

Comparison of the accessibility of websites of voivodeship cities in Poland Porównanie dostępności stron internetowych miast wojewódzkich w Polsce

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Abstract

This article presents the results of an analysis of the accessibility of websites of 16 voivodeship cities in Poland. The study aimed to evaluate the extent to which the websites representing voivodeship capitals comply with WCAG 2.1 standards and to compare the results. The findings indicate discrepancies in meeting the requirements, emphasizing the need to implement more effective practices to improve website accessibility.

Keywords: website accessibility; WCAG 2.1; voivodeship cities; WAVE

Streszczenie

W niniejszym artykule zaprezentowano wyniki analizy dostępności stron internetowych 16 miast wojewódzkich w Polsce. Celem badań było sprawdzenie w jakim stopniu strony reprezentujące stolice województw spełniają normy WCAG 2.1 oraz porównanie wyników względem siebie. Otrzymane wyniki wskazują na rozbieżności w realizacji wymagań. Podkreśla to potrzebę do wdrożenia skuteczniejszych praktyk mających na celu poprawę dostępności stron internetowych.

Słowa kluczowe: dostępność stron internetowych; WCAG 2.1; miasta wojewódzkie; WAVE

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1. Introduction

In the era of today's technological advances, using websites and doing business mainly online is crucial to the functioning of the greater part of society. An important aspect of these activities is the ease and intuitiveness of operation and presentation of content on sites that are visited by users. The guidelines that underpin the provision of these features are contained in the Web Content Accessibility Guidelines (WCAG) [1].

Web accessibility is crucial in today's society. For people with disabilities, access to public websites is essential to ensure equal opportunities in the use of information and services. According to the 2019 Digital Accessibility Act [2], public institutions in Poland are required to comply with WCAG 2.1 guidelines.

The main thesis of the thesis is the assumption that the official websites of voivodeship cities in Poland show a significant variation in the degree of compliance despite the existence of a legal framework for digital accessibility and the availability of automated assessment tools based on WCAG 2.1 standards. This suggests a lack of standardized and systematic implementation practices for website development in the public sector.

2. Purpose of research

The purpose of this study is to assess how voivodeship city websites meet these requirements, and to identify the most common problems and differences in compliance levels. The data used in the study will come from the results shown by the Web Accessibility Evaluation Tools (WAVE) web tool [3].

3. Literature Review

This section presents scientific publications in which the accessibility of websites is discussed and checked. It also presents and describes the methods used for this purpose along with their description.

Studies on website accessibility in Poland, such in article [4] indicate that many public websites do not fully meet WCAG requirements.

The authors of the second article [5] focus on an accessibility analysis of websites in the e-commerce sector. The aim of the conducted study is to identify accessibility barriers on e-commerce platforms with emphasis on WCAG.

Research in articles [6, 7] highlights the importance of combining such tools [8] with regular audits. However, this study focuses solely on automated evaluation.

The research conducted in the article [9] was focused on the websites of educational institutions. In their work, they analyzed more than 100 cases identifying the main problems and solutions.

In the article [10], authors focused on the relationship between web accessibility and user experience. They examined ways that, by improving accessibility, affect the quality of interaction of users using websites.

The article [11] provides a comprehensive review of methods for evaluating web accessibility. The aim of the study was to identify and classify methods for evaluating the do-ability of websites. The authors emphasize the importance of combining automatic and manual methods in the overall evaluation of accessibility.

The authors of [12] article presented the impact of responsive web design on the intuitiveness of using mobile web applications. They show how responsiveness affects the user's experience in using websites.

The article [13] presents an analysis of the accessibility of the websites of thirty-three Saudi universities, evaluated according to 38 WCAG criteria using AChecker and TAW tools for this purpose. The results indicate that the automated tools identify both errors that require immediate intervention, as well as potential problems that require manual verification. The authors emphasize that accessibility assessment requires the participation of users with disabilities and further empirical research.

Accessibility assessment using automated tools such as AChecker and WAVE is also described by the authors of the article [14]. In it, they examine the websites of 20 Malaysian public universities. The results of their analysis indicate a low level of compliance with WCAG 2.0, mainly due to the lack of text alternatives, keyboard accessibility problems and inadequate contrast. Despite the implementation of some accessibility features, the authors recommend improvements, especially for navigation and adaptability. The tips provided provide a valuable basis for change for web designers.

Automated tools have also been used in articles [15, 16] to analyze travel agency and hotel sites from Portugal. Both studies used AccessMonitor and TAW for 182 and 306 sites, respectively. The results indicated a low level of compliance with WCAG 2.0 standards, indicating a lack of accessibility in tourism.

Government websites of various countries have been analyzed in studies on website accessibility in articles [17-23]. In them, the authors highlight numerous aspects that need immediate improvement.

4. Methodology

The analysis included the websites of 16 voivodeship cities in Poland as shown in Table 1. The WAVE tool was used to automatically verify compliance with WCAG 2.1 guidelines. To automate data collection, a Python script utilizing the pandas, selenium, and time libraries was used. After analyzing the results, it is possible to determine whether the inter-net sites of voivodeship cities in Poland meet the standards associated with the Web Content Accessibility Guidelines (WCAG).

Table 1: Voivodeship cities in Poland with links to websites

No.	The capital of the province	Website address
1	Białystok	www.bialystok.pl
2	Bydgoszcz	www.bydgoszcz.pl
3	Gdańsk	www.gdansk.pl
4	Gorzów Wielkopolski	www.gorzow.pl
5	Katowice	www.katowice.eu
6	Kielce	www.kielce.eu
7	Kraków	www.krakow.pl
8	Lublin	www.lublin.eu
9	Łódź	www.uml.lodz.pl
10	Olsztyn	www.olsztyn.eu

11	Opole	www.opole.pl
12	Poznań	www.poznan.pl
13	Rzeszów	www.erzeszow.pl
14	Szczecin	www.szczecin.eu
15	Warszawa	www.um.warszawa.pl
16	Wrocław	www.wroclaw.pl

The analysis with the Wave tool will result in the results of each page for three categories. The first is Errors, showing accessibility problems that do not meet WCAG requirements affecting particular groups of people. The second category is Contrast Errors, showing incorrect contrast levels that significantly affect the perception of content on the page. The last category is Alerts describing elements that may not meet WCAG standards, which need attention. Pages will then be ranked based on the product of the normalized values for the group and the assigned weights according to Table 2.

Table 2: Categories and weights of results

Category	Weight
Errors	0.5
Contrast Errors	0.3
Alerts	0.2

Calculation of the component values needed to determine the level of compliance with WCAG is performed based on the formula:

$$x' = \frac{x - x_{min}}{x_{max} - x_{min}} \quad (1)$$

where:

x' - the normalized value,

x - the original value,

x_{min} - the minimum value in the dataset,

x_{max} - the maximum value in the dataset.

The final score for each category will be calculated using the sum of the product of the normalized value and the weights assigned to the selected category which is described by the formula:

$$W = w_1 \times x'_1 + w_2 \times x'_2 + w_3 \times x'_3 \quad (2)$$

where:

W - weighted average,

w_1 - the value of the weight of the error criterion,

x'_1 - normalized value for the number of errors,

w_2 - the value of the weight of the contrast error criterion,

x'_2 - normalized value for numbers of contrast errors,

w_3 - the value of the alert criterion weight,

x'_3 - normalized value for numbers of alerts.

5. Results analysis

The analysis revealed significant differences in the accessibility levels of the website. The results of the study presented in Table 3 show websites that achieve a high level of compliance with WCAG, which have a low number of errors and structural problems. The results also include websites that have a low WCAG compliance rate. They are characterized by a large number of errors.

Table 3: Results of number of errors, number of contrast errors and number of alerts obtained with the Wave tool

No.	City	Errors	Contrast Errors	Alerts
1	Białystok	0	0	2
2	Bydgoszcz	5	0	219
3	Gdańsk	28	0	66
4	Gorzów Wielkopolski	1	78	24
5	Katowice	5	31	23
6	Kielce	5	4	46
7	Kraków	0	0	52
8	Lublin	6	51	0
9	Łódź	7	5	954
10	Olsztyn	6	0	17
11	Opole	6	108	105
12	Poznań	54	7	76
13	Rzeszów	14	0	38
14	Szczecin	2	65	70
15	Warszawa	1	0	42
16	Wrocław	1	40	71

5.1. Analysis of errors

The analysis presented in Figure 1 shows errors that do not comply with the WCAG guidelines found on each site. The sites that stand out in terms of lack of errors belong to Kraków and Białystok. The lowest score was recorded for the Poznań website, with 54 errors.

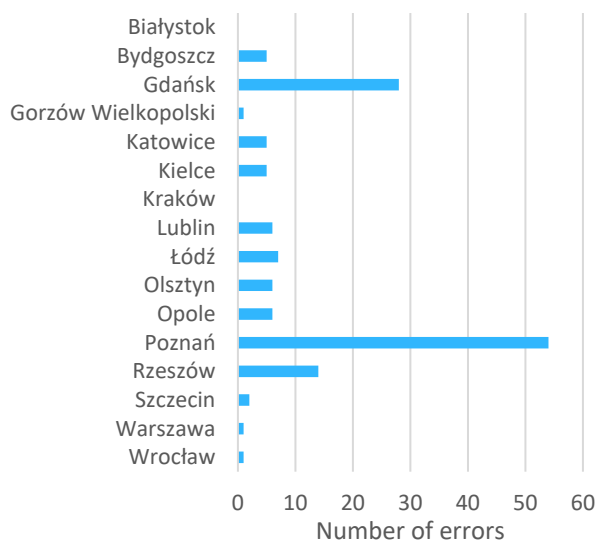


Figure 1: Number of errors found on pages.

5.2. Analysis of the number of contrast errors

Contrast error analysis illustrated in Figure 2 shows a big difference in compliance with WCAG rules regarding the scale of contrast that should be applied to the elements of the web pages. The websites belonging to Bydgoszcz, Kraków, Warszawa, Rzeszów, Białystok, Gdańsk and Olsztyn were designed in accordance with the recommendations and have no violations. This means that 43.75% of all web platforms of voivodeship cities in Poland comply with WCAG recommendations specifying contrast.

The Poznań site has the highest number of errors with a score of 108 irregularities. This is the only such extreme case, which indicates a lack of adherence to the specified and required standards.

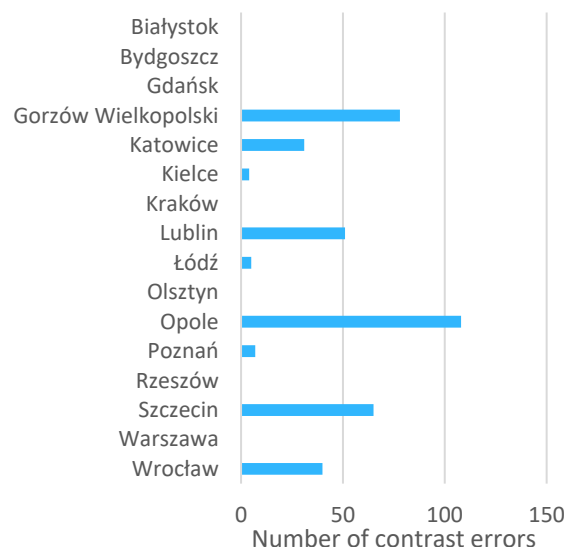


Figure 2: Number of contrast errors on pages.

5.3. Analysis of the alerts

The analysis in Figure 3 shows a large discrepancy in the number of alerts between the websites representing voivodeship cities. Lublin's site is the only one with no alerts, which means that apart from errors and contrast errors, there are no other potential inconsistencies related to WCAG compliance. The website belonging to Łódź received the worst extreme score with as many as 954 alerts. Such a high probability of not meeting WCAG requirements suggests a significant risk of non-compliance with accepted accessibility standards.

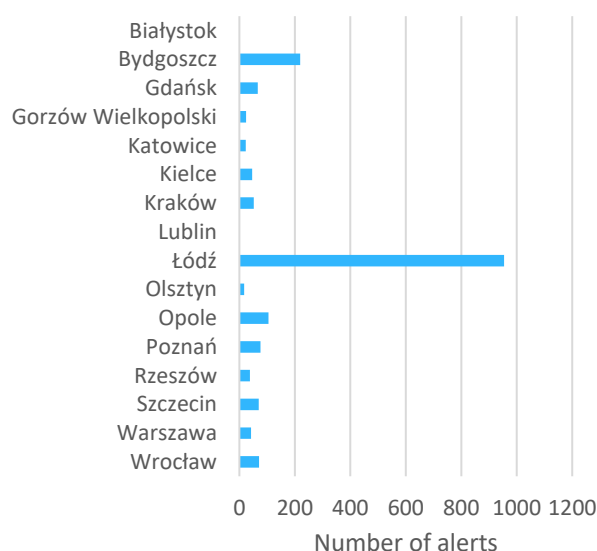


Figure 3: Number of alerts on pages.

5.4. Summary analysis

The normalized values of errors, contrast errors and alerts used to calculate the weighted averages are shown in Table 4. A summary analysis presented in Table 5 shows that the website of Białystok is the closest to meeting WCAG standards reaching a weighted average of the three components of 0.0004. This value is nearly 0, which indicates full compliance with the standards. In contrast, Poznań recorded the lowest level of compliance, with a score of 0.5354. This is the only such extreme value.

Table 4: Normalized values for each category

N o.	City	The value of normalization of errors	The value of normalization of contrast errors	The values of normalization of alerts
1	Białystok	0.000	0.000	0.002
2	Bydgoszcz	0.093	0.000	0.230
3	Gdańsk	0.519	0.000	0.069
4	Gorzów Wielkopolski	0.019	0.722	0.025
5	Katowice	0.093	0.287	0.024
6	Kielce	0.093	0.037	0.048
7	Kraków	0.000	0.000	0.055
8	Lublin	0.111	0.472	0.000
9	Łódź	0.130	0.046	1.000
10	Olsztyn	0.111	0.000	0.018
11	Opole	0.111	1.000	0.110
12	Poznań	1.000	0.065	0.080
13	Rzeszów	0.259	0.000	0.040
14	Szczecin	0.037	0.602	0.073
15	Warszawa	0.019	0.000	0.044
16	Wrocław	0.019	0.370	0.074

Table 5: Weighted average of three values

No.	City	Weighted average
1	Białystok	0.0004
2	Bydgoszcz	0.0922
3	Gdańsk	0.2731
4	Gorzów Wielkopolski	0.2310
5	Katowice	0.1372
6	Kielce	0.0671
7	Kraków	0.0109
8	Lublin	0.1972
9	Łódź	0.2787
10	Olsztyn	0.0591
11	Opole	0.3776
12	Poznań	0.5354
13	Rzeszów	0.1376
14	Szczecin	0.2137
15	Warszawa	0.0181
16	Wrocław	0.1353

6. Discussion

This study compared the level of accessibility of the websites of 16 voivodeship cities. The analysis was based on three categories: number of errors, contrast errors and alerts. The results indicate large differences in the implementation of WCAG 2.1 standards. It was found that sites where the design process took accessibility principles into account performed significantly better. Automated tools such as WAVE can quickly identify problems, but their results should be supplemented with manual analysis to catch all the nuances that affect the ultimate usability of a site.

The results suggest that apparent differences in accessibility levels are primarily due to the lack of consistent processes for implementing WCAG standards at the design stage. The websites of Białystok, Kraków and Warszawa show the best score, suggesting that they are compliant with the standards recommended by WCAG. This means that people without disabilities will not have problems with uncomfortable use of these portals. The sites of Opole and Poznań are the least adapted, which could mean serious problems in using them by people with limitations such as problems with vision, color perception or those using screen readers.

7. Conclusions and recommendations

Based on the analysis, it can be noted that not all websites belonging to voivodeship cities in Poland are properly adapted for people with disabilities. In order to improve accessibility, it is recommended that those responsible for the sites take action. These actions should include:

- Developing detailed guidelines for web designers based on WCAG 2.1 to facilitate implementation of the standard.
- Conduct regular audits using tools such as WAVE to continuously identify and resolve issues.
- Securing adequate financial resources in the budgets of voivodeship cities to improve digital accessibility.
- Organize training sessions for web developers to increase their awareness and skills in accessibility.

In conclusion, the survey underscores the need to raise awareness of the importance of digital accessibility among local governments. Only through such efforts can websites become more user-friendly and accessible to all, regardless of their skills and condition.

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