Web 2.0 services for informing elderly people: Web for Health

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Abstract – **This research on user requirements defines functionalities of the Web 2.0 systems for the targeted user group (elderly, people with impaired vision, hearing, speech, and neurodegenerative diseases - TUG) in order to improve the quality of their lives. For this purpose, there is a proposal of Web 2.0 technologies (HTML5 and PHP) whose functionalities allow dynamism and adaptability of information to the TUG. Architecture of solution is based on Cloud Computing (CC) technology which provides 24/7 support for provision of service and safety. Functionalities defined in this paper, are in fact a form of an assistive technology, which allows a registration of the TUG and enables a necessary adjustment of websites according to the degree of deficiency. Due to the functionalities listed within this paper, developed application solution allows the TUG to spend their third age in a dignified manner, providing them with the possibility to have more interaction with people and the opportunity to participate in various activities in their fields of interest.**

Key words: HTML5, Cloud Computing, assistive technology, eHealth

I.   INTRODUCTION

Human life time has lengthened in the last twenty years, which indicates a large population of elderly people. It is a known fact that older people have difficulties in adjusting to the hectic world around them and mostly to the use of the functionalities based on newly developed technologies.

The research [1] is aimed at older people who have mental health problems and want to stay at home. A significant number of people is in need of greater care and technology is one of the things that can help them self-manage their health. This requires a large number of mutually synchronized devices. The application solution would decrease the number of needed devices, because everything would be available in one place. Based on [2], it can be concluded that a small number of older people use Internet and that is because they do not have it implemented at home or because they find it unnecessary. Content that is available via Internet is considered unattractive because it's based on providing services of interests to young people. Therefore, it is necessary to understand the needs and interests of the elderly in order to create a compelling content. Because some of the users do not have a constant access to the Internet, a development of application based on HTML5 programming language would give them the privilege to use it without the need of constant Internet connection. The article [3] has examined how older people respond to the introduction of new technologies. They think that the usage of new technology will not be much of a help for them in their everyday life, primarily because the learning of how to use new technologies requires a lot of time. Therefore, they think they need help in acquiring the new knowledge, and the application solution must provide them with sufficient information of its appliance.

Due to previous facts, several researches were carried out in order to gather information about the needs of older people. It was concluded that there is still no satisfactory hardware and software solutions to match the high-quality forms of the assistive technologies. Therefore, the proposed application solution contains functionalities that can provide greater autonomy and awareness of the TUG. The implementation of the web application and its development allows TUG to customize the user interface according to their actual needs with an aim to provide accurate and real-time information services. Considering that the technology is constantly evolving, the learning and the appliance of new technologies is often considered repulsive so it is necessary to create the proper environment and a simple visual presentation to enhance TUG's desire for education. The proposal of the CC technology as the operational basis of the *Web for Health* solution is conducted on a previous research and based on the accuracy of the use of real-time information [4]. Wireless technologies of collecting and providing information on the status of user and his further movement depend on specification and technical capabilities of the service which can provide the user with desired useful information [5].

The aim of this research is to create a Web 2.0 service which will be based on new web technologies and suitable for targeted deployment. Based on the previous research and studies, it is possible to make a selection of services that are

proved as useful to the TUG and also represent a basis for functionalities of the application solution.

II. RESEARCH METHODOLOGY

To assure that functionalities of the service are fully customized to the TUG, important information were gathered by conducting a survey. The survey included questionnaires and interviews of elderly in 10 nursing homes in the city of Zagreb. From the total number of 208 respondents, 56% were older than eighty years. Other data about the age of respondents is shown in Figure 1.
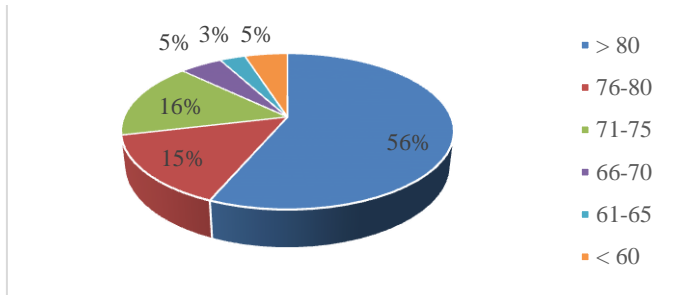

Figure 1. Structure of the test sample (i.e. users) according to age

Figure 2 shows the reasons for the use of services based on new technologies. Out of total, 42% of respondents listed that they find the application solution most helpful in terms of health problems, 23% of respondents find it most helpful for the orientation and mobility, and 16% for the communications and entertainment (19% of the respondents have listed other reasons).
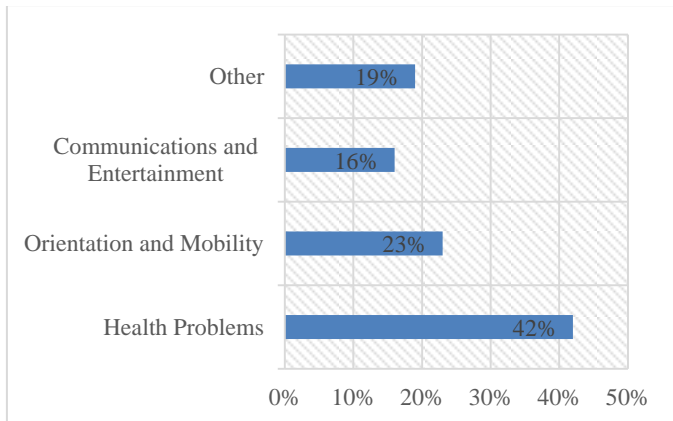

Figure 2. The purpose of using Web for Health services (i.e. interests of the TUG)

Considering the fact that a large percentage of respondents defines a health care as their most important need, it was necessary to conduct an additional research on their health problems. Visual impairment is present within the 49% of the respondents, and the hearing loss within the 38% as well as the presence of neurodegenerative damage. These results provide the information on how to adjust the registration for people with cognitive impairment as well as how to adjust the application solution. The TUG rarely use mobile devices or computers to solve such problems, but they're willing to learn how to use the application solution that could be customized to their needs with quality instructions.
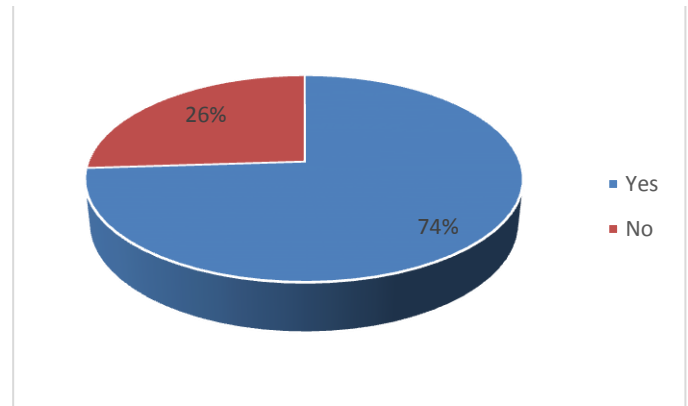

Figure 3. The percentage on the use of mobile terminal devices within the TUG

A percentage of targeted users who use a mobile terminal device is surprisingly high and it even ranges to 74% (Figure 3). But, out of the total number of respondents only 22% use a personal computer. While conducting the research on the purposes of using a mobile terminal device or a personal computer it is concluded that the 23% of respondents use their devices to access the Internet and the 21% use their devices for the purpose of health care. The results of this conducted research have greatly contributed to the adjustment of proposed application solution. There was also a research about technologies that make the best match for the form of application solution, conducted by a simple communication with the TUG in order to find out what kind of content and layout of the application is considered suitable. Through the interview of the individuals who are in a nursing home, it was concluded that the best solution would be if there is a person who will show them how to use the application or a tutorial that will provide a voice guidance throughout the application. The concept of this service does not require any demanding action and provides a tutorial that guides the user through every step of it so it could truly be easy to use. If the user forgets how to use a service he can restart tutorial at any time.

III. PROPOSED TECHNOLOGIES FOR *WEB FOR HEALTH SOLUTION*

The accessibility of application solution is carried out and assured by the current information and communication technologies, the optimization for search engines, the offer of alternative solutions and tools and the modern design that was developed in HTML5 environment. Application solution must be developed according to the guidelines for the development of accessible web applications published in 2008 under the name of WCAG 2.0. The appearance of application solution is adjusted to TUG, based on instructions for the operability of the web applications. A nine criteria is taken into account [6]. The standardization is made for the purpose of abbreviated keyboard using six recommended shortcuts as well as the definition of the direction of navigation that goes from left to right. Informative architecture is composed of two most important types of information; the main and the useful. Flashing content and pop-ups are not readable for the visually

impaired, therefore, are not used within the application design. Each page content that is in text, visual or audio form contains its short description in tags. A need for a visual adaptability is also taken into consideration, therefore the users are able to adjust the size of the letters, select the color and choose a background color. The information about which color and size TUG finds most appropriate for the use was also collected, and it was taken into account when developing application solution.

Registration system makes one of the most important components of the application solution. It includes user defined

users, the registration system is inevitable process of defining the purpose of the usage and the functionalities of application solution.

The registration process is designed in the form of a small windows where the main window contains a series of steps for the user. The user is not allowed to pass onto the next step until he finishes the present step. If the user cannot see well, he opens a window of defined issues related to his damage, and after he answers all the questions, he passes to the following possible deficiency. On this basis, the application adapts itself
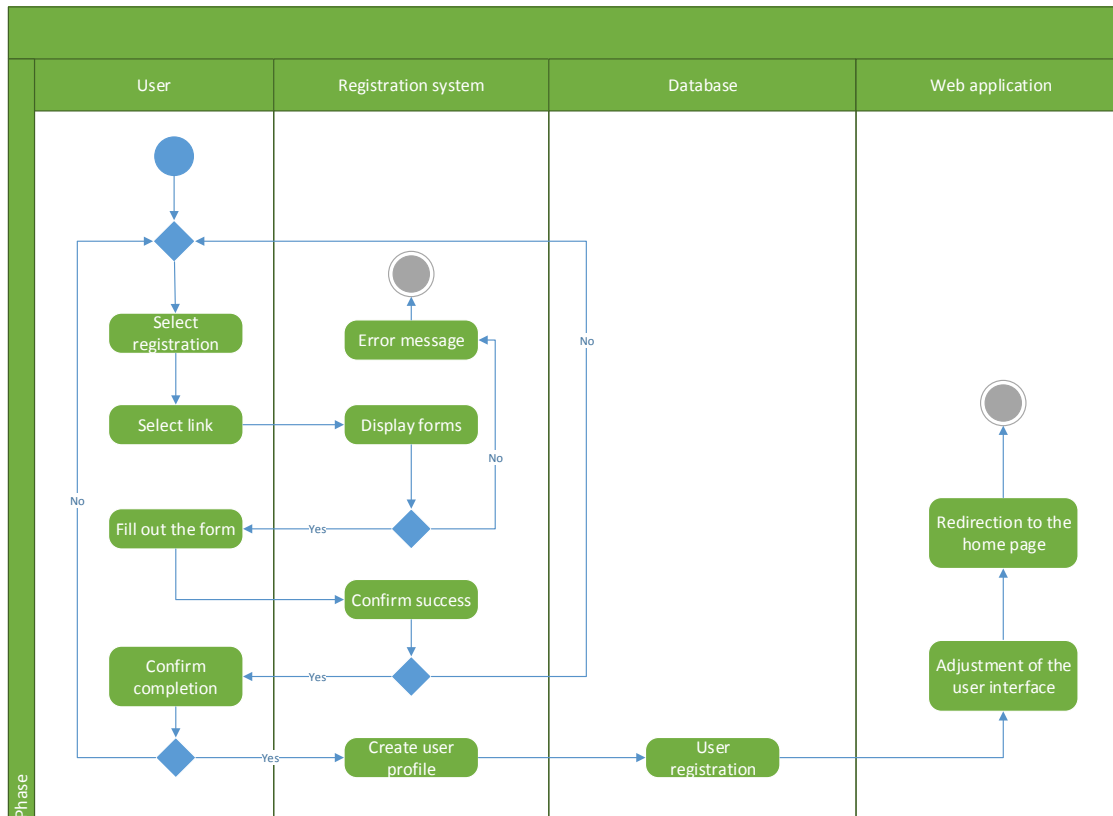

Figure 4. The registration process

desires and needs, as much as it is possible. Registration is required as it contains questions whose answers directly affect the layout of the application solution. The Figure 4 shows the process of registration. The authentication system is activated by accessing the page and it opens a dialog box for entering a name and a password. The registration process actualizes the integration of applications and databases with the authentication system.

Users who actively interact with the web page are divided into three groups and each group has a different color of username for the purpose of easy recognition when using the application solution. The first group consists of administrators who have access to all elements of the page. The second group consists of end users, or people who are not a part of development team but use applicative solution to inform and communicate. The last group consists of volunteers whose page content is limited in order to prevent any confusion of the end-users. Because of the present differences between the

to the user. The issues related to problems with concentration, dyslexia, epilepsy etc. are also included. The steps of application customization are written within the PHP script, and they can, for example, define the background color and the content that will not initiate epileptic seizures. When the assessment of the user's deficiency is made, he fills in a questionnaire about his personal data. The required data such as the user's name must be entered, but it cannot be seen by other users. The reason for this principle is to increase the privacy of the users and thus reduce the occurrence of false identity and provide comfortable use of the application. To avoid confusion, the entire registration is defined by simple questions that motivate users to learn and to use modern software solutions. After completing the registration process, applicative solution adapts to the user's needs. If the user is not satisfied with the choice of colors or just want a change, he is always able to choose the background color as well as the font size and color.

The background is made of selected MySQL backend database for web content organization. The application is based on the CC solution and it defines its architecture. The reason for choosing PHP technology is that it provides access to a variety of platforms, and the development time in the PHP environment is much shorter compared to ASP.NET. Short codes within the application program provide faster operability of application solution and directly affect on the speed and the

is important to note that users are not provided with the infrastructure or the development platform but with finalized application solution. The service provider is in charge of the improvements, maintenance and development of application solution distributed in the *Software as a Service* (SaaS) environment [10], [11].
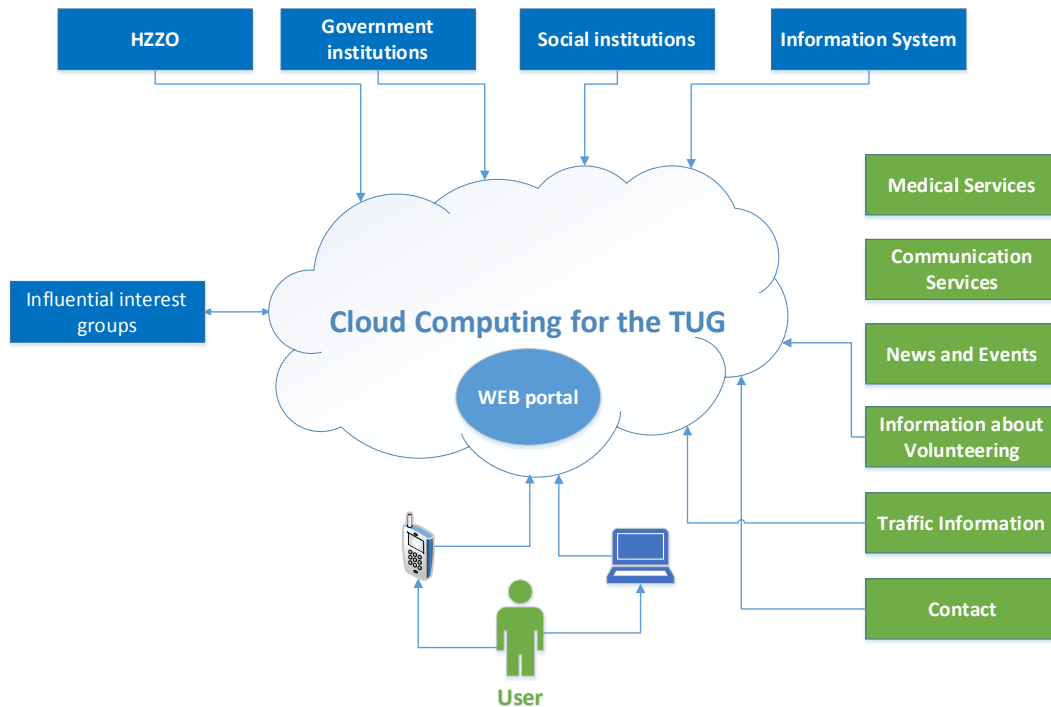

Figure 5. Architecture of the Web4Health application solution based on CC technology

availability of information to the user. PHP has better connectivity and communication with MySQL - TV & MSSQL and is compatible with a variety of databases which enables easier appliance of assistive technologies [7], [8].

HTML5 development environment was chosen because it has great advantages compared to a *native app* [9]. Developing and adapting in a *native app* requires a separate work on every operating system (OS), while in HTML5 it's not necessary due to the fact that the same applies to all versions of OS's. Applied technology is distributed through the conceptual architecture of the application solution which is based on the CC technology as shown in Figure 5. Elaborated recommendation of the CC environment from the user's point of view includes services of informing and social networking. Since the customer wants to increase the quality of life, the application solution also includes external links to social and government institutions that have been added to provide users with additional information [4].

The reason for the use of CC environment are many advantages from the user's point of view, such as very simple management, automatic update, facilitated cooperation and communication among users, data compatibility, worldwide availability, and data security through its backup and update. It

IV. FUNCTIONALITIES OF THE APPLICATIVE SOLUTION BASED ON THE RESULTS

According to the results, it is noticed that the majority of users have problems with visual or hearing disabilities. Because of these difficulties, application solution includes functionality that will adapt the text depending on deficiency. Textual alternatives are assured for all elements that are not textual so that they can be converted into a needed form, such as the texts for the visually impaired, braille, speech, symbols or simplified language. Each user has an optional choice of visual, audible, tactile or combining form to read the content. Full developed application solution includes the user registration system that allows customization of interfaces depending on the user's disabilities and needs.

Figure 6 shows the segmentation of the Use-Case diagram of functionalities within the application. Certain functionalities present the fields of interest for certain stakeholders. Communication services enable virtual communication through a public chat groups and a private chat. That functionality is the field of Interest for the TUG. Informative functionalities are medical information services, the Events and news, the Traffic information services and the external links and they are a field of interest for influential interest group, as well as for the TUG.

Application functionality of Volunteers represent a list of volunteers and services they are willing to provide to the TUG. The TUG can communicate through the Contact of the service provider, i.e. via e-mail.
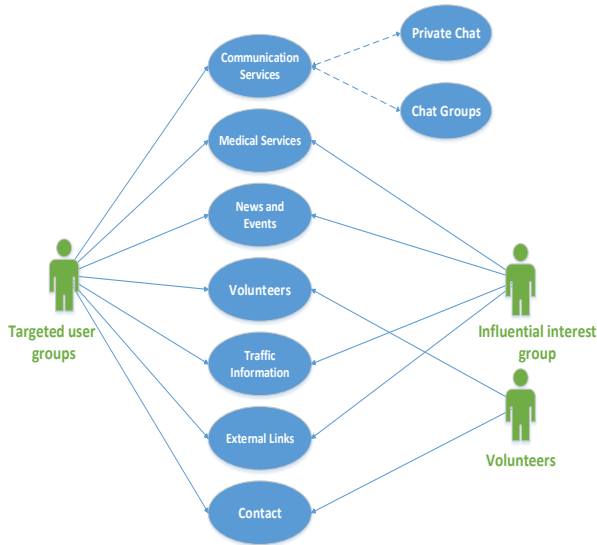

Figure 6. Use-Case diagram of Web4Health functionalities

Medical information services provide the user with reminders and lists of health institutions. The reminder consists of a calendar and an alarm. The calendar is made for the purpose of writing down the events on a specific dates, such as visiting the doctor, the pharmacy, but also as the reminder on the general events like birthdays and family visits. During each use of the application, the home page shows the scheduled events for the present day. The alarm is designed for the purpose as any other, as an alarm clock, but also as a reminder that at certain times of the day the user has to take a medicine or perform some scheduled chores. The alarm can be defined by the daily time for taking medications. The calendar automatically synchronizes with the alarm reminding the user to perform a defined task/chores. This option greatly helps individuals that are suffering from Alzheimer's disease, because it reduces user's dependence on the medical staff, i.e. increases TUG's independence.

List of health institutions is divided into a list of physiotherapists, doctors, pharmacies and hospitals and it includes their addresses. The system is implemented to show user's current location and provide directions to the nearest or/and needed medical facilities so that the user can easily find needed facility even if it is placed in an unfamiliar part of the town.

As a large number of respondents have expressed a desire to communicate with people of their age, it was necessary to create a communication service. Each user has his own profile and can use two different types of service defined within communication service. There is a public chat group, based on the principle of the forum, where users can talk about their current issues. There are administrators who are responsible for the inspection and the maintenance of the content. The second part consists of private conversations that provide the user with the ability to communicate with people of their choice without publicly sharing conversational content with others.

The service of events and news is created for establishing a better connection between the users. The TUG is frequently attending group dances, theater, drawing classes and similar group activities. The application defines events within the user's location area and provides information about places to visit.

To avoid isolated gathering of the elderly, a service of volunteering gives a possibility to volunteer and to participate in the lives of TUG and spend some time with them. Also, it is desirable to avoid socializing based only on a virtual environment, so this service makes the application very popular to use. Every volunteer is verified to determine whether the person is capable to satisfy certain customer requirements.

If the users have any questions, there is a part of the application solution for this purpose. Contact service enables communication of users and administrators and provides users with answers in the shortest possible time. Also, a certain part of the page shows frequently asked questions as well as corresponding answers.

Users can create their travel information with the aim of effective real time informing and better navigation through the transport network. They can create their own routes of interest and points of view, and review their content anytime they want. Creating of personal routes for the movement through the city traffic provides the TUG with a sense of security.

V.   ACCESSIBILITY OF DESIGN AND SECURITY MEASURES

The users have different user equipment so it is necessary to make the web application accessible to all users. Therefore, it is necessary to define the natural language, and given that the users being questioned are the citizens of Croatia, the language of the web site is defined as Croatian. Since there are citizens of foreign nationality, application solution supports English language as well. Natural language enables the search engine to find the key words. The applicative solution is designed to be applied by the people with certain deficiency, so it was taken into account that animated and flickering content makes it difficult to read and the creation of such content is therefor avoided [12].

In the case of presentation of animated content, implementation scripts for creating animation enables each user to exclude or skip this effect [13]. Considering that the application solution should be operable on various mobile terminal devices and on a desktop computer, an adjustment was made to provide its operability with a large number of user's equipment. It is extremely necessary to visually separate navigation bar, main site area, registration area and other areas/parts of site so users can easily navigate. It is taken into a consideration that a blind person cannot see the content, therefore, the option of read screen text allows users to read the contents of the applicative solution and to use the application through voice commands or specially adapted keyboard for the blind. Each section of the site is specially appointed so that visually impaired people would know when to move from one part of the content to another.

The protective measures starting at the registration are intended for a smooth and safe operation of the application. The measures are implemented through three basic procedures: identification, authentication and authorization. Considering that the TUG is not aware of the potential attacks that can be executed, there are measures for the protection of the electronic mail. In case of hacking the user's account, protective measures disable access to personal data of users, such as codes that are stored in a database. Stored procedures are used for database protection to ensure that the SQL query is entered by the user who has permission to enter the stored procedures. The result of this protection is in high-reliability queries. Stored procedures reduce the burden on the server when calling a standard SQL query. In the case of the attempted attack to user's account through registration, the detection of malicious activities is performed by the client and the server. JavaScript (client) retrieves and writes down the information about the IP address, username and password. Then the client sends data to a server that communicates with the database from which data is taken and verifies them. If the data from a database and JavaScript do not match, the user is alerted. The user account will be temporarily blocked if the wrong password is entered three times in a row. An e-mail is sent to the user and the account is blocked until the user confirms that it's a real person.

VI. CONCLUSION

This research has examined the possible application of new technology development in order to improve the quality of life of the targeted user group (TUG). HTML5 and PHP web technologies proved themselves as a good choice for development of application solutions due to their characteristics and functionalities. With the help of this web tools, it is possible to make a specific type of user registration with a dynamic representation of the content and the applicative solution. Specific registration can eliminate everyday difficulties of the TUG when using Internet services. The choice of CC architecture has proved as a quality selection in a combination with HTML5 technology providing users with constant access to data at any time and from any place, regardless the terminal device they use. The appliance of mobile terminal devices within the TUG is increasing and so is their need for the integration with new technologies and the services they provide.

This application solution is adapted to the TUG in a way to satisfy users' requirements that are, based on the conducted research, proved to be significant for the development of quality service. New information and communication technologies have greatly contributed to the development of this particular application solution. Further research and development can create other effective solutions that will be able to provide accessibility of the computerized contents and services to the elderly. The significance and the contribution of this research is reflected in a possibility of affective usage of information and communication technologies and services. The effectiveness is shown in a better way of informing the user about his everyday necessities and that can be of a great significance for the TUG.

ACKNOWLEDGEMENT

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