

# Usability analysis of the user interface of movie-related websites in terms of universal design

## Analiza użyteczności interfejsów stron internetowych o tematyce filmowej pod kątem projektowania uniwersalnego

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### Abstract

The aim of the paper is the usability analysis of the user interface of movie-related websites in terms of universal design. The analysis was performed in order to verify the influence of implementing the universal design concepts on services usability. The studies were based on two web services: existing Filmweb and its auctorial equivalent. For the purpose of analysis the following research methods were used: questionnaires, experiment using eye-tracking technique and validator tests. Moreover, there was compliance with World Wide Web Consortium (W3C) and Web Content Accessibility Guidelines (WCAG) standards checked for both services. Ten participants aged 23–25 took part in the study. Results analysis have shown that deploying universal design conceptions significantly increases usability of the interface.

*Keywords:* usability; eye-tracking; user interface; universal design

### Streszczenie

Celem artykułu jest analiza użyteczności interfejsów stron internetowych o tematyce filmowej pod kątem projektowania uniwersalnego. Analiza dotyczyła weryfikacji wpływu zastosowania założeń projektowania uniwersalnego na użyteczność serwisów. Badania wykonano bazując na dwóch serwisach internetowych: istniejącym Filmweb oraz jego autor-skim odpowiedniku. Podczas analizy użyto następujących metod badawczych: ankiety, eksperymentu wykorzystującego technikę eyetrackingową oraz testów przeprowadzonych walidatorami. Dodatkowo, dla obu serwisów sprawdzono zgodność ze standardami World Wide Web Consortium (W3C) i Web Content Accessibility Guidelines (WCAG). W badaniach wzięło udział dziesięciu uczestników w wieku od 23 do 25 lat. Analiza wyników wskazała, iż wdrożenie koncepcji projektowania uniwersalnego znacząco poprawia użyteczność interfejsu.

*Słowa kluczowe:* użyteczność; okulografia; interfejs użytkownika; projektowanie uniwersalne

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## 1. Introduction

With the development of the film industry, companies responsible for accessing content on such topics create IT solutions to open up to new recipients. As a result of these actions, modern implementations of functionalities focus on aesthetic aspects, while pushing usability into the background. A potential user decides to choose between websites with similar content or functionalities – as they concern the same topic – but with a distinctive graphic design. Nowadays, concepts such as availability are often ignored in interface design. In this paper, an attempt was made to emphasise the influence of complying with terms of universal design on interface intuitiveness. Those terms consist of e.g.: simple and intuitive use, perceptible information. Considering mentioned concepts, authors created service with consistent graphic design, assuring high content readability.

Usability is considered to be resultant of factors such as: learnability, efficiency, memorability, errors and satisfaction. It's a characteristic of software quality from perspective of user [1]. Therefore, usability focuses on user experience with emphasis on the indicators such as knowledge of using the Internet or sight defects. In

order to conduct this kind of studies, there was a variety of researches performed, including: eyetracking experiment, questionnaires, and testing by the use of online validators.

## 2. Literature review

### 2.1. Objective analysis research

In the article "A measurable website usability model: Case Study University of Jordan" [2], the usability of websites was examined on the example of the website of the University of Jordan. The authors proposed a hierarchical model of website usability assessment consisting of 9 main categories and 24 measurable criteria. There was expected the most unified usability measuring model by integrating numerous methods tested by various media, such as a smartphone, a tablet or a desktop browser. The criteria proposed by the authors included: headings (check if they summarise the content of page), mobile (adaptation to devices with smaller screens), page names, internal links, compatibility with operating systems and browsers, universal language (a native version of the website), server response time, server behaviour (error handling) or code quality

(meeting the requirements of W3C). The criteria were repeated in 9 categories, therefore they have been given weights. The free tools: Nibbler, Gtmetrix, Checkmycolours and PowerMapper were used for the study, and the usability of the website of the University of Jordan was verified. Each experiment was repeated 6 times, where 5 different subpages were checked with the use of the above-mentioned tools. For each criterion, points ranging from 0-10 were assigned. The obtained results were inserted into the equation with weights depending on the number of occurrences of the criteria in order to obtain the percentage response. The result of the research was, on the one hand, the indication of numerous errors in the website code, and on the other hand, positive results for the universality of the language, compatibility, refreshing, links to the home page, page names or versions for mobile devices.

The aim of the study in the article "Accessibility Testing of European Health-Related Websites" [3] was to research websites related to health care in 9 European countries to assess their accessibility with an emphasis on users with disabilities. The research was carried out thanks to the automation of software testing and statistical analysis of users' feelings. 48 pages from Eastern Europe were compared with 51 pages from Western and Northern Europe. The research was divided into 3 phases: testing with AChecker, then with Nibbler, and finally filling in questionnaire by users. The main assumption was to find aspects such as the ability to read CAPTCHA tests or keyboard navigation that negatively affected the accessibility of websites for users with disabilities. No correlation was found in the results between the economic situation of the countries where the pages came from and their sizes in kilobytes, the number of barriers or their accessibility results measured with the Nibbler tool. The different percentage of age of citizens also did not affect the differences in the approach to page design between the eastern, western and northern parts of Europe.

The aim of the research in the article "Enhanced Colour Scheme Assessment Tool (COSAT 2.0) for Improving Webpage Colour Selection" [4] was to verify the impact of colour selection on the website on its visual usability. The authors used the COSAT 2.0 tool that defined the principles of colour selection together with a guide in terms of increasing usability. The COSAT influenced aspects such as colour combinations, their contrast and brightness. The website was researched and it was improved on an ongoing basis along with the tips obtained from user testing and the COSAT, WCAG and W3C tools. The research results clearly indicated that the pages created by developers using this tool obtained high usability ratings, which proved the significant impact of COSAT rules on the feeling of using a web application.

The authors of the paper "User Experience Analysis of binus.ac.id Website with The Usability Testing Perspective (A Case Study Approach)" [5] researched the BINUS University website to see how transparent it was to potential users such as prospective students or their

parents. Two most important aspects of the study were: quality assurance and page loading speed. The main goal was to find missing elements that had not been initiated since the implementation of the website. The university website was tested with the Web Accessibility Evaluation tool (WAVE) to list the problems affecting the website accessibility and with the Catchpoint software for connection analysis and page loading speed. The results were to serve as an indication of what aspects were omitted and which had a significant impact on the performance and availability of the website. These aspects were: page header and footer contrast, lack of labels, especially for the page logo.

The authors of the article "Accessibility of environmental data for sharing: The role of UX in large cyberinfrastructure projects" [6] examined which of the user experience (UX) tests were implemented by the DataONE research service over the decade. Between years 2009 and 2019, employees created tools for managing the company's data, with one of the groups working on the new solution for usability and diagnosis. They developed 44 tests to verify the usability of their products and websites at different stages of the development process. The research was divided into 4 stages: design, development, implementation and maintenance. The process involved from 5 up to 14 users depending on the test type. Such solutions were applied as polls, interviews, usability tests in the form of finding an element on the page without and with hints, discussion in a focus group, research in terms of fulfilling heuristics (mainly Nielsen) or testing with an eye-tracker. The authors emphasized the significant impact of testing cyberinfrastructure design. The solutions they implemented improved subsequent versions of their websites with a simultaneous increase in user satisfaction and the usability of large and complex projects such as websites.

## 2.2. Non-objective analysis research

In the article "The Effects of the Floating Action Button on Quality of Experience" [7], the impact of the Floating Action Button (FAB) on the quality of receiving the page was examined from the user's point of view. It was highlighted that several user interface (UI) and user experience design specialists were sceptical about the implementation of this solution in both web and mobile application interfaces. They argued that the FAB was a distraction, interfering with other functionalities, as well as unable to be used in applications designed for iOS. The purpose of this article was to verify the FAB for a quality user experience. Both static and animated buttons were tested and it compared to another toolbar. The research was conducted on advanced users with the use of Nielsen heuristics to assess the usefulness of the FAB in the application. Users had to perform specific tasks using the FAB, and then a toolbar, during which the execution time, the fact that the task was completed, the number of errors and the degree of difficulty of the task were counted. As a result of the research, it turned out that the use of FAB did not have a positive effect on

the usability of the application, but it improved the aesthetic aspect.

In the article "Web Navigation and Usability Analysis of Educational Websites in Pakistan" [8], the trunk test was used to verify the quality of navigation on the website and to test the comfort of use and usability with over 100 websites of universities in Pakistan. The trunk test was carried out on the basis of 6 open questions regarding the placement of elements on the page, such as: where to search for the content, what were the users options at this stage in the application or what subpage the user was on and what were the main sections of the page. The research was carried out by the authors of the articles and the results were also compared between their achievements. As a result of the study, a conclusion was drawn that it was necessary to introduce amendments to the navigation methods used in Pakistani websites. About 43% of Pakistani educational sites had problems including navigating and finding desired content due to the lack of indicators for the current path and insufficient search filters.

The aim of the research in the article "Redevelopment of the Predict: Breast Cancer website and recommendations for developing interfaces to support decision-making" [9] was to create an interface for a breast cancer prognosis tool. The website was designed to facilitate postoperative treatment as well as visualize the disease prognosis as much as possible for patients and their doctors. The research was conducted with the use of questionnaires with a five-point scale of assessments, exchange of opinions in an interview as well as usability tests based on interviews with patients and doctors. Problems were detected with the recognition or finding of a clickable button. The design was based on the prioritizing user needs. As a result, an interface more accessible to a wider audience was obtained thanks to new forms of visualization, continuous data updates, advanced content aimed at clarifying issues or implementing solutions that predict, for example, the course of the disease. The main conclusion was that the participation of a potential user in the creation process, as well as basing the design architecture with the end user in mind, gave the opportunity to benefit from the aspects of life intended for them and concerning them – with an emphasis on predicting the future.

The aim of the article "Usability evaluation of a library website with different end user groups" [10] was to verify how diverse the end users of the library website were. The research was carried out in terms of usability, the components of which were: effectiveness, efficiency and satisfaction. Usability was tested through the thought-to-voice protocol, journal analysis and questionnaires. Efficiency was measured as the time in seconds required to complete a set task. Efficiency was assessed on a five-point scale using a task-based methodology. User satisfaction was measured using a questionnaire using a five-point scale. As a result of the static analysis, the conclusion was obtained that different groups of end users achieved different degrees of effectiveness and efficiency, while maintaining no dif-

ferences between the level of satisfaction in groups. Participants did not reach the "useful" threshold. In view of the detected shortcomings, the authors proposed solutions to improve the usability of the website.

With regard to literature review authors have formulated the following hypothesis: "deployment of universal design concepts significantly improves interface usability".

### 3. Research methods

#### 3.1. Research objects

The first research object was the online movie-related service Filmweb.pl. The website offers some of the functionalities for users who are not logged in and extended actions for those who has acquired an account. Service client can browse information about movies, movie crew, posters, trailers and rankings. In case when user is logged in, he or she can add a content in form of reviews and ratings or mark some of the content to get notifications. The service is used by a large community, thanks to comprehensive contents of database about cinema movies, television movies and series, as well as editors section with news from the world of motion pictures. The second service was created by the authors of this paper. Both websites were similar in case of functionalities but with different implementation of user interface. Authors' interface was implemented with use of components assuring accessibility and readability of content. There was intuitive layout created in contrary to Filmwebs vertical elements arrangement to decrease time that user spends on subpage to seek for information.

In order to create the service similar to Filmweb, the authors used React – a JavaScript based library with MUI components pack [11]. React is based on components managing their own state that allows developers to compose complex user interfaces [12]. The project was developed with use of the Node Package Manager (NPM) [13]. It allowed to maintain versions of libraries that project used, as well as building and running it. For application development purposes authors chose Visual Studio Code IDE (Integrated Development Environment) that allowed to manage project files and integrate it with programming plugins and the Git version control system. The Git is a tool that ensures managing project as remote repository on GitHub platform [14]. For the duration of analysis, created website was hosted by Firebase hosting [15].

Authors focused on functionalities connected to displaying and adding content of singular movie. Moreover, emphasis was put on distinguishing page contents from advertisements. There were defined personas and interface mockups created during design process of the application. It helped to determine functional and non-functional requirements. Moreover, created mockups allowed to avoid initial mistakes with content placement within the interface before implementation. Figure 1 shows an example view of the user interface implemented for the purpose of the study.



Figure 1: Example view from authors' interface.

## 3.2. Research criteria

Questionnaires focused on the user satisfaction and mainly verified if examined website is readable and easy to navigate. There was considered criteria such as: layout, color theme, navigating ease, information structure. Before filling in the questionnaires, users cannot be able to see interface of newly developed service to avoid a situation when user knows the arrangement of the graphical user interface Tests carried out with eye-tracking technique as a practical approach were performed to assess average element searching time, number of fixations and time to first fixation on searched element. There were also heatmaps generated to visualise frequency of visiting specific interface areas (Figure 3). In addition, there was validators tests carried out to verify quality of source code and check compliance with WCAG and W3C guidelines. Those directives consider criteria such as: contrast errors and warning, code structure errors, warnings and Accessible Rich Internet Implementation (ARIA) attributes count.

## 3.3. Research procedure

### 3.3.1. Questionnaire

In order to carry out the research, both tools for obtaining the most objective result of the website usability assessment were used, as well as methods taking into account the subjective feelings of users. Ten people aged 23-25 with similar education, who regularly use internet services, were involved in the research. The surveys focused on the highest possible accessibility and intuitiveness of using a given website. To evaluate quality of the user interface the Lublin University of Technology (LUT) questionnaire [1] was used. The participants focused on LUT's areas such as "Navigation and structure", "Messages, feedback, user support", "Application interface", "Text of subpages", "Data entry", with each question using a scale from 1 to 5, where 1 meant worst score and 5 the best one. Working with both services, users were supposed to complete the same set of tasks. After realizing all tasks users were given questionnaires to rate their experience. Example scenario of testing the service before filling the questionnaire:

1. Finding where user is actually now.
2. Locating the searchbar.

3. Distinguish different sections after reaching each one.
4. Remembering the path to go back.

### 3.3.2. Eye-tracker

The eye-tracker tests were carried out in accordance with the research scenarios prepared after the preliminary analysis of interface not complying with universal design concepts as well as interface implemented by authors. Scenarios consisted of sequence of tasks, that user had to perform. They concerned issues affecting the usability such as: finding a given element on the page, testing the speed of finding an information with different contrasts, or the impact of advertisements display methods and their placement on distinguishing them from subpage content.

Table 1: Eye-tracker specification

Visual angle accuracy	0.5-1.0°
Sampling rate	60Hz or 150Hz
Calibration	5 or 9 point
Permissible head movement	35cm (vertically) x 22cm (horizontally)
Head movement depth range	±15cm
Physical parameters (dimensions)	235 x 45 x 47 mm, 125g

A single scenario considered actions like reading the task and finding the element on page. Example scenario of usability testing was placed in Table 2.

Table 2: Scenario of locating interface elements that implements concepts of universal design

<b>Name:</b> Speed analysis of locating interface elements that implements concepts of universal design.		
<b>Research aim:</b> Verify impact of elements arrangement in user interface on locating speed.		
<b>Initial conditions:</b> Next views are presented to user.		
<b>Final conditions:</b> Data gathered from eye-tracker has been saved after end of scenario.		
<b>Participants in research:</b> 10		
<b>Scenario steps</b>		
Number	Description	Expected result
1	Instruction is viewed to user that concerns locating of adding movie button.	User begins the research.
2	View of interface fulfilling the universal design concepts is presented to user.	User tries to locate the element.
3	User has visually located searched button.	User begins next scenario.
<b>End of scenario</b>		

The time that participants spent on completing the task of the scenario was measured. Additionally, the eye-tracker system recorded their eye movements, thanks to

which it could visualize the "route" on the website interface. The same scenarios were conducted using interfaces of both services. The specification of eye-tracker was presented as contents of Table 1.

### 3.3.3. Validators

Testing with the free web-based WAVE [16] tool was aimed at obtaining errors in the source code that have a real impact on the reception, and thus the usability of the page, such as the lack of alternative text in the case of an unloaded image or inadequate contrast. After conducting the tests, the researchers received the results in the form of a list of errors and warnings related to specific elements of the website.

In order to highlight the errors contained in the code, but which may not be directly reflected in the visualization of the page, but influencing its functioning, the W3C validator was used [17]. The validator listed errors and warnings in the source code and marked, for example, which attributes were missing in a given element.

AChecker validator [18] is an online tool that provides website accessibility review taking into consideration up to AAA level WCAG 2.0 guidelines. By testing with AChecker, authors received the list of contradictions with accessibility guidelines on appropriate level.

## 4. Results

### 4.1. Eye-tracker test results

Results concerning the average task realisation time per respondent gathered from eye-tracker test were presented in Figure 2. Analysis of eye-tracker test results showed if participants had problems finding the desirable element. Heatmaps gathered thanks to research scenarios were marking more issues in case of Filmweb interface versus interface proposed for the purpose of the study. The plot contained standard deviations for both tested interfaces as well.

In Figure 3 the most visited areas concerning eye movement were visualised. Heatmap is a resultant of series of completing research scenario by all respondents. The most visited areas, marked with red color, presented in Figure 3 are: poster, trailer miniature, title, information about movie crew and rating section. Considering the fact, that task was to find button allowing user to enter the trailers section, this view made numerous difficulties during the experiment. The correct solution was to click on poster, which was not intuitive. Participants had trouble recognising that, until he or she hovered over this area. There also wasn't appropriate information present to give user information about action performed after clicking that element. Users were misled by the play button, that indicated possibility of watching trailers of movie.

### 4.2. Questionnaire results

After conducting LUT questionnaire, the WUP (Web Usability Points) indicator was calculated [1]. Table 3 contains partial respondent-based and average WUP

scores for both interfaces. WUP rate was counted using formula presented in equation 1 [1].

$$WUP = \frac{1}{n_a} \sum_{i=1}^{n_a} \frac{1}{s_i} \sum_{j=1}^{s_i} \frac{1}{q_{ij}} \sum_k^{q_{ij}} p_{ijk} \quad (1)$$

where:  $n_a$  is areas number,  $s_i$  is subareas number in area  $i$ ,  $q_{ij}$  is questions number in area  $i$  and subarea  $j$ ,  $p_{ijk}$  is grade for question number  $k$  in subarea  $j$  and area  $i$ .

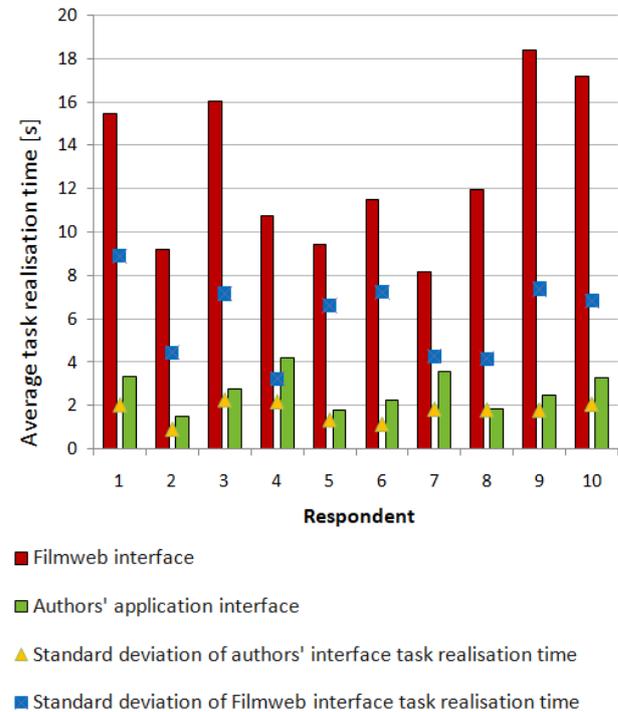


Figure 2: Average task realization time for both interfaces.

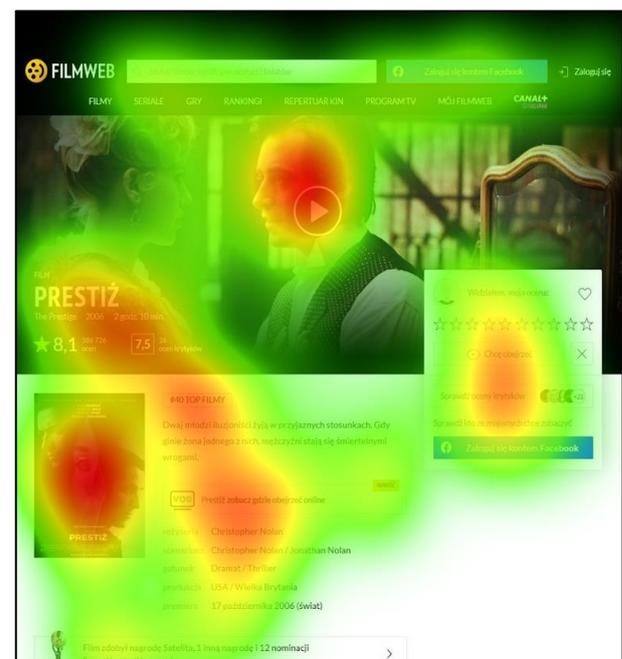


Figure 3: Heatmap for Filmweb interface examine scenario.

Table 3: Partial and average WUP scores for both interfaces

WUP scores		
Interviewee	Authors' interface	Filmwebs interface
1	4.76	3.25
2	4.41	3.16
3	4.44	3.56
4	4.70	3.21
5	4.42	3.34
6	4.30	3.08
7	4.24	3.14
8	4.46	3.22
9	4.35	3.05
10	4.35	3.16
<b>Average WUP</b>	<b>4.44</b>	<b>3.22</b>

4.3. Validator results

Obtained results from WAVE validator test were presented in Figure 4. Web Accessibility Evaluation allowed to outline problems contained in both services such as: errors, contrast errors, alerts, features, structural elements and ARIA.

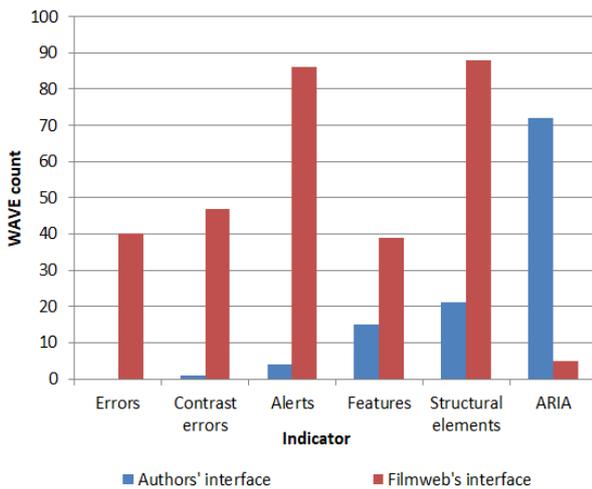


Figure 4: WAVE validator results visualization.

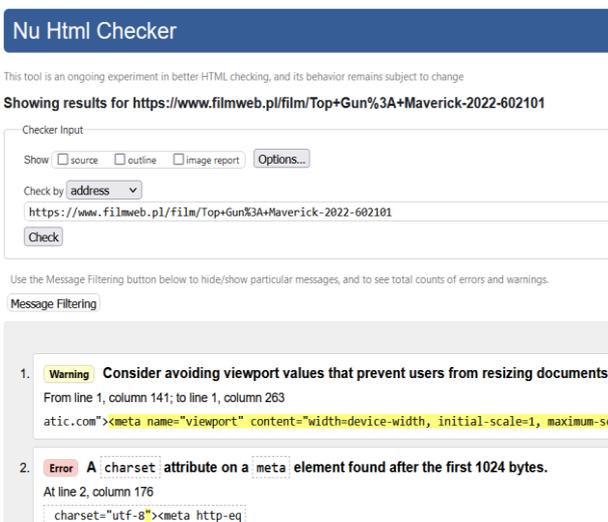


Figure 5: W3C validator results for Filmweb subpage interface.

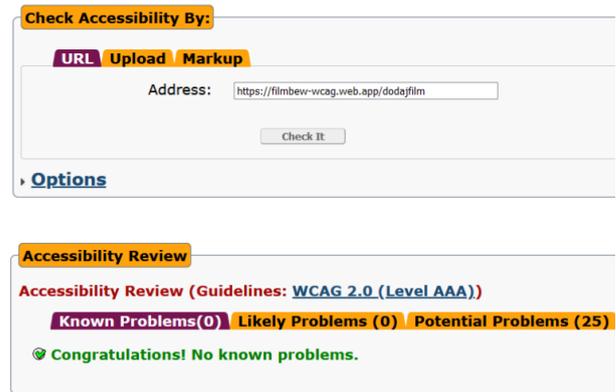


Figure 6: AChecker validation results for authors' interface.

The W3C validator helped to distinguish warnings and errors contained in the code in a list form. Tests were performed for chosen subpages of Filmweb and in contrast for authors' interface. Example results for analysed services were presented in Figure 4.

Compliance with WCAG 2.0 guidelines was checked and visualised also by the AChecker tool. Figure 5 contains screenshot of a test result for interface proposed by the authors.

5. Discussion

Taking into consideration objective and non-objective research methods, the authors were able to verify the hypothesis formulated at the beginning of the paper. Objective methods were eye-tracking and validator testing. On the other hand, there was one non-objective method, the questionnaire. Research group which includes ten people who was asked to rate both tested interfaces using LUT questionnaire and take part in eye-tracking study.

5.1. Objective methods

Eye-tracking and validators were two main objective usability analysis methods used in articles discussed in literature review.

Eye-tracking method proposed in article "Accessibility of environmental data for sharing: The role of UX in large cyberinfrastructure projects" [6] ensures objective assessment intuitiveness of interface taking into consideration such factors as examining time, time to first fixation and correctness of examination. Collected data were gathered in tables. In the study presented in this paper, the authors also interpreted heatmaps. Analysis of average scenario completing time shown that executing the task of finding element takes 474% more time in case of interface not fulfilling universal design concepts (Figure 2).

The authors have predicted that some of the Filmweb views can be misleading so they prepared some hints for the specific scenarios. It was important to distinguish the time that participant took to accomplish task from the time to the first fixation. As an example, it can be observed during scenarios for finding trailers sections in Filmweb. This problem has reflection in results and states interface designed for purpose of study as more intuitive (Table 3).

Another method for objective interface analysis was to use validators such as AChecker, W3C, and WAVE. Similar tools were also presented in articles, where European health-related websites were tested [3] and websites user experience was analysed [5]. Authors of this paper has rejected the Nibbler tool, hinted by mentioned articles from literature review [2, 3], because of its inability to point specific service subpage to test. WAVE results represented by alerts, errors and contrast errors were many times higher. On the other hand, such score in section like ARIA was positive indicator that reflected on containing attributes in code that have major effect on accessibility. According to the W3C validator results, Filmweb interface had numerous usability defects. AChecker tool allowed to verify compliance with WCAG 2.0 guidelines [4]. The interface created for the purpose of the study fulfills the universal design guidelines, what comes out in favor of validator examination. For example, analysis of movie-info subpage for Filmweb interface has count for known problems at rate of 88 in contrary to authors' interface with zero known problems (Figure 6).

## 5.2. Non-objective methods

The non-objective interface analysis was mainly realised by employment of questionnaire [9, 10]. Authors availed of LUT questionnaire to gather respondent's subjective evaluation after using both compared interfaces. Afterwards, the WUP indicator was calculated, which was in average 38% higher in case of interface fulfilling universal design concepts. Despite the contrast warning during validator analysis, authors have decided to visualise movie rating with the use of stars symbols instead of numeric grade. This decision was influenced by the interviews with users, who claimed that star rating has significantly higher aesthetic value [7]. According to problems raised by authors of article "Redevelopment of the Predict: Breast Cancer website and recommendations for developing interfaces to support decision-making" authors of this paper had created appbar with service name in it, in order to ensure simple navigation [8].

## 6. Conclusions

Comparative analysis of user interfaces of movie related services allowed to indicated factors having impact on usability. The obtained results have shown that modern design of interface used by movie services is more appealing but it often doesn't follow universal design guidelines. Thanks to eye-tracking technique there were distinguished elements and areas that drew attention of potential user. Variety of heatmaps brings up intuitiveness issue. Heatmaps created from interface fulfilling universal design concepts show that user was able to find element or information without analysing whole page view. The questionnaire result analysis and the indicators calculated with its use shown that usability of interface which sticks to WCAG and universal design guidelines was considerably higher. Validator testing pointed out that created interface was more accessible.

The obtained results allowed to verify the hypothesis "deploying universal design concepts significantly improves interface usability". Tests carried out on both interfaces had shown that universality factors had major impact on participants scores. Interface that implements terms of universal design turned out to be less problematic and got better feedback in contrary to one that did not. Therefore, the hypothesis is true.

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