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AN ATTEMPT TO USE EYE-TRACKING TO IMPROVE A CHOSEN ICT SYSTEM

The main goal formulated in the paper is to assess the value of the eye-tracking method described in section 2 for the purpose of improvement of information and communication technology (ICT) systems. The possible range of application of the method is described in section 4, which presents the chosen results of the study described in section 3. It concerns the proposal to improve the System Professionals project mentioned in section 1 which is available through the platform zawodowcy.org. The results of the study are helpful for people who will be responsible for the future training of users and communication with them during the project also described in section 1. The research has indicated the possibility of using eye-tracking measurements in improving ICT systems at least in the area of designing their functionality and user interfaces.

Keywords: ICT system, eye-tracking

1. INTRODUCTION

This chapter focuses on the System Professionals, the IT solution supporting the process of communication between the company and the candidates for training, internships or work. The idea of creating the system appeared when defining the problem of difficulties in accessing reliable information about resources of knowledge on the market. After recognizing the problem, it was decided to develop a methodology and tools to support access to this information. The project has been implemented and tested under the acceleration of technical knowledge and mathematics and natural sciences programme and financed within the framework of the

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project "Wielkopolska – monitoring and forecasting"[1]. The essence of the project was to design, to test and to implement an innovative system for monitoring the needs of entrepreneurs connected with competence and upward communication of information on the labor market in order to improve the effectiveness and efficiency of work processes in enterprises. The full implementation of the System Professionals platform took place as part of 'Time of professionals – Wielkopolska vocational training'. It was a systemic project realized in the period from July 1, 2012 to September 30, 2015 under Priority IX of the Human Capital Operational Programme. Its main objective was to improve the quality of vocational training. From the point of view of business management, improving the training process is a preventive action. The project allowed to develop and to increase the popularity of the System Professionals platform[2].

The project was highly rated by the regional population, including the business results of the project, which led to a second edition of the programme being launched in 2015 under the name "Time BIS professionals – professional Wielkopolska". The project tells about further development of System Professionals.

System Professionals is a software tool, a web platform supporting communication between businesses and people who seek an internship or work. The system consists of two basic modules: the entrepreneur module and the worker module. The entrepreneur has the ability to determine the expectations of a future employee precisely, while the employee filling out the profile defines their competencies and skills. After completing the appropriate profile, the system adjusts the job to profile candidates automatically (Szafrański, Goliński, 2015).

The development of the system is determined by constant changes in order to adjust to the needs of users. To research the needs of the system's users, the creators employed individual interviews, group interviews, surveys and expert studies of the Delphi technique. As it is clear from the literature, the previously used research methods are characterized by a high dependence on the tested person, therefore conclusions are made from the given responses (Więcek-Janka, Kujawińska, 2010). Due to the fact that in such research a subjective assessment of respondents plays a very important role, it was decided to use an eye-tracking method for further improving of the system. It will allow to look through the users' eyes at the functionality of System Professionals more objectively. The possibilities of the use of eye-tracking methods were recognized in previous studies, where the object of the study was a leaflet advertising a company car. The research was carried out in October 2015 in one of the laboratories of Poznan University of

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[1] Detailed information on the implementation of the management model of accelerated creation of the knowledge in the book: Szafrański M. (2015).

[2] For more information about the 'Project Time Professionals – Wielkopolska vocational training see: http://www.awt.org.pl/projekty/httpwww-awt-org-plczas-zawodowcow-wielkopolskie-ksztalcenie-zawodowe-3/ [as of 20 March 2016].

Technology. The reliability and objectivity of the results and, above all, their usefulness led to the re-use of the available tools.

2. EYE-TRACKING – DESCRIPTION OF THE METHOD AND TEST EQUIPMENT

Eye-tracking is a test method by which it is possible to carry out the measurement, recording and analysis of the movement of the eyeball. The essence of the method is the relationship between the movement of the eye and neurological processes occurring in the brain (Bojko, 2013).

The human eye is a complex sensory organ, it fully expresses the emotional states of a man. Understanding the structure and mechanism of the perception of the eye allows to better understand the mechanisms of the eye-tracking research method. During image perception eyes are not moving continuously. The eyeball performs abrupt movements, known as unintentional and fixation movements. The fixation movements are in a stillness phase in which stimulators reach the brain, where they are processed consciously. The fixations play a key role in the ET research while the unintentional movements are the opposite of fixations. Their characteristic feature is an extremely fast movement of the eyeball causing unconscious recording of the information by the brain, which leads to the processing of the information (Kaczmarek, Olejnik, Springer, 2013).

The eye-tracking research aim is to use a system of video cameras placed in glasses. In the course of investigating, the camera tracks and records eye movements of the tested human. This analysis is done by using a special software (Szymusiak, 2012). The results are presented in a visual form: the path of sight, heat maps, remark maps and clusters application.

The path presents a visual sequence and the length of the road on which the subject's eyes move during the use of the system. The visual form is a composition of the following unintentional movements (solid lines) and fixations (wheels). The size of the wheel is adequate to the length of stops on the eye point. The numbers on the circles define the order of the fixations.

The heat map presents a collection of the observed object coded by colors. A color map is applied over the analyzed object which shows the elements of greater or lower intensity of focusing. The method of coding information using colors is as follows: green means small intensity of the phenomenon, while the red color - high. The longer a person tested looks at a given point, the shade of red is more intense. If the tested person looks at the given point longer, the shade of red is more intense.

The remarks map is based on the heat map, but, unlike it, it shows only the area seen by the test, while the rest is shaded.

Clusters, which mean areas of interest determined after analyzing the looks of all the respondents, designate the areas with the highest concentration of eyesight that may become the basis for more detailed analysis (Kaczmarek, Olejnik, Springer, 2013)

The tool used for investigating and analyzing eye movements is an eye-tracker using the mechanism of light reflection from the eye. There are two types of eye-trackers: mobile or stationary[3]. The eye-tracker used to examine is integrated with a camera recording the image and the mobile unit recording data in digital, it tracks eye movement non-invasively and in a natural environment, without restricting movement of the body under the test. The exterior design resembles glasses and in the same way can be put on the head of a tested person. The eye-tracker is based on three main elements, among which we can highlight:

– Tobii glasses which contain a built-in video camera,
– digital media through the device is calibrated and records all the measurements,
– IR markers, which by means of invisible infrared light cooperate with glasses.

3. THE DESCRIPTION OF THE RESEARCH PROCESS

During the subsequent stages of improving System Professionals, a very important question appeared: Are the project workers, who in a few months will begin training future users, able to handle System Professionals without obstacles? To best prepare employees to continue performing their duties, it was decided to examine their proficiency with using the instrument and how the platform is received.

Two decision problems were identified:

"Whether and in what scope the training of employees who will be responsible for training users should be done?"

"Whether and, if so, to what extent should System Professionals be modified?"

The consequence of formulating the decision problems was to isolate the following research problems:

– which parts of the system attract the most attention?
– which platform elements are not noticed by the users?
– what elements of the interface and content in the system maintain the longest interest of users?[4]
– what is the direction of scanning[5] the space of the platform[6].

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[3] More information about eye-trackers can be found in (Kaczmarek, Olejnik, Springer, 2013, p. 199).

[4] By means of greatest interest it is meant elements on which the eyes of the tested person linger the longest amount of time.

[5] The word of scanning is defined as a viewing point by point of the study area.

To solve such research problems, a landingpage was examined- page product, which is the first page on which the user lands wishing to use System Professionals. The main purpose of the page is convincing users to the product which depends on the marketing strategy, meaning for a user to conduct a specific task – in the case of the study it was to sign up for the system

The study used a method of eye-tracking, which is a physiological measure. The tool was a mobile eye-tracker with the Tobii Studio software, described in section 2. The use of mobile tools allows for non-invasive tracking of eye movement without restricting the movements of the body of the respondent.

The sampling method of research used non-random selection. The sample was intentional in its composition, consisting of four employees of the project "Time BIS professionals – professional Wielkopolska" and three potential system employees, who formed the control group in the study. The research sample N = 7 was used and it was a sufficient attempt needed to formulate reliable conclusions with qualitative evaluation of the tested visual material on System Professionals[7]. While determining the attempt, gender of the tested subjects was not included due to the fact that the majority of the examined people were employees in the project. We examined four of the six employees of the project, whose task will be to train future users. The study also included a control group whose objective was to verify if the contact of already employed workers with System Professionals will affect the efficiency of the registration system from the platform zawodowcy.org. While selecting the respondents there were such restrictions – the study subjects may not have any impairment of their visual ability, which excludes the wearers of glasses or contact lenses or suffering from eye disorders, as well as women with strong eye makeup.

The study was performed at the Technology Laboratory Organization Ads in Poznan University of Technology, where there are provided the right conditions for this kind of research. Particular attention should be paid to the intensity of the light, because an eye-tracker incorporates the light reflection from the eye and in the case of excessive amounts of light the testing apparatus does not indicate the points of fixations.

The test procedure for each of the participants in the study took place in the same manner and under the same technical conditions and environment. Performing the measurement was preceded by appropriate preparation of the research tool- placing the batteries and memory card in a digital medium, as well as the appropriate preparation of the monitor screen, which was used by the test subjects. Before the test it was necessary to calibrate the analysis device, it is performed on a uni-

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[6] The difference between attracting attention and is interested in the length of time to focus the respondent on the item.

[7] The property sampling of research at the level of 7 people was confirmed by the source of literature: (Kaczmarek, Olejnik, Springer, 2013, p. 199).

form surface. The test stand at a distance of 0.75–1.25 cm followed the moving marker by the investigator. The screen digital media displays 9 points. Each of them had to be marked on the screen with a green color, which confirmed positive calibration. Only a properly calibrated device correctly records eye movements.

The subjects were asked to use System Professionals, playing the role of a potential user. They had to perform accurate tasks:

– register in System Professionals through the platform zawodowcy.org as a job seeker,

– activate an account,

– complete the candidate profile for work,

– find a job according to own requirements,

– do not apply, only after reading the offer, log out of the system[8].

The final stage of the study was to copy the data from the memory card inserted in the device to the programme Tobii Studio, which allowed to perform the analysis. Completing the task permitted to evaluate the selected functions of the system, as well as to identify the elements of pages and sub-pages in the system noticed or unnoticed by the users. On the basis of the conducted measurements, it was examined what kind of possibilities are created for further development of the system by eye-tracking research.

4. ANALYSIS AND INTERPRETATION OF OWN RESEARCH

The qualitative analysis of the data was carried out in four steps:

– **phase I** – preparing recordings made during the study, or copies made during recordings from the memory card to the specialized software,

– **phase II** – there were put in appropriate filters, which are described in section 2,

– **phase III -** sorting the data by studying recordings and assigning each of them to the appropriate test, which allowed to analyze the results. This step is important because of the need to distinguish the control of the relevant research group,

– **phase IV** – conducting a proper analysis, including the interpretation of downloaded data.

The following results are presented in four visual forms: the path of sight, a heat map, a remark map and clusters. Although the study covered the entire registration process and the creation of a competence profile, the following results of the study are presented only for the first page of the registration system. The presentation of such range of the research results is sufficient to achieve the objective pursued by

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[8] The study subjects could not apply because it was only a research process, tasked with simulating a real situation.

this publication. At the same time, by limiting the scope of the obtained results, it is possible to present the use of the eye-tracking tools accurately.

The analysis of the first stage of the user registration system platform zawodowcy.org could help to determine the way the users' sight finds the registration module. It is important whether the navigation menu for people who do not know the page is clear, and how the user reacts to the contents of images and text – which elements attract attention, and which are overlooked when using the system. The analysis was performed by applying the appropriate filters described in section 2.

The first filter was clusters, or the designation of areas with the highest concentration of sight, as illustrated in Figure 1. The results show that the respondents pay the most attention to the upper right corner of the screen, up to 86% of the respondents focused the most attention in this area. Then, study subjects focused their eyes on the left side of the main menu (71%). In turn, the most important element of the home page, or input module to the system, attracted the attention of only 29%. In addition, the subjects did not pay attention to the text, but only to the pictorial element module. Such a view may result from the order of the perception of the human eye. The eye draws attention to the pictorial elements first, and then to the text elements. Comparing the control group to the study group it can be said that their eye movement was not different. Both present employees of the system and the control group paid special attention to the upper right corner, and then to the main menu and to a lower extent to the input module to the system.
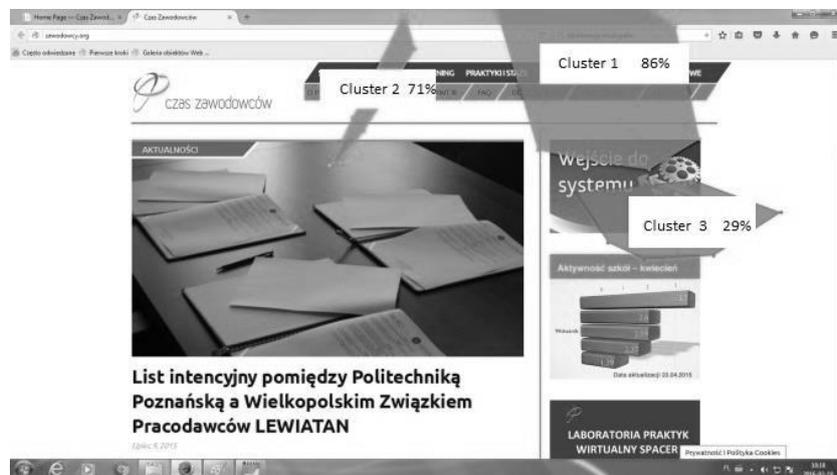

Fig. 1. Cluster for the main system (source: own study based on the conducted research)

Another filter which was used was gaze plots, or the path of vision which was followed by the sight of the tested subjects. The paths of sight of each respondent on the homepage are shown in Figure 2. Analyzing the resulting image, it can be concluded that the respondents' eyes fell on the upper-right corner of the screen

first, then respondents drew their attention to the center of the screen image. Other elements scanned by the user were the main menu and to a lower extent, the right side of the screen where the position of the input module to the system is. The study subjects began scanning the home page from the upper right corner, which is not consistent with the principle that the human eye reads from left to right or watching images starting from the upper left corner. The reason for this order of the reception system can be a task that users had to perform or registering. Also, in this analysis, the paths of sight of the already present workers and the control group sample are largely consistent with each other. The exception was the technical staff of the project (specialists), whose perception started on the module input to the system, which passed for the later stages of the tasks described in section 3.
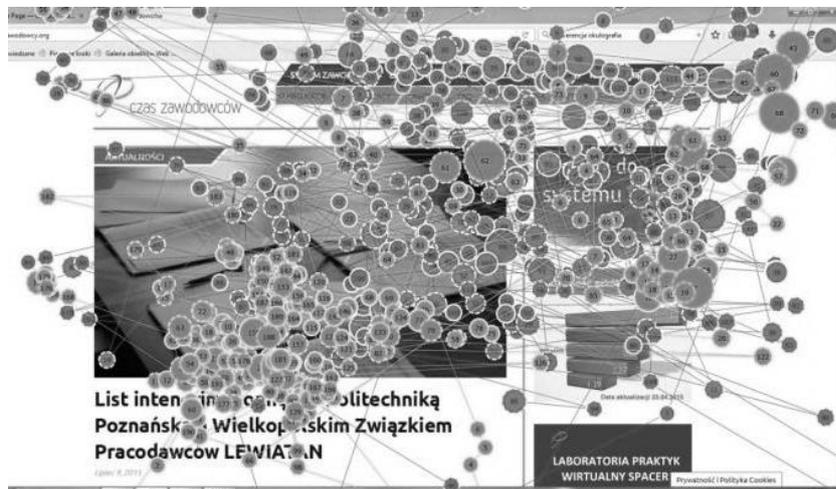

Fig. 2. The gaze plots for the homepage of the system (source: Own study based on the conducted research)

The third filter which was applied was the heat map showing the intensity of sight encoded by using color, the resulting effect is shown in Figure 3. This analysis showed the greatest eye focus on the pictorial element, and then on the main menu system. The focusing on the picture can result from the order in which the human eye captures visual content, seeing first images and next text content. Considering the intensity of the gaze on the input module to the system, it can be noticed that the eyes of respondents mostly fall only on segments in which there are graphics and no inscriptions. Such a view may result in not using the possibilities offered by the input module to the system. The used filter shows little interest in the inscription on the module inputs to the system, it can be concluded that it is a vision of the present employees of the system, namely technical staff, who have knowledge of the system which is used with no hesitation.
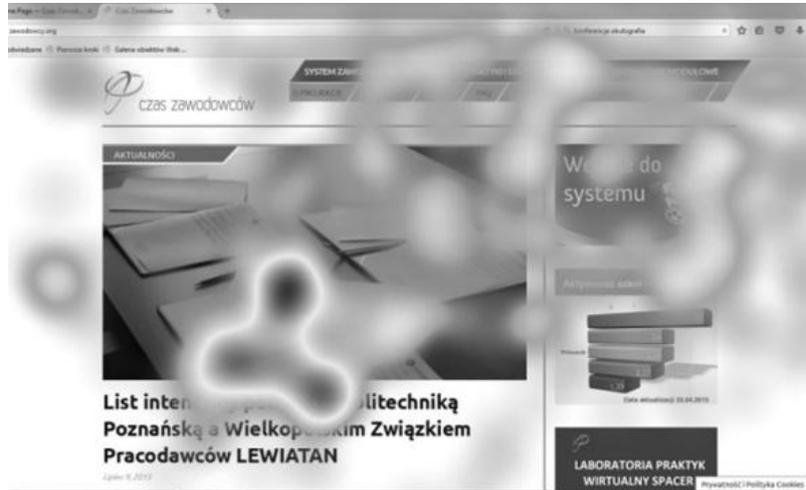
Fig. 3. The heat maps for the homepage of the system (source: own study based on the
conducted research)

The last of the analyzed maps which is shown in Figure 4 is a remark map
which pictures those parts of the main page of the system that the human eye actu-
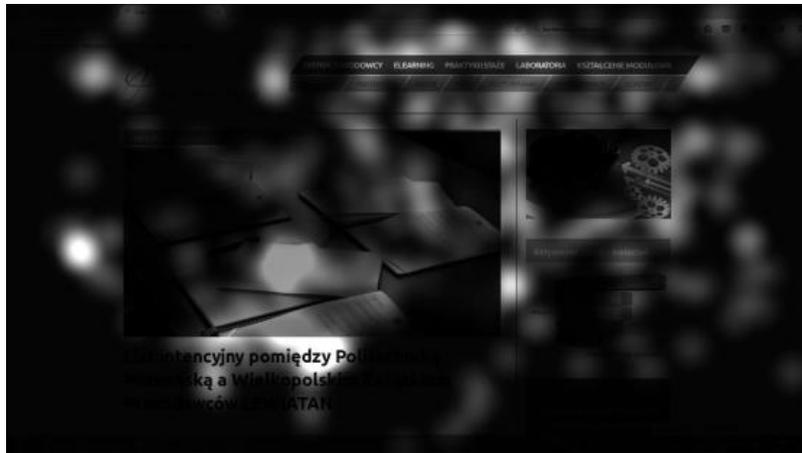ally observes.

Fig. 4. The remark map for the homepage of the system (source: own study based on the
conducted research)

The analysis of the individual map leads to a general opinion about the recep-
tion site of the "the eyes of users." The perception of the main page of the system is
not ordered, the tested people view the main page uncontrollably in order to find
the registration module, seeking registration in the upper right corner in the first

place. This behavior is intuitive, most of the population has a preconceived view of the construction of the widely used web pages i.e. Facebook.pl, pracuj.pl, goldenline.pl. In each of the examples recording modules are located in the upper right corner. In the case of zawodowcy.org recording unit is disposed also on the right, but slightly lower, which can cause reduced visibility. According to the respondents it is an unusual format of the registration module, it is not compatible with the main menu of the system and it is treated as an advertisement.

Another aspect of the research shows the merits of a full-featured main menu system. The study shows that the main menu element retains user interest for the longest. The longest focus on the interest on the main menu may be due to searching for the recording module. However, the mass of information included there can cause confusion to the user and can lead to the disordered reading. Responding to the research problems: which items are visible and which are ignored, it is worth to notice the fact that all the main menu items are necessary in the light of usefulness. None of the respondents drew attention to the content posted on the website and did not give much attention to the information contained in the main menu. This fact may result from a clearly defined task, which is to register to the system, which resulted in an immediate search for the registration field. Nevertheless, the mass of information on the main menu extends the search field recording, which can cause irritation and raise user reluctance to continue in using the system. After analyzing all the recordings, it was determined that the average time to find the registration field was 40 seconds. It should be noticed that the system is aimed at young users who are accustomed to quick and intuitive operation of all kinds of online platforms. Therefore, during the process of redesigning the system some questions should be asked: What should be on the home page of the system, and what does the recipient of the system expect?

Table 1 summarizes the test results in terms of the research issues formulated with reference to the registration platform zawodowcy.org.

Table 1. The summary of the results of the eye-tracking research in terms of formulating the research problems

The research problem	The problem referred to the registration page of the system	The conclusions of the study
Which parts of the system attract the most attention of the users?	Which elements of the registration system page attract the most attention of the users?	-upper right corner of the page -the left side of the main menu -the image in the center of the screen
Which parts of the platform are omitted by the user?	Which elements of the registration page are omitted by the user?	-banner login to the system, in particular text elements -other items on the page

Table 1 cont.

The research problem	The problem referred to the registration page of the system	The conclusions of the study
What interface elements and content in the system maintain the longest user interest?	What elements of the interface and content of the registration maintain the longest user interest?	-pictorial element in the middle of the screen -main menu
What is the direction of the scanning space platform?	What is the direction of scanning of the registration page to the system?	The order of sight direction: 1. upper right corner of the screen 2. the image placed in the center of the screen 3. main menu 4. the right side of the screen where the position of the input module to the system was

Further investigation concerned the whole process of user registration on the platform zawodowcy.org, navigating through the pages of the system in order to carry out the tasks described in section 3 of the paper. The results of these studies are not presented in detail here. They can become the topic of a subsequent publication.

To sum up, at the basis of the approximate test results of the registration page to the system, it can be said that the study showed some beneficial elements of the system and a field for its improvement. The most important element, which was to 'enter the system', tasked with immediately redirecting the user to the platform by logging in or recording, was unnoticed. After applying the filters on the main page, it turned out that the sight of respondents was directed to the input module to the system, but most did not use the opportunities that were given. The input module to the system enables a faster redirection to the registration, but users handled the tasks described in the section by using the main menu from which they came to the registration module. The only exception are the technicians of the project (specialists), which may result from their prior knowledge of the system. For deeper understanding of the study and for an explanation of such a procedure an interview was performed, which asked the question to the tested person: Why did not you use the 'entry into the system' option? The responses included the information that this element was treated as an advertisement. From the presented results it can be concluded that the attention of users is attracted by photos or colorful images.

In the further stages of improving the system, placing the registration module in the upper right corner should be analyzed. It is a place where users intuitively look for this function, as is demonstrated by the studies.

SUMMARY

The analysis of the results made it possible to know the mechanism of perception of System Professionals, bringing the authors to draw meaningful conclusions, which will help to create a training program for employees who will train future users of the system. The system is not a commercial venture and addresses issues, which are difficult for users, so regardless of the technical improvement, System Professionals needs direct contact with users, and training on how to use the tools, but also the role of competence in the labor market. The described impact mismatch and design errors can be reduced through the appropriate training of trainers, whose task will be to help users in the efficient use of the system. The completed research also revealed elements of the system, which can be analyzed in the next stages of system improvements. The experience of the user should be carefully analyzed with regard to the usefulness of the website for System Professionals and answer the questions: Whom is System Professionals directed to? What the homepage should tell and if it does? What messages should be in the system to make movement for the user easier?

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PRÓBA ZASTOSOWANIA EYE-TRACKINGU
W DOSKONALENIU WYBRANEGO SYSTEMU INFORMATYCZNEGO

Streszczenie

Głównym celem sformułowanym w rozdziale jest ocena przydatności metody eye--tracking opisanej w punkcie 2, na potrzeby doskonalenia systemów informatycznych. Możliwy zakres zastosowania metody przedstawiono w punkcie 4, prezentując wyniki badań własnych, opisanych w punkcie 3. Dotyczą one propozycji doskonalenia Systemu Zawodowcy, przybliżonego w punkcie 1 dostępnego za pośrednictwem platformy zawodowcy.org. Uzyskane wyniki badań stanowią pomoc dla osób, które będą odpowiadać za szkolenie przyszłych użytkowników i komunikację z nimi w projekcie, o którym mowa również w punkcie 1. Przeprowadzone badania wskazują na możliwość zastosowania pomiarów eye-trackingowych w doskonaleniu systemów informatycznych, przynajmniej w obszarze projektowania ich funkcjonalności i interfejsów użytkowników.

Słowa kluczowe: system ICT, eye-tracking