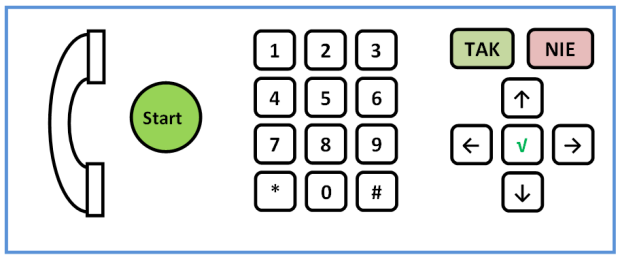

Fig 2. Sample layout of the manipulator panel [source: own]

Fig 3. A typical information kiosk and a kiosk of the Infomat-E system [source: own]

The basic element of the manipulator will be a keyboard consisting of two parts: a numerical keyboard and a navigation keyboard (arrows). Both keyboard systems are very popular and commonly used (the numerical keyboard is used as a standard in phones, while the navigation keyboard – mobile phones). The START button will be specially distinguished. Its role will be to return to the initial state of the dialogue or to check whether the kiosk is operable. The keyboard will have clearly marked button travel while the buttons will have convex-print captions. There will be convex prints of symbols and Braille alphabet signs. The manipulator will also have a telephone receiver in order that the user could have some privacy. Additionally, the receiver will enable voice contact (listening and control) and will help people with hearing devices to use the system thanks to a built-in induction loop. There are plans to add a movement sensor to the manipulator so that a person approaching the kiosk could be detected. This will allow to implement certain reactions of the kiosk to such a situation. A Bluetooth module will allow to use the Infomat-E system through a mobile phone. It will be possible to send a note to a mobile phone, information about how to get to a certain place (map of the building), etc. What is more, it will be possible to connect the manipulator to already existing and functioning kiosks (Fig. 3). Thus there are two solutions worth mentioning here. The panel of the manipulator will be connected to the kiosk by means of special handles – this way if the manipulator needs to be adapted to a new type of kiosk, it will not be necessary to re-design it. The second quality which makes the system more universal is the use of a USB connection to connect the manipulator to any computer.

The concept of the Infomat-E system focuses on the part which is responsible for information display – the information kiosk. However, the kiosk is not the only element of the system. The system structure will make it possible to start the system on a single kiosk or on many kiosks operating within a network (Fig. 4).

It is planned that one database with texts will be used for many types of interfaces – the same content and different way of presentation on different devices. Thanks to one coherent management of such content, the quality of information service is increased because the presented data are coherent and updated (a change in one place is followed by changes in all types of interfaces).

V. Conclusion

The project enables to integrate the elements which have been scattered so far and which are results of separate research projects. The developed system will facilitate contacts with administration and other public institutions for a wide group of users, particularly those who have sight or hearing dysfunctions. The adopted concept of the system development allows easy information management within the system. The project contributes to all efforts against social exclusion and is an answer to social needs for such types of systems.

Additionally, the objective of the project is to develop a solution that would allow integration with any information kiosks offered by commercial companies on the market, provided that the kiosks comply with the technical requirements stipulated by the project. The presented technical concept enables to fulfill this objective.

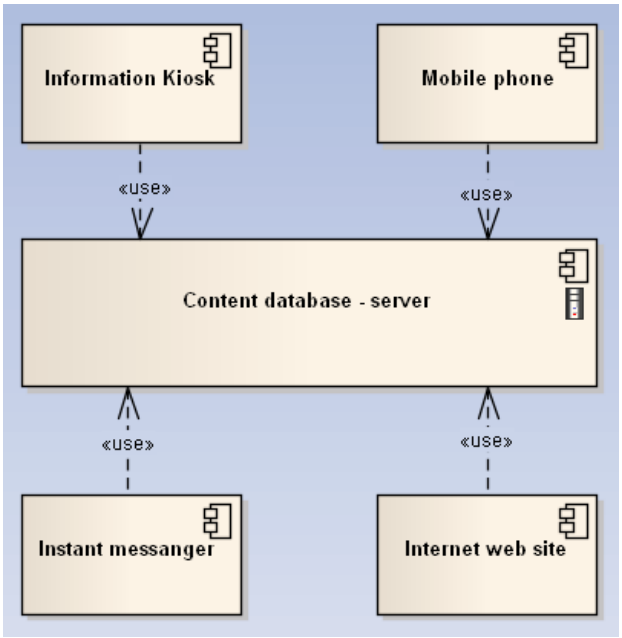

Fig 4. Infomat-E system architecture [source: own]

The results of conducted research and analyses will allow better identification of difficulties encountered by the blind, poorly sighted, deaf and hard-of-hearing. Higher awareness with respect to the existing barriers is sure to initiate another projects aimed at assisting the handicapped in their everyday living, similar to the Infomat-E project. Particularly the results of analytical works related to the presentation methods and content can be helpful in other projects which aim at providing access to information to people with sight or hearing dysfunctions.

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