WEB ACCESSIBILITY COMPLIANCE TO WCAG 2.0 STANDARD: A CASE OF A MALAYSIAN PUBLIC UNIVERSITY

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Article History: Received: 27 August 2022, Revised: 15 October 2022, Accepted: 15 November 2022

ABSTRACT

Most universities now communicate, exchange pertinent information, and facilitate transactions among their stakeholders through their websites. Website accessibility is, therefore, essential to ensure equal access to information from the institution regardless of their physical limitations and other potential restrictions. Based on ACHECKER and WAVE, the objective was to present the features of non-compliance to WCAG 2.0 standard and ways to overcome for a Malaysian public university homepage. The study found a low degree of compliance with the WCAG 2.0, respectively. Parsing, labels or instruction, headings and labels, link purpose, resize text and information and relationship are some of the aspects that require rapid attention. It is possible to further improve issues with navigation, adaptability, input assistance, compatibility, empty links, and empty headings. An expert's insights indicated that without proper monitoring from the higher authority of the government body like MAMPU, the web accessibility would remain partially or completely inaccessible to certain sectors of the population. Overall, this study provides insightful information, especially to web designers who can better adhere to the standards when creating their websites.

Keywords: *ACHECKER, WAVE, a Malaysian public university, WCAG 2.0, web accessibility*

1.0 INTRODUCTION

The topic of web accessibility has received attention as e-services have expanded over the past 20 years to ensure that everyone can use these services without any restrictions. One of the most important aspects that should be considered while creating websites is online accessibility. Web developers should follow the Web Content Accessibility Guidelines 2.0 (WCAG 2.0,1999) to make sure that web contents are accessible to all users, especially those who are disabled. Many automated tools have been created to assess whether websites adhere to accessibility standards like WCAG 2.0 and to aid web designers and content producers in creating pages without barriers for people with disabilities.

While the website's visitors come from a variety of backgrounds and abilities, as well as technological limits and limitations such as the device and browser they use, as well as the type and speed of their internet connection, the website should be able to accommodate these concerns. To put it another way, the website should be able to accommodate accessibility dependent on the users' requirements and the technology they use.

In the context of web applications, "accessibility" refers to making web pages accessible to all users, including those who have visual, physical, auditory, cognitive, or other disabilities. Accessibility, according to Shawn (2006), is the property of a website that allows people to use it - to find it navigable and understandable - even when they are working under restrictive conditions or constraints. According to the World Wide Web Consortium (W3C)(2005), web accessibility means that individuals with disabilities can perceive, comprehend, navigate, and engage with the Web, as well as contribute to it.

For all users, web accessibility "addresses discriminatory elements associated to equivalent user experience on the web" (Laitano, 2015). Considerations of usability, which "is about effective, efficient, and pleasant design of websites and mobile applications," can be included in online accessibility. Websites, web apps, online-based tools and platforms, and other internet-connected technologies are all included in web accessibility.

Lack of or insufficient attention to including accessibility features for online content (including websites), limited adaptability in product and service functionality, and weak policy frameworks to support the provision of an accessible digital environment – being online has become an integral part of life today – are just a few of the barriers. The usefulness of a website that is accessible to all users, regardless of ability or disability, is referred to as web accessibility. For many instructional designers and trainers, "accessible" is associated with regulatory criteria such as WCAG 2.1.

It is important to follow the principle of PROGRESSIVE ENHANCEMENT when designing accessible web applications—that is, design web pages in layers so that the basic content and interaction are available to all, and the more interactive (i.e., enhanced) options become available as browser and/or device capabilities increase.

Application pages must use SEMANTIC MARKUP, UNOBTRUSIVE STYLE SHEETS, and UNOBTRUSIVE JAVASCRIPT to enable for progressive enhancement. Because web applications rely on forms for user interaction, it is critical that they are made as accessible as possible (ACCESSIBLE FORMS). Furthermore, other content on pages should be made available as well (ACCESSIBLE IMAGES, ACCESSIBLE TABLES, ACCESSIBLE NAVIGATION).

2.0 LITERATURE REVIEW

2.1 Standards and Regulations for Web Accessibility

WCAG 1.0 was created in the late 1990s and finalised in 1999, before the World Wide Web Consortium introduced WCAG 2.0 in 2000 and made it official in 2008 (W3C, 2005). The Web Content Accessibility Guidelines (WCAG) 2.0 and Section 508 of the United States Rehabilitation Act are the two standards and guidelines now in use.To ensure web accessibility, several countries have enacted various laws and guidelines. The Americans with Disabilities Act (ADA), the Individuals with Disabilities Education Act (IDEA), and Section 508 of the Rehabilitation Act of 1973 are all applicable standards and regulations in the United States.

2.1.1 Web Content Accessibility Guidelines (WCAG) 2.0

With consideration for diverse web technologies, WCAG 2.0 was created to offer suggestions for improving the accessibility of web content . It has 12 standards where each recommendation includes different success criteria (SCs). The standards are viewed as a framework that directs web designers and developers who want to make information easily accessible for persons with disabilities. To remove any obstacles from older and disabled users' access to material, it is crucial

to follow these rules. To gauge and test whether the contents adhere to the rules or not, however, is challenging.

The Web Content Accessibility Guidelines 2.0 (WCAG 2.0) offers a wide range of recommendations for making Web content more accessible. In order for everyone to use a website, it must include material that is perceivable, operable, comprehensible, and robust (Rmen & Svanaes, 2012). WCAG 2.0 has four broad accessibility principles, 12 recommendations, and 61 success criteria with three degrees of conformance: A (lowest), AA, and AAA (highest).

The Web Content Accessibility Guidelines 1.0 (WCAG 1.0) and WCAG 2.0 are among the most essential and comprehensive guidelines in satisfying the accessibility needs on the Web and complying with the legislation as mentioned. These guidelines explain how web developers can make their sites and web applications accessible to persons with impairments, and they are founded on four principles as shown in Table 1.

Table 1: Principles of WCAG 2.0

No.	Item
1.	Perceivable a.Provide text alternatives for nontext content. b.Provide captions and other alternatives for multimedia. c.Create content that can be presented in different ways, including assistive technologies, without losing meaning. d.Make it easier for users to see and hear content.
2.	Operable a.Make all functionality available from a keyboard. b.Give users enough time to read and use content. c.Do not use content that causes seizures. d.Help users navigate and find content.
3.	Understandable a.Make text readable and understandable. b.Make content appear and operate in predictable ways. c.Help users avoid and correct mistakes.
4.	Robust a.Maximize compatibility with current and future user tools.

Moreover. the World Wide Web Consortium's (W3C) Web Accessibility Initiative (WAI) has established a number of techniques, guidelines, and tools to assist in making the Web accessible to people with disabilities10. WAI provides a worldwide venue for collaboration between industry, disability organisations, accessibility researchers, government, and other online accessibility stakeholders.

The W3C procedure has released a set of web accessibility recommendations (Internetsociety.org). Web accessibility is not a single activity; it is made up of a number of components, each of which can be improved significantly:

- Web content: refers to any part of a website, including text, images, forms and multimedia, code or mark-up that defines structure, presentation, scripts, applications etc.
- User agents: refer to software that is used by people (users) to access web content, including desktop graphical browsers, voice browsers, mobile phone browsers, multimedia players, plug-ins, and assistive technologies etc.
- Authoring tools: refer to software or services that are used by people (users) to produce web content and websites, including code editors, document conversion tools, content management systems, blogs, database scripts etc.

2.2 Web accessibility in Malaysian context

In the context of Malaysia, the Multimedia Development Corporation (MDeC) has established many web accessibility standards based on WCAG 2.0 in the form of Provider-Based Evaluation (ProBE) 2015. For all government websites, including public universities, there is a Self-Assessment Manual. Despite the fact that accessibility is a non-mandatory criterion, it is necessary to boost online usage and improve user experiences.

Websites must meet the requirements of Level A of the Web Content Accessibility Guidelines (WCAG) 2.0 in order for a disabled person to utilise them. Most policies require WCAG compliance at the AA level, which means that most policies do not require the highest level of accessibility (Gartland et. al, 2022).

2.3 Web accessibility: Past Studies

Few studies have been conducted on web accessibility in Malaysian context of learning organizations. Abdullah Alsaeedi (2020) examined first how well web accessibility evaluation tools performed in identifying WCAG 2.0-based web accessibility issues, and then it assessed how well websites adhered to these standards. Two well-known web accessibility assessors, WAVE and SiteImprove, were chosen to assess the performance of six Saudi university homepages. The results demonstrated that SiteImprove performed better than WAVE. The results of the study also revealed that Taibah University's homepage is easier to reach than the homepages of other Saudi universities. The framework can be used by web administrators and developers to gauge how accessible their websites are based on the study's findings.

Abuaddous, Jali, and Basir (2013) assessed the accessibility of Malaysian public higher education websites by comparing accessibility results from 2012 and 2013 using three accessibility tools: Accessibility Check, ACHECKER, and TAW Online automated tools, all based on the Web Content Accessibility Guidelines (WCAG) 1.0. The findings indicate that none of the websites investigated were totally accessible with room for improvement. Similarly, Aidi Ahmi and Rosli Mohamad (2015) evaluates the accessibility of the 20 public universities in Malaysia based on the Web Content Accessibility Guidelines (WCAG) 2.0 and Section 508 of the United States Rehabilitation Act. The result suggested that although there are some improvements have been made as compared to the findings from the previous studies, some actions need to be taken to ensure that the universities websites are accessible to everyone regardless of their ability, constraint and limitation. Among the issues that are important to be highlighted include distinguishability, keyboard accessibility, navigability, adaptability and text alternative for non-text elements.

In addition, using the ACHECKER and WAVE tools, Ku Azhar Ku Saud (2017) examined the experience of 20 Malaysian public university libraries in dealing with web accessibility issues and evaluated the current state of web accessibility compliance of their website as outlined by WCAG 2.0 and Section 508, as well as the current state of web accessibility compliance of their website as outlined by WCAG 2.0 and Section 508 guidelines. The findings

indicated a low level of adherence to the criteria as written, and he concluded that while sharing material under an open access framework is critical for web accessibility, libraries' flexibility and competence must also be equal.

The literature shows the low adherence towards web accessibility standards in the learning organizations of Malaysia. Limited studies of web accessibilities are apparent for learning organizations in Malaysia especially with regards to Human Resource Development realms where staff training is concerned. The present study is to bridge the gap by producing Web Accessibility Framework toward enhancing Strategic Human Resource Development (SHRD) Delivery for Learning Organizations through investigating in depths the issues and solutions by consulting the web accessibility experts' insights.

2.4 Automated tools usage

When evaluating web accessibility with the help of professionals, bias may be present when identifying accessibility violations and impediments (Elkabani, I.; Hamandi, L.; Zantout, R.; Mansi, S.,2015). Although this method is more effective than automated evaluation at finding all accessibility problems, it takes more time (Grantham, J.; Grantham, E.; Powers, D. ,2012).

Testing with the assistance of users, such as users who are impaired, is another strategy. Finding accessibility problems while disabled persons interact with the content of websites is also known as user testing (Alayed,2018). Testing with the assistance of impaired users, is more expensive and effective than relying on experts' assessments [Grantham et al, 2012). Because of the constraints of these web accessibility evaluation, automated tools have been utilized.

The tools' success can be attributed to the fact that they can produce evaluation findings fast, are simple to use, and have excellent usability (Lujan-Mora, Navarrete, & Penafiel, 2014). In addition, automated tools that highly correspond to the applicable web accessibility standards/guidelines further enhance reliability and relevancy of the results generated. ACHECKER's driving principle has been to reach the largest audience possible. By making it available as open source software, it can continue to be used, researched, and improved upon as Web accessibility understanding and technology advance.

The automatic tool known as WAVE was created by WebAIM (2013) and allows users to enter the web address of an existing website. It seeks to assist web designers in assessing a particular webpage's accessibility and improving it (Martín, A.; Cechich, A.; Rossi, G. (2008). It includes icons on a webpage that let users and specialists check for potential accessibility problems. All of the light blue icons denote structural, semantic, or navigational aspects, while the red icons denote accessibility faults, the yellow icons alerts, the green icons accessibility features.

While automated tools are highly useful to objectively predict web accessibility, part of the results reported require human judgment or manual inspection of the web (Peters & Bradbad, 2010). Hence, interpretation of the results generated from an automated tool deserves careful scrutiny and should be interpreted within its limitations.

3.0 METHODOLOGY

The methodology employed was twofold; accessibility testing (experiment) and qualitative insights of a web master. Three phases were executed as follows; web accessibility testing via automated tools (ACHECKER and WAVE); challenges faced by the web master along with the recommendations for way forward.

3.1 Sampling

A homepage of a Malaysian public university was selected as a case study. A methodology employed by Al-Khalifa (2012), Alshamari (2016) and Rana et al. (2011) was to measure only a homepage. The reason behind selecting the homepages only is that they are indicators for other webpages and the starting points for visitors.

3.2 Automated Tools

Moreover, ACHECKER and WAVE were selected to measure the website performance. These checks were chosen because they are free, open source, and descriptive tools that include descriptions of accessibility concerns and pertinent criteria that have been violated. Evaluators can navigate accessibility concerns in the source codes and on the webpages using both tools.

3.3 Procedure

Two stages were executed namely web accessibility evaluation and interview session with the webmaster. ACHECKER and WAVE automated tools were utilised to gather the data.

4.0 RESULT AND DISCUSSION

4.1 Achecker

The ACHECKER automated tool were used to determine the violations of the university homepage. There are38 violations of Level A and 6 violations of Level AA. Table 2 shows the problem categories and total.

Table 2: University website categorization of total problems

# of accessibility problems	University Homepage	
ACHECKERS	Level A	Level AA
< 20		6
21-25		
26-30		
31-35		
36-40	38	
> 40		
Total	38	6

4.1.1 Level A

Level A of WCAG 2.0 consisted of 21 criteria.38 violations were faced by the homepage under six main categories. The six problems that were encountered in the university homepage could be listed as parsing, labels or instruction, headings and labels, link purpose, resize text and information and relationship. Fig 1 and Table 3 show the details of the violations.

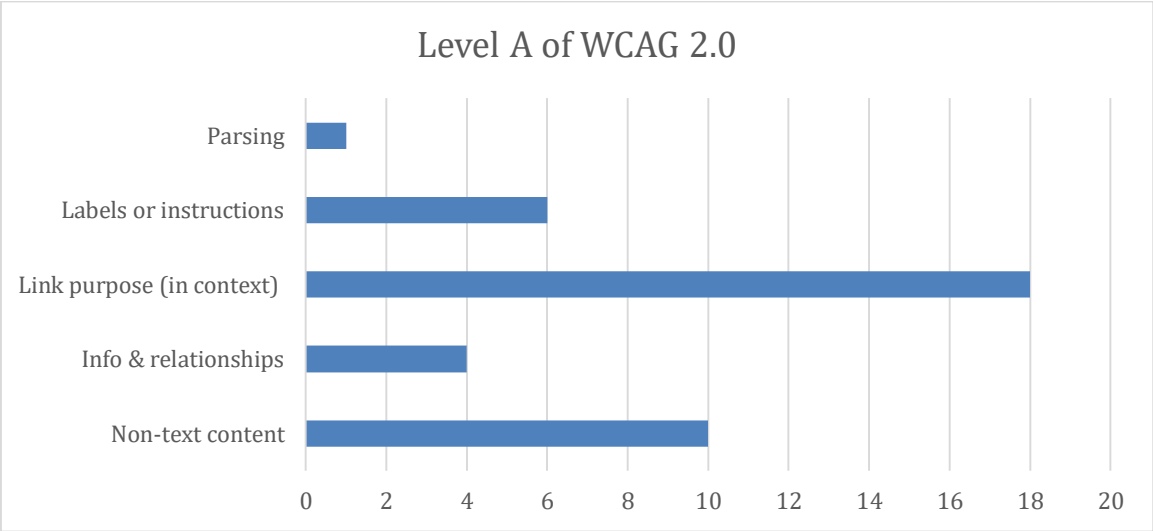

Fig. 1: Problems at level A of WCAG 2.0

Link purpose (in contact) was the highest violation with 17 items, followed by Non-text content with 10 items, Information& relationship and labels and instruction with 4 and 6 items respectively and parsing comprised 2 items. Table 3 illustrates the details of the problems at Level A.

Table 3: The problems at Level A.

1.1	**Text Alternatives: Provide text alternatives for any non-text content** **Success Criteria 1.1.1 Non-text Content (A)**
Check 7: Image used as anchor is missing valid Alt text. Repair: Add Alt text that identifies the purpose or function of the image.	
Check 1: img element missing alt attribute Repair: Add an alt attribute to your img element.	
1.3 Ensure that information and structure can be separated from presentation **Success Criteria 1.3.1 Info and Relationships (A)**	
Check 213: input element, type of "text", has no text in label. Repair: Add text to the input element's associated label that describes the purpose or function	
Check 57: input element, type of "text", missing an associated label. Repair: Add a label element that surrounds the control's label. Set the for attribute on the label elem as the id attribute of the control. And/or add a title attribute to the input element. And/or create a la contains the input element.	
Check 208: Label text is empty for select element. Repair: Add text to the label associated with the select element.	
2.4 Navigable: Provide ways to help users navigate, find content, and determine where they are. Success Criteria **2.4.4 Link Purpose (In Context) (A)**	
Check 174: Anchor contains no text.	

Repair: Add text to the a element or the title attribute of the a element or, if an image is used within to the image.

3.3 Input Assistance: Help users avoid and correct mistakes.
Success Criteria 3.3.2 Labels or Instructions (A)

Check 188: Label text is empty. Repair: Add text to the label element.

4.1 Compatible: Maximize compatibility with current and future user agents, including assistive technologies. Success Criteria 4.1.1 Parsing (A)

Check 185: id attribute is not unique.
Repair: Modify the id attribute value so it is unique.

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4.1.2 Level AA

Level AA of WCAG 2.0 consisted of 13 criteria. 6 violations were detected pertaining to headings and label and resize concerns. Figure 2 shows the violations.

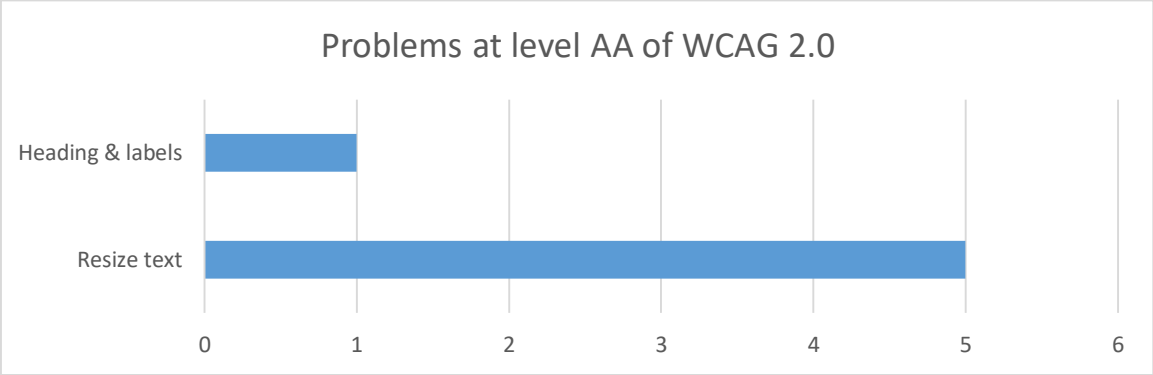

Fig 2: Problems at level AA of WCAG 2.0

4.2 Wave

The summary of the web accessibility findings produced by WAVE, a tool integrated into the Google Chrome browser, can be found in Table 6. By inserting icons and indicators into the page, this tool gives visual feedback regarding how accessible the web content is. The browser was used throughout the entirety of the analysis. WAVE compares accessibility problems based on WCAG 2.0 (Level A), WCAG 2.0 (Level AA), by analysing web accessibility mistakes, alerts, features, structural components, HTML5, and Accessible Rich Internet Applications (ARIA) as illustrated in. Fig. 3.

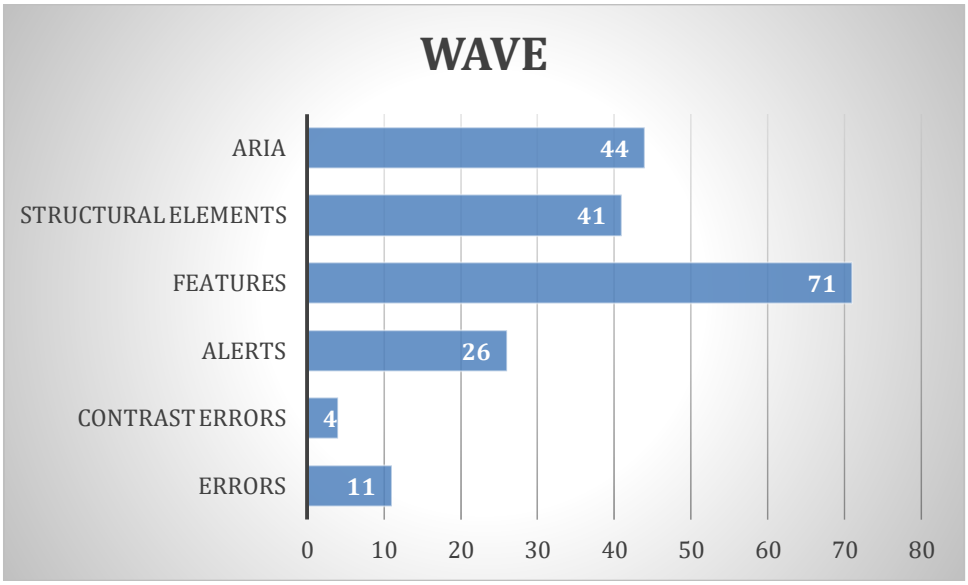

Fig 3: Violations of features in WAVE

Based on the WAVE report, Null empty alternative text dominated the violation of features, followed by ARIA labeling and heading

4.3 Discussion

ACHECKER analysed the web's accessibility using the WCAG 2.0, Level A and AA standards. The significant amount of faults detected for each test level is partially due to ACHECKER's usage of the latest, highly comprehensive standards, WCAG 2.0 (Adepoju & Shehu, 2014). Contrary to Aidi Ahmi & Rosli Mohamad (2016) that found three institutions reported conditional passes, one of the websites evaluated for the present study did not pass the lowest accessibility test specified in WCAG 2. 0 (Level A). Hence, through three-year gap, the website tends to violate the standard criteria of the web accessibility.

Finding the common accessibility problems in relation to the four guiding principles is crucial. Al-Faries et al. (2013) noted that the operable principle's 2.4 is the most frequently broken rule. Additionally, the experiment's results demonstrated that 2.4 is the rule that is most frequently broken, particularly the 2.4.4 criterion, thus verifying the current findings. The purpose of guideline 4.1 in relation to the robust accessibility principle is to facilitate interoperability with assistive devices like screen readers. The results of the experiment revealed that the 4.1.1 criterion is often violated less frequently than other criteria.

The specifics of the issues that WAVE found and that the website administrator needs to fix right away are an empty link, or a link provided on the website but with no text, deemed the most frequent error among the websites. Several other investigations (Adepoju & Shehu, 2014; Shawar, 2015) corroborate this. The webmaster must include text describing the link's functioning and/or target within the link in order to correct this mistake.

Missing alternate text for photos is another common cause of errors. In essence, an alternative text serves as a textual substitute for non-text content on a website and obstructs accessibility, particularly for screen-reader users (WebAim, 2013) as the ability of a sighted reader to select the text to focus on at any time is essential to visual design (Barreto, 2008, Edwards 2008).

The literature shows that this type of error is common in all the homepages. The importance of adding descriptive text for links is to aid people using a screen reader, Braille, or a text browser to distinguish different links. Web developers should ensure that elements receiving keyboard focus are highlighted on focus. It is vital to find the common accessibility issues with respect to

the standard guidelines. Regarding the robust accessibility principle, guideline 4.1 is intended to support compatibility with assistive technologies such as screen readers and this web page has adhered to the standard to some extent. Other violations such as empty link and empty heading are very common in all the homepages.

5.0 CONCLUSION

In conclusion, most violation for both tools ACHECKERS and WAVE are empty heading errors, which means there are heading tags, but the text is empty. The web page fails to add alternative text for image links. However, both tools express these errors using different warning messages. These errors violate two criteria, 1.3.1 and 2.4.4, according to the ACHECKERS. In terms of WAVE it is shown through Features, errors and ARIA labels. It is apparent that most links do not contain text and are considered by WAVE as accessibility errors. In short, the studied homepage has accessibility issues including missing alt text for images, empty links, headings without content, and image links without alternate texts. A fascinating future extension of the study would be to create online databases with all potential web accessibility violations and the associated error messages generated by all tools for each potential violation. This might be updated by the designers of web accessibility checkers. Following the development of such a database, we might train various classifiers, such as support vector machines, to consider all probable errors as well as their intended categories, which include perceivable, operable, understandable, and resilient. The classifier will therefore be able to categorise any accessibility.

ACKNOWLEDGEMENT

We would like to express our gratitude to Universiti Teknikal Malaysia Melaka for funding this research through university grant of PJP/2022/TD/IPTK/S01835.

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