THE RESEARCH OF THE PERCEPTION OF PICTURES EVOKING THE FACULTIES OF THE UNIVERSITY OF ŽILINA

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Abstract

The present time is specific by the development of information and communication technologies through which diverse applications are provided in all spheres of social life. Since most of the surrounding world is perceived through the visual organs. In the field of information and communication technologies there are a number of technologies that seek to find answers to where the user is looking, how long he is looking and how often he is returning with his view at a point. One of the more significant technologies is also eye tracking. The research of the perception of pictures that evoke the main focus of the faculties of the University of Žilina was realized with the eye tracking technology. The main reason why we realized the research was that we wanted to find out the potential interest of young people in studying at the individual faculties of the University of Žilina. By the means of the research, we wanted to emphasize that by looking at images that represent the main focus of individual faculties, it can be decided where a potential student could apply for study.

Keywords: university study, neuroscience, eye tracking, potential students.

1 INTRODUCTION

The present is characterized by a relentless competition for every student due to the financing of the universities in Slovakia. The allocation of funds to universities is determined in the terms of quantity of students that enrol at the university. This fact is a problem in Slovakia and every university fights for each student. Another reason, why the Slovakian universities fight for each student in the conditions of unfavourable demographic development, is the process of continuous and long-term student migration to universities in Czech Republic. Another challenge with which universities in Slovakia must cope is constant growth of number of universities and decreasing number of secondary education graduates. [22]. Despite this facts, the role of universities should focus on promoting creativity, increasing levels of human capital, and thus income and job opportunities in the labour market. [23] The University of Žilina with its faculties and departments have to adapt to these trends and face these problems in the best way possible.

This university is one of the leading educational and research institutions in Slovakia. The university is known for its rich offerings of the educational programs and research activities. The main goal of the university is to provide for students and researchers alike a modern educational and scientific institution. In the performed research, we focused mainly on the following faculties of the University of Žilina: Faculty of Operation and Economics of Transport and Communications, Faculty of Mechanical Engineering, Faculty of Electrical Engineering and Information Technology, Faculty of Civil Engineering, Faculty of Management Science and Informatics, Faculty of Security Engineering.

The University of Žilina is involved in the recruitment of students through participation on various educational events, recruitment events in high schools, days of opportunities and so on. The European Night of Researchers is an event where the University of Žilina regularly presents the results of its research to potential students. These potential students are mainly young people, who attend primary and high schools. As part of our research, we focused on measuring the potential interest of young people in studying at the University of Žilina. Measurements were made using the specific method of eye tracking.

Most of the knowledge of the outside world is obtained through our eyes. While all the senses are important, we tend to rely most on sight. [5] Where we look and move our eyes is closely linked to what we pay attention to. Eye tracking technology has evolved to provide the information about eye movement and eye fixation. [1]

Other definitions similarly describe eye tracking as the estimation of direction of the user’s gaze. In most of the cases the estimation of the gaze direction means the identification of the object upon which the gaze falls. [2] [3] [4] We can also view eye tracking as a method which offers a unique measurements of
Human attentional behaviour. In the research dedicated to the eye-based human-computer interaction, eye tracking is defined as a way of tracking eye movements or a process of monitoring movements of eyes or the total point of gaze which refers to the point of the user’s gaze which is focusing at the visual output. The choice of an eye tracking method should be based on the particular demands of the application. None of the current methods is the universally best for all applications. We distinguish two types of eye trackers that we use in eye tracking methods - remote eye trackers and head mounted eye trackers. There is no attachment between the tested subject and remote eye tracker during the measurements of eye movement at a distance. That’s why this type of device is mounted under or placed near to a computer screen and tested subject is seated in front of eye tracker. Head-mounted eye trackers record eye activity from a close range and are mounted onto lightweight eyeglass and tested subject is able to walk around freely with such device. The eye tracking method is applied in several areas. For example in areas such as research of visual systems in transport. Such study uses eye tracking glasses, which are designed to record a driver’s natural gaze behaviour in real-time. Another fields where eye tracking is being utilized is medicine and psychology. In medicine, processing images of the eye has become possible to reveal abnormalities in eye functioning. Psychology research is more and more oriented on conducting a cognitive studies focusing on learning about people’s emotions and intentions. Eye tracking is being frequently used in advertising and marketing as a method in human computer interaction in product design research which focuses primarily on usability. An eye tracking system records how the eyes move while a subject is completing a task for example on a web site. By analysing these eye movements we are able to gain an objective insight into the behaviour of that person. In other words by mapping active areas of the brain it is possible to discover what will convince the buyer to buy.

The main reasons why we decided to conduct experimental research, are not only the problems we stated at the beginning of the introduction. We also wanted to find out the potential interest of young people in studying at the individual faculties of the University of Žilina. By the means of the eye tracking research, we wanted to emphasize that by looking at images that represent the main focus of individual faculties, it can be decided where a potential student could apply for study. Our findings can provide insight into what selected segments of potential students the university’s marketing campaign could focus on.

2 METHODOLOGY

The research was realized at the event of the European Researchers’ Night which was held in Aupark Žilina. For this type of research it is enough to reach out six respondents. The research was performed on a sample of 55 participants who were in the age group of 11 – 15 years of age. The respondents were divided into 2 groups. In the group of girls there were 23 respondents and in the group of boys there were 32 respondents. From the group of girls we selected representative respondent which we called “Girl”. The sample of boys represents by a “Boy”. At the start of testing the respondents had to survey a figure which consists of six different pictures. It is worth emphasizing that every picture represents particular faculty of the university.

<table>
<thead>
<tr>
<th>Faculty of Operation and Economics of Transport and Communications</th>
<th>Faculty of Security Engineering</th>
<th>Faculty of Management Science and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Faculty of Electrical Engineering and Information Technology" /></td>
<td><img src="image2.png" alt="Faculty of Civil Engineering" /></td>
<td><img src="image3.png" alt="Faculty of Mechanical Engineering" /></td>
</tr>
</tbody>
</table>

*Figure 1. Pictures representing selected faculties of the University of Žilina.*
The first picture on the left in the first row represents the Faculty of Operation and Economics of Transport and Communications. The faculty provides education in all sorts of transport and that's why on the picture we can see various means of transport. The background of the picture creates a globe which represents interconnection of trade and communication between countries.

The second picture in the middle of the first row depicts the Faculty of Security Engineering which provides study programmes, such as security management, rescue services or crisis management. The picture displays the work of the firefighters what reflects the rescue services study programme.

The third picture on the right in the first row reflects the Faculty of Management Science and Informatics. This faculty provides education in study programmes such as informatics, management and computer engineering. The main goal of the faculty is to educate students in the field of information and communication technologies where after successfully completing their studies they can employ as, programmers, developers, designers or technologists of computer systems. That's why the picture representing this faculty contains computers.

The fourth picture situated on the left in the second row, represents the Faculty of Electrical Engineering and Information Technology. The faculty devotes its activity to educating students in study programmes, such as electric power systems, telecommunications and radio-communications engineering or photonics. Within the study the students learn how to create integrated circuit and that's why the picture consists of integrated circuit.

The fifth picture in the middle of the second row evokes the Faculty of Civil Engineering which focuses on the field construction of land and road infrastructure. The quintessential feature of the faculty is bridge construction and for this reason this activity is depicted on the picture.

The last picture on the right of the second row shows the Faculty of Mechanical Engineering which offers study programmes, such as industrial engineering, vehicles and engines or materials and technologies in automotive production. Faculty provides knowledge in the field of engineering materials and technologies in production processes. In regards to this fact we have decided to display a cogwheel on the picture as the feature of the faculty.

After the set of pictures (Fig. 1) was presented to the respondents, they had to answer to question what attracted them the most in their opinion. Based on the answer of the respondents we could compare the answers to the results of eye tracking testing.

The perception of the pictures was monitored through a research method of experimental eye-camera testing. For testing we applied eye tracker REDn Scientific model of company SMI which enables researchers to conduct fixation based studies with a sampling rate of 30 or 60 Hz. In the research we used the software SMI Experiment Suite Scientific. The HW and SW equipment is a part of scientific research infrastructure located at Human-Machine Interaction Laboratory (HMI-LAB) of University of Zilina. The pictures representing the faculties presented Areas of Interest (AoI) what are tools to select regions of a displayed stimulus, and to extract metrics specifically for those regions. Area of Interest defines the area (zone) by which other metrics are calculated. They might be defined either before the experiment or after it, during the analysis process. We exposed respondents for 10 seconds to survey the pictures. Subsequently, we evaluated the results of measurements with the eye camera in the SMI BeGaze software. To express the degree of interest in the appropriate stimulus, we chose the following metrics - Entry Time, Dwell Time and Revisitors. The indicator Entry Time represents the average duration from start of the trial test to the first gaze view of an AoI. The indicator Dwell Time is the time spent looking within the defined area of interest. It presents sum of all fixations and saccades within an AoI for all selected subjects. And the last indicator Revisitors counts the number of subjects with more than one visit in an AoI. Based on the selected indicators we specified the degree of area of interest. Subsequently, we evaluated that the area of interest with the highest degree presents the faculty which attracted the respondents the most.

3 RESULTS

After the realization of research we achieved the results of the measurements, which are stated in the following table 1. The first step which we done was the identification of three selected indicators on whose measurement we focused on. The first indicator was the entry time followed by the dwell time and the last value we measured was the revisitors indicator.
Table 1. Comparison of selected indicators for the groups of boys, girls and all respondents.

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Entry time (ms)</th>
<th>Dwell time (ms)</th>
<th>Revisitors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>All</td>
</tr>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>All</td>
</tr>
<tr>
<td>Faculty of Operation and Economics of Transport and Communications</td>
<td>1122.4</td>
<td>768.9</td>
<td>974.6</td>
</tr>
<tr>
<td>Faculty of Security Engineering</td>
<td>841.2</td>
<td>990.6</td>
<td>903.7</td>
</tr>
<tr>
<td>Faculty of Management Science and Informatics</td>
<td>2876.4</td>
<td>2836.8</td>
<td>2859.8</td>
</tr>
<tr>
<td>Faculty of Electrical Engineering and Information Technology</td>
<td>3962.5</td>
<td>4562.7</td>
<td>4218.1</td>
</tr>
<tr>
<td>Faculty of Civil Engineering</td>
<td>4072.2</td>
<td>3968.6</td>
<td>4028.0</td>
</tr>
<tr>
<td>Faculty of Mechanical Engineering</td>
<td>3614.1</td>
<td>3996.1</td>
<td>3776.8</td>
</tr>
</tbody>
</table>

In table 1 we can see that the indicator of entry time shows us that the picture of the Faculty of Security Engineering was viewed the first. This picture was viewed first because it was viewed by all respondents under one second. From the point of view of the last picture observed by the respondents, we can say that the picture of Faculty of Electrical Engineering and Information Technology took the least interest. We can also see that for the group of girls this picture was also least interesting. Their total entry time was 4562.7 ms. On the other hand for the group of boys the least viewed picture, in terms of entry time, was the picture of Faculty of Civil Engineering with the time of 4072.2 ms.

The second indicator dwell time tells us how much time the respondent spent looking at the picture. According to the data stated in table 1, we can conclude that the picture of Faculty of Operation and Economics of Transport and Communications was the most viewed picture among all respondents. If we look at the results of our measurements by gender we can see that the dwell time was not only for this picture but among all pictures highest for the group of girls. The least interesting picture on which respondents spent shortest time was the picture of Faculty of Mechanical Engineering. Total time of viewing at this picture for all respondents was less than 2 seconds. The group of boys had the lowest dwell time at this picture too. Girls spent least time on the picture of Faculty of Civil Engineering. This lack of interest from girls can be attributed to the fact that, in general, girls are not very interested in the field of electrical engineering and on the other hand the picture of Faculty of Operation and Economics of Transport and Communications is closer because among all of the pictures the objects on the picture appear to be the least technically based.

The last examined indicator was revisitors. The numbers shown in table 1 show us that every girl respondent visited almost every picture except for one – the picture of Faculty of Operation and Economics of Transport and Communications. For the group of boys are the results of measurements slightly different because not even in one picture is the indicator of revisitors 100 %. This finding can be attributed to the fact that we can see from the table that the boys spent more time looking at the pictures for the first time than the girls. If we evaluate this indicator for all participating respondents we can conclude that the most repeatedly visited picture was the picture that represents the Faculty of Security Engineering.

The second part of our research was dedicated to finding the perception of selected pictures from the point of view of selected individual from each group of respondents (Girl, Boy). As in the first part of our research we conducted measurements of the same indicators. The results are stated in table 2.
<table>
<thead>
<tr>
<th>Faculty</th>
<th>Entry time (ms)</th>
<th>Dwell time (ms)</th>
<th>Revisitors</th>
<th>Entry time (ms)</th>
<th>Dwell time (ms)</th>
<th>Revisitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty of Operation and Economics of Transport and Communications</td>
<td>232.4</td>
<td>8299.2</td>
<td>1</td>
<td>243.3</td>
<td>4499.6</td>
<td>1</td>
</tr>
<tr>
<td>Faculty of Security Engineering</td>
<td>732.3</td>
<td>2399.7</td>
<td>1</td>
<td>743.3</td>
<td>2866.4</td>
<td>1</td>
</tr>
<tr>
<td>Faculty of Management Science and Informatics</td>
<td>1165.6</td>
<td>1866.6</td>
<td>1</td>
<td>1343.2</td>
<td>1666.6</td>
<td>1</td>
</tr>
<tr>
<td>Faculty of Electrical Engineering and Information Technology</td>
<td>2432.1</td>
<td>1299.9</td>
<td>1</td>
<td>5909.3</td>
<td>1966.4</td>
<td>1</td>
</tr>
<tr>
<td>Faculty of Civil Engineering</td>
<td>2065.5</td>
<td>1233.1</td>
<td>1</td>
<td>7142.6</td>
<td>1433.3</td>
<td>1</td>
</tr>
<tr>
<td>Faculty of Mechanical Engineering</td>
<td>1532.2</td>
<td>1133.2</td>
<td>1</td>
<td>5642.8</td>
<td>3466.4</td>
<td>1</td>
</tr>
<tr>
<td>White space</td>
<td>32.4</td>
<td>166.7</td>
<td>0</td>
<td>10.0</td>
<td>366.6</td>
<td>1</td>
</tr>
</tbody>
</table>

As we can see the indicator of entry time was the lowest in the white space for both respondents. White space is the background of the pictures. This space was viewed as first. Respondent representing boys – Boy had his entry time about two thirds smaller than representing of the group of girls – Girl. This means that Boy looked at the white space shorter in comparison with Girl. Results of measurements for Boy show us that he viewed the pictures in the order as they were arranged (see figure 1). At first he observed the first row of pictures and then he continued to the second row. He ended his observation at the picture of Faculty of Civil Engineering where his entry time was 7.14 seconds. Girl looked at the pictures similarly. First off she observed the first row of pictures and then continued to the second row. The last picture she observed was the picture which represented the Faculty of Electrical Engineering and Information Technology. In overall she spent about 5 seconds less at her entry time than Boy. We can conclude that for Girl the pictures might have been less attractive than for Boy.

Both Girl and Boy, according to dwell time indicator, looked at the picture representing the Faculty of Operation and Economics of Transport and Communications the most. This fact is directly linked to the findings of the first part of our research where we measured that this picture among all of the pictures was most interesting. For Girl, the second most interesting picture was a picture that represented the Faculty of Social Engineering. Other pictures were equally interesting for her and in average she spent 1.5 seconds looking at them. Second most interesting picture for Boy was a picture which represents the Faculty of Mechanical Engineering. After this picture the third picture which caught Boy’s attention was the picture of Faculty of Security Engineering.

From the point of view of revisitors indicator we can see that both Girl and Boy returned with their view to each of the pictures and looked at them again. Results show us that Boy was looking at the pictures more carefully and consistently despite the fact that he looked at the white space.

After the selected respondents viewed all the pictures we asked them one question. What was the most interesting thing in the pictures we displayed to you? Both Girl and Boy could choose from 6 answers. The answers they could choose were – transport and means of transport, rescuers and firefighters, computer, electronics, buildings, machinery and construction.

Girl chose from all the options two times option computer and once she selected the option transport and means of transport. However, if we look at the measurements of her eye movement displayed through the heat map (see Fig. 2) we can see that she spent most of her time looking at traffic and vehicles. Then she spent most of her time looking at the picture of computer.
Based upon the results obtained in the table 2 and the heat map in the picture 2, we can say that the selected respondent – Girl can be more inclined to study in the fields of economics and management in transport or in the fields of informatics and management. Girl spent most of the time looking at the pictures that represents the Faculty of Operation and Economics of Transport and Communications and Faculty of Management Science and Informatics, which are oriented to such fields of study.

Boy responded to the question same as Girl and chose computers as most interesting and then two times marked the option electronics. Looking at the Boy’s heat map (see Fig. 3) we can see that he spent most of his time looking at the picture with computers. Second picture which caught a lot of his attention was the one with the vehicles. A lot of interest from Boy gained the picture with integrated circuit.

Based upon the measured results in the table 2 and in the figure 3 we can conclude that respondent Boy is potentially interested in studying in fields of computers and electronics. Boy spent the most of his time looking at the pictures that represent the Faculty of Management Science and Informatics and the Faculty of Electrical Engineering and Information Technology. Both of these faculties provide study programmes which are oriented to computers and electronics.
4 CONCLUSIONS

The University of Žilina is one of the leading educational and research institutions in Slovakia. In present, the university faces different problems. One of these problems is decreasing number of applicants for study at the university. That’s why the university is focusing on participating in the events where it tries to address potential students. The European Researchers Night is one of the events where we have realized the eye tracking research. The achieved results of the research stated that the most compelling picture was the picture illustrating the means of transport which are characteristic to the Faculty of Operation and Economics of Transport and Communications. One of the possible reasons of these results is the location of the picture. The picture is located in the top left corner of the first row. According to the principles of image composition, the viewing of the picture is realized from left to right and then from up to down.

Based upon this principle, we can state that all respondents establish the viewing of the pictures from left to right. Another possible reason of the results is the fact that in general girls do not tend to incline to technological fields as boys. From the point of view of gender, we measured that the girls spent less time observing the pictures than boys. This matter reflects in the overall time spent on viewing the particular pictures. The dwell time from the perspective of the girls lasted three times more compared with boys. On the contrary the entry time was longer in the group of boys. The most captivating picture was the picture of the Faculty of Operation and Economics of Transport and Communications in group of girls. The boys like the most the picture of the Faculty of Management Science and Informatics. Emphasising this fact we can conclude that the Faculty of operation and Economics of Transport and Communications could address mainly the segment of girls within the future marketing activities. Contrariwise the technical faculties such as the Faculty of Management Science and Informatics or the Faculty of Electrical Engineering and Information Technology could address the segment of boys. Thus, the research provides valuable information which confirms the well-known fact that most of the girls do not tend to study in the technical fields and vice versa the boys tend to study in technical fields.

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REFERENCES
