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EVALUATING THE ACCESSIBILITY OF KUWAITI E-GOVERNMENT WEBSITES

Iyad Abu Doush[1] and Zainab AlMeraj[2]

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ABSTRACT

Nowadays, the Web is used as a medium for providing different kinds of services for people. The needs of people with disabilities have to be taken into consideration when developing E-government. The objective of this work is to evaluate the Web accessibility issues facing people with disabilities in Kuwait in an attempt to identify problems, enhance government awareness and promote inclusion. In order to evaluate the accessibility of E-government services in Kuwait, we apply automatic and expert evaluation on the top 17 E-government services used in 2018 in Kuwait. The obtained results show that 13 of the evaluated E-services are impossible to use and thus reveal a serious weakness in adhering to the Web Content Accessibility Guidelines (WCAG) 2.0 level A for most of the evaluated websites. In addition, the study shows the importance of following the task-based approach when evaluating the accessibility of the websites, as navigation between different pages when completing each task can help in discovering other accessibility issues.

KEYWORDS

E-government Services, Accessibility, Blind, People with Disabilities, Web Accessibility Evaluation.

1. INTRODUCTION

Web accessibility means that people with disabilities can perceive, understand, navigate, interact with and contribute to the Web regardless of age or ability [1]. Accessibility encompasses all disabilities that affect access to the Web, including visual, auditory, physical, speech, cognitive and neurological disabilities.

The increased use of Information and Communication Technologies (ICT) and the affordable Internet access has engaged governments around the world to provide their citizens, residents, visitors and businesses with online services through government portal [2]. According to Taewoo Nam [3], there are five types of E-government uses which are: service use, general information use, policy research, participation and co-creation. The world development report [4] mentions that the benefits of providing E-government services include stable relations with citizens, better delivery, savings and more efficiency.

The World Wide Web Consortium (W3C) is an organization for standardization of the Web. W3C developed a set of accessibility recommendations called Web Content Accessibility Guidelines (WCAG 2.0). These guidelines provide a set of recommendations for Web developers to provide a Web content which can be accessed by people with different kinds of disabilities. Another set of recommendations and guidelines is introduced in Section 508. It demands that the electronic information for the US government must be accessible to people with disabilities.

To achieve universal digital access, the Web Accessibility Initiative (WAI) established a set of guidelines to help make the Web accessible for people with disabilities, later called the Web Content Accessibility Guidelines (WCAG) in 1999. Since then, WCAG have been used as standards for developing accessible Web content. The standards start with version 1.0 (i.e., WCAG 1.0) which focuses on HTML. After that, the standard was updated in 2008 to WCAG 2.0 by focusing on generic digital assets instead of a specific technology. Lately in 2018, WCAG 2.1 was introduced to add success criteria that are not in WCAG 2.0. As mentioned by W3C[1], "WCAG 2.1 does not deprecate or supersede WCAG 2.0".

[1] https://www.w3.org/WAI/standards-guidelines/wcag/

1. I. Abu Doush is with Department of Computer Science and Information Systems, American University of Kuwait, Salmiya, Kuwait and Department of Computer Sciences, Yarmouk University, Irbid, Jordan. E-mail: idoush@auk.edu.kw
2. Z. AlMeraj is with Department of Information Science, Kuwait University, Adailiya, Kuwait. E-mail: z.almeraj@gmail.com

The countries across the globe provide E-government to enhance transparency and allow faster and easier interactions between citizens. However, the efficiency and accessibility of these E-government services have been investigated to provide equal access to all country citizens [2]. Based on the United Nations E-government report, Kuwait is ranked 40th out of 193 countries in the development index and 55th out of 193 countries in the E-participation index.

The State of Kuwait launched the Kuwait Government Online portal (https://www.e.gov.kw) through the Central Agency for Information Technology (CAIT) to provide information and services to all citizens, residents and visitors in addition to the governmental and business sectors. The portal is reachable through the Web or mobile platforms and lists usage statistics, news, announcements, laws and regulations. Since its establishment, the government has been committed to achieve a usable working government portal to encourage citizens' participation and to empower all those living and residing in Kuwait. The government has been further motivated to achieve the realization of efficient E-government to fulfil the New Kuwait Vision 2035, announced in 2016, which entails areas contingent on ICT and cloud-based technologies [5].

Previous studies have shown that accessibility in E-government in the Middle East and the Gulf Cooperation Council (GCC) region suffers from several weaknesses. The main challenge facing the E-governments in Kuwait, Qatar and UAE is the lack of knowledge of Web accessibility standards among Web developers [6]. Saleem [6] tested 10 different sites and checked their conformance to the accessibility standard (WCAG 2.0). The results show after testing five pages from 10 Kuwaiti government websites that the percentage of error is 93%.

The total number of registered people with disabilities in Kuwait in 2016 is 51,243[2]. The inclusion of people with disabilities by offering them different services is essential to ensure their financial security and engagement with society, as well as to promote independence [7]. Kuwait is among the countries which signed the UN convention on the Rights of Persons with Disabilities (CRPD) [8]. In addition, the country has its own disability law to protect and support people with disabilities [9].

Kuwait is currently working on achieving Kuwait 2035 Vision through the ratification of the UN CRPD for people with disabilities and achieving 17 of the UN Sustainable Development Goals (SDG) [10] through the following:

1. Enhancing human capacities and institutional effectiveness for prevention, early detection, diagnosis and rehabilitation of disabilities.
2. Removing barriers to social, economic and educational inclusion of people with disabilities.
3. Increasing technical expertise and organizational capacities for the implementation of universal design and countrywide use of technology enablers [11].

In pursuit to achieve this vision, the General Secretariat of the Supreme Council for Planning and Development (GSSCPD) in collaboration with Public Authority for Disabled Affairs (PADA) and the UNDP have publicly announced the Kuwait National Framework for Digital Accessibility in May 2018 based on international standards with the aim of transforming the Kuwaiti digital environment into a qualified and supportive environment for people with disabilities [10].

This paper evaluates a set of commonly used government E-services using two approaches; multiple automatic tools and task-based expert reviews. The results will further help in promoting equality, inclusion, awareness, learning and implementation of local and international accessibility standards.

In this study, a task-based approach is used in which different pages are navigated in order to evaluate the accessibility of the provided E-service. This help in checking the accessibility of the provided E-service in a situation similar to what the user encounters in real life. Furthermore, this enables checking the ease of navigation between the pages when the user is completing the service.

The rest of the paper is organized as follows. We first give a brief overview of related work (Section 2). We then present our methodology (Section 3). After that, we present and discuss the findings (Section 4). Finally, we present conclusions and discuss opportunities for future work (Section 5).

[2] http://www.pada.gov.kw/

2. RELATED WORK

Government websites enable citizens to easily interact with them through efficient platforms that host public information and services. To access these E-services, people with disabilities use computers with specialized software commonly called assistive technologies. Screen readers are the most popular type of assistive technology for users with visual impairments [12]. Those with hearing impairments, cognitive disabilities and motor skill impairments may require other technologies, such as voice browsers, special joysticks or trackballs [49].

Many studies have investigated the accessibility of government websites. One form of evaluating accessibility involves benchmarking website designs and functionality with WCAG 2.0 guidelines. These guidelines and success criteria are organized around four principles to allow access and use of Web content [13]:

1. Perceivable - Information and user interface components must be presentable to users in a way that they can perceive. This means that users must be able to acquire the presented information through their senses.
2. Operable - User interface components and navigation must be operable. This means that users must be able to operate the interface (i.e., the interface cannot require interaction that a user cannot perform).
3. Understandable - Information and the operation of user interface must be understandable. This means that users must be able to understand the information as well as the operation of the user interface. For example, the information sequencing is meaningful to the user or the presented information allows the user to complete the required action.
4. Robust - Content must be robust enough so that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.

The most common means of accessibility evaluation is the use of automatic tools to check whether or not the Web pages follow the WCAG 2.0 guidelines. The most popular automatic tools include AChecker, HTML Validator, CSS Validator, APrompt, Cynthia, Says and EvalAccess 2.0 [50]. These tools differ in their criteria from effciency to conformance levels (A, AA and AAA). In WCAG, the success criteria for level A are easy to meet and do not affect the website design or structure. On the other hand, levels AA and AAA are more strict and require more work [51]. Because of this, we selected level A in our evaluation which represents the minimum level of accessibility requirements.

In an automatic evaluation study [14], the authors analyzed the usability, accessibility and vulnerability of 61 Turkish E-government websites using six automatic tools that assess navigation, HTML errors, content quality, conformance to W3C standard and compatibility. Their results show that E-government websites did not conform to international standards despite efforts made towards implementing a Web accessibility policy issued by the government in 2001. It is important to improve design features of E-government websites to be more effective and user-centric [14].

Similar studies have been conducted with variations of automatic tools for multiple governments, such as Ghana by Yaokumah et al. [15], Kenya by Wanyonyi Kituyi and Waweru [16], Saudi Arabia by Al-Faries et al. [17], Jordan by Doush et al., among others [18]-[19], [52]-[53], Dubai by Mourad and Kamoun [20] and Kamoun and Almourad [21] and Korea by Park [22] with similar outcomes suggesting the need to improve website accessibility. A cross-continent study by Patr et al. [23] evaluated 15 Asian government websites and found overwhelming evidence of lack of accessibility awareness and implementation.

In a multilingual study [24], ten E-government websites from the Arab world were evaluated in English and Arabic using four automatic evaluation tools; SortSite, TAW, AChecker and WAVE. Its findings include noticeable un-explained differences between accessibility scores of Arabic *versus* English websites. The authors discussed the importance of choosing the right tool for the right evaluation test and the adjustment of government regulations to include rules and guidelines for developers and managers.

A total of 302 Indian universities' websites are evaluated using automatic accessibility evaluation tools in [25]. After that, the websites are classified into poorly accessible websites, intermediately accessible websites and highly accessible websites.

In an effort to check enhances in conformance levels with WCAG 2.0, Al-Khalifa [26] evaluated the accessibility of the Arabic version of 34 Saudi government websites in 2010 and re-evaluated them in 2016 [27]. Each homepage was inspected using the WAVE and Web developer evaluation toolbars. In the 2010 evaluation, it was found that no website followed the minimum guidelines set by WCAG 2.0. But after enforced regulations on E-readiness and accessibility in 2016, remarkable improvements were noticed.

Some accessibility evaluators tested accessibility using automatic quantitative metric scores such as the work conducted by Vigo et al. [28]. They tested seven website accessibility metrics and showed that three of them; namely, accessibility quantitative metric, page measure and Web accessibility barrier produce higher quality assessments than the others. Relying solely on these kinds of scores does pose an issue for evaluation as we discuss later.

Akram and Sulaiman [29] discussed accessibility issues on Saudi Arabia E-government websites. The authors identified Web accessibility issues of government and university sites across the country and stated that it is not enough to just check WCAG 2.0 conformance and that more effective standards need to be identified. According to AkgUL and Vatansever [30], human judgment is needed to provide an accurate evaluation of Web accessibility. Automatic tool evaluations, for example, cannot give a full picture of the interaction between Web contents and assistive technology; they cannot detect all violations and can therefore result in false positives and false negatives [21].

Other forms of accessibility evaluations include expert reviews, end-user testing, Web developer surveys and combinations of the latter commonly referred to as multi-method approaches. In a multi-method approach [31], the authors provided an accessibility evaluation of 100 federal home pages using both human and automated methods to check conformance to Section 508 [32] accessibility guidelines. Using two methods, they found a better understanding of the limitations and suggested improving policy related to Section 508 compliance for websites for better accessibility.

Another study by Jaeger [33] used a different multi-approach method which combines policy analysis, expert testing, user testing, automated testing and Web developer questionnaires with the aim of using each result to present an accurate presentation of the accessibility status.

In the Malaysian study by Hanapi [34], one automatic tool and a survey were adopted to understand E-government Web developers' awareness of accessibility guidelines. More recently, Doush et al. [18] performed three evaluation methods to get a deeper understanding of how to enhance accessibility in Jordan. They recruited 20 blind users to test the accessibility of nineteen E-government websites, distributed a survey to E-government Web developers and recruited two experts to test all websites for a complete assessment. Their findings suggest a lack of awareness, understanding and adoption of accessibility guidelines.

E-government websites in three Gulf Cooperation Council (GCC) countries: UAE, Kuwait and Qatar have been studied by Saleem [6]. The author used case studies, automated website assessments, manual assessments and document analysis. He found that the Arabic language accessibility resources and tools were causing limitations in providing accessibility. In a follow-up study by Saleem [35], he went on to further develop and implement an Arabic accessibility resource of guidelines for Arabic speaking Web developers. A similar approach was used for localizing Web accessibility content of Arabic university websites in Saudi Arabia by [36].

E-government evaluations have also brought together testing of accessibility and usability of websites. The investigation by Al-Faries et al. [17] evaluated the accessibility of 20 E-government websites using automatic tools and went on to evaluate the usability of the same websites using expert reviews. In this work, we conduct a multi-method approach using five automatic tools followed by expert reviews in an effort to identify the extent of accessibility problems facing people with disabilities when searching for information and E-services on the Kuwait government portal.

3. METHODOLOGY

3.1 E-government Web Site Selection

There are sixty-one organizations listed on the Kuwait E-government website portal as of May 2018 [37]. The total number of E-government services offered was 1902 services which are splitted between

909 E-services and 993 informative services. The websites selected for the study were chosen from a list of the top 20 E-services in 2018 collected from the Central Agency for Information Technology[3]. In Kuwait, each government agency has its own website with same E-service that Kuwaiti government online portal provides, but in different style and format. The E-services in the government agency websites have not been tested.

The top 17 E-services in the list are used as a sample for the Kuwaiti E-government evaluation (see Table 1). Note that N/A in the table is for the unavailable tasks which are 3, 6, 10, 11, 15, 16 and 17. This is because either the service was unavailable (3, 6, 11 and 16) or the service link was not found (10, 15 and 17) using the search box or by looking into the service links in the government portal homepage.

There are mainly five types of E-government services; service use, general information use, policy research, participation in decision-making and co-creation of policies, information and services with government and other citizens [3]. The type of the service is listed in the table as well as the number of tested pages. The number of tested pages represents how many pages are needed to complete the service by the expert when evaluating the service.

In addition to these E-services, we evaluated the homepage of the Kuwaiti government online portal[4]. The English version of each of these websites was chosen for the evaluation as a preliminary step in this investigation. Future work will include evaluating the Arabic versions.

Table 1. The top seventeen E-services of the Kuwaiti E-government for the year 2018, highlighted rows are for unavailable services.

No.	E-service	Government agency	No. of tested pages
1	Inquiring about Civil ID Status	Public Authority for Civil Information	2
2	Violation Payment (Traffic & Immigration)	Ministry of Interior	3
3	Inquiring about lawsuits filed against you	Ministry of Justice	N/A
4	Inquiring about phone bill and E-payment	Ministry of Communication	4
5	Electricity and water bills enquiry and E-payment	Ministry of Electricity and Water	4
6	Renew work permit	Public Authority of Manpower	N/A
7	Request appointment for food checkup	Ministry of Health	3
8	Mobile bill payment and recharge services	eNet Company	4
9	Results of staff inward and outward transfer	Ministry of Education	3
10	Inquiry into status of an application (altarasul system)	Civil Service Commission	N/A
11	Reserve a hall	Ministry of Social Affairs and Labor	N/A
12	Multi-civil renewal and payments	Public Authority for Civil Information	3
13	Inquiring about travel ban	Ministry of Interior	1
14	Personal inquiry about MOI	Ministry of Interior	4
15	Civil ID fines E-payment	Public Authority for Civil Information	3
16	Inquiring about travel violations	Ministry of Interior	3
17	Inquiring about arrest warrants	Ministry of Justice	N/A

[3] We would like to thank Mrs. Nadia AlKhalifa, Statistics Department, CIAT for providing this information.
[4] https://www.e.gov.kw/sites/kgoEnglish/Pages/HomePage.aspx

3.2 E-government Website Accessibility Evaluation

In order to evaluate the Web accessibility of the selected Kuwaiti E-government services, we used multiple automatic tools and expert reviews. In addition, we tested the conformance of the E-services to the HTML and CSS standards. Note that the Kuwaiti E-government services are evaluated using a personal computer (PC).

3.2.1 Automatic Tools

As mentioned in Section 2, there are several automatic tools that can be used for Web accessibility evaluation. We selected three automatic evaluation tools; AChecker, Total Validator and WAVE jointly to overcome any drawbacks of a single tool use, as mentioned in [38]. The study by Bazeem et al. [39] investigated 23 evaluation methods and favored the results of the Web Accessibility Checker (AChecker) over the other tools.

We use AChecker [40] to automatically evaluate the selected E-government websites. AChecker can be used to check the website conformance to standards and guidelines, such as WCAG 1.0, WCAG 2.0 and Section 508. The tool classifies the recognized problems into the following: known problems (these are certain accessibility barriers), likely problems (these are probably accessibility barriers), and potential problems (these need a human decision). In order to share accurate results, we only presented the known problems detected for WCAG 2.0 with a level of conformance and left the others for expert interpretation.

The second tool used in our evaluation is Total Validator [41] with the basic feature settings. The tool can check the accessibility against the standards WCAG 1.0, WCAG 2.0 and Section 508 as shown previously in [27]. Lastly, we determine the level of Accessible Rich Internet Applications (ARIA) standards usage of the evaluated websites using a third online tool called WAVE [42]. WAVE is utilized to find the number of ARIA features in the evaluated website, errors, contract errors and structural elements. Note that in the automatic tool evaluations the first Web page of the used service is evaluated and it is the E-service URL shown in Table 3.

3.2.2 HTML and CSS Validation

HTML and CSS code validation refers to comparing Web page scripts against syntax rules and standard specifications. The validation of hypertext markup language (HTML) is considered one of the main steps of evaluating Web accessibility according to researchers [43]. Assistive technologies rely on these standards when accessing HTML and cascading style sheets (CSS) [44].

In addition to the automatic evaluation tools, we validate the websites selected using the HTML markup validation service[5] and CSS validator service[6]. These two services are available for free from World Wide Web Consortium (W3C).

3.2.3 Expert Reviews

Many of the accessibility problems cannot be identified using automatic tools (e.g., inaccessible Captcha). In order to investigate the accessibility problems deeply, we use expert evaluation. Expert evaluation can be applied by examining the code of the Web page to look for accessibility problems or the evaluator can simulate the user usage of the E-service by completing a specific task. In this study, we apply a task-based expert review to mimic the challenges encountered by the users when they use the E-services. The experts are the two authors of the paper who have expertise in Web accessibility guidelines.

The evaluated tasks are shown in Table 1. The experts did a walk-through of each website to complete the defined tasks in a similar process adopted by the experts' review in [18]. In order to identify the accessibility problems in the website, the tasks are completed using NVDA screen reader[7] using the English language. NVDA screen reader is selected to perform the evaluation, because it is free and it is one of the most popular screen readers [48].

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[5] https://validator.w3.org/
[6] https://jigsaw.w3.org/css-validator/
[7] https://www.nvaccess.org/

Table 2. The success criteria for level A used in the manual evaluation.

No.	Success criteria	Criteria (all level A)	No.	Success criteria	Criteria (all level A)
1	1.1.1	Non-text Content	14	2.3.1	Three Flashes or Below Threshold
2	1.2.1	Audio-only and Video-only (Prerecorded)	15	2.4.1	Bypass Blocks
3	1.2.2	Captions (Prerecorded)	16	2.4.2	Page Titled
4	1.2.3	Audio Description or Media Alternative (Prerecorded)	17	2.4.3	Focus Order
5	1.3.1	Info and Relationships	18	2.4.4	Link Purpose (In Context)
6	1.3.2	Meaningful Sequence	19	3.1.1	Language of Page
7	1.3.3	Sensory Characteristics	20	3.2.1	On Focus
8	1.4.1	Use of Color	21	3.2.2	On Input
9	1.4.2	Audio Control	22	3.3.1	Error Identification
10	2.1.1	Keyboard	23	3.3.2	Labels or Instructions
11	2.1.2	No Keyboard Trap	24	4.1.1	Parsing
12	2.2.1	Timing Adjustable	25	4.1.2	Name, Role, Value
13	2.2.2	Pause, Stop, Hide			

The experts' evaluation process occurred between 1/May/2018 and 25/May/2018 and is based on WCAG 2.0 level A, as shown in Table 2. The experts were asked to identify the following measures when completing the task: time to complete, violating the success criteria, number of tabs and difficulty level. Note that if the evaluated content does not have a content that matches a success criterion, the success criteria are assumed to be satisfied as suggested by the W3C "Understanding Conformance"[8] document. For example, audio-only and video-only success criteria are not found in the evaluated content. As a result, these success criteria are recorded as satisfied.

In order to provide a perspective of the tested task, time is measured from the starting of the task until completing the task. The time needed to finish the evaluation of each task can help in measuring the task efficiency in web accessibility [47]. The common accessibility problems are investigated by identifying the violated success criteria and pointing out the reason for the problem. The number of keyboard tabs needed to complete a specific task is used as one of the indicators of the obstacles that hinder users who navigate the Web only using the keyboard from completing a task [18]. As the number of tabs increases, the degree of difficulty increases when trying to complete a given task. The difficulty level can take four different values: easy, medium, difficult and impossible.

4. Evaluation and Discussion

4.1 Automatic Tools

The following are the evaluation results for the automatic evaluation tools ACheker and Total Validator. In both tools, we choose WCAG 2.0 level A conformance. The URLs of the tested government E-services are shown in Table 3. Figure 1 shows the number of failed success criteria for the evaluated tasks in Kuwaiti government portal using the two tools. As the figure shows, Total Validator detects more errors of WCAG 2.0 level A in the portal homepage than ACheker. On the other hand, ACheker detects more errors of WCAG 2.0 level A for task 14 than Total Validator. Such observation verifies the benefit of using more than one automatic tool to evaluate accessibility to overcome drawbacks of a single tool use [38].

Table 4 shows the failed WCAG 2.0 (level A, AA and AAA) success criteria for Kuwaiti governmental websites using ACheker automatic tool.

As the table shows, the homepage and the tasks 14 and 16 have the highest number of failed success criteria. Note that the tasks 3, 6, 10, 11, 15 and 17 are not validated, either because we could not find a

[8] https://www.w3.org/WAI/WCAG21/Understanding/conformance#levels

Table 3. The E-service URLs.

No.	Ministry	Task	E-service URL
		E-gov. Portal Homepage	https://www.e.gov.kw/sites/kgoEnglish/Pages/HomePage.aspx
1	Public Authority for Civil Information	Inquiring about Civil ID status	https://www.e.gov.kw/sites/kgoEnglish/Pages/eServices/PACI/CivilIDStatus.aspx
2	Ministry of Interior	Violation Payment (Traffic & Immigration)	https://portal.acs.moi.gov.kw/wps/portal/violations
4	Ministry of Communication	Inquiring about phone bill and e-payment	https://www.e.gov.kw/sites/kgoenglish/Pages/eServices/MOC/BillsQuery.aspx#
5	Ministry of Electricity and Water	Electricity and water bills enquiry and e-payment	https://www.e.gov.kw/sites/kgoenglish/Pages/eServices/MEW/InquiryAboutBills.aspx
7	Ministry of Health	Request appointment for food checkup	https://www.e.gov.kw/sites/kgoEnglish/Pages/eServices/MOH/FoodCheckup.aspx
8	eNet Company	Mobile bill payment and recharge services	https://www.e.gov.kw/sites/kgoenglish/Pages/eServices/Enet/MobilePayments.aspx
9	Ministry of Education	Results of staff inward and outward transfer	https://www.e.gov.kw/sites/kgoenglish/Pages/eServices/MOE/InternalExternalShifiting.aspx
12	Public Authority for Civil Information	Multi-civil renewal and payments	https://www.e.gov.kw/sites/kgoEnglish/Pages/eServices/PACI/CivilIDRenewal.aspx
13	Ministry of Justice	Inquiring about travel ban	https://www.e.gov.kw/sites/kgoEnglish/Pages/eServices/MOJ/BanTravel.aspx
14	Ministry of Interior	Personal inquiry about MOI	https://www.e.gov.kw/sites/kgoenglish/Pages/eServices/MOI/PersonalInquiry.aspx
15	Public Authority for Civil Information	Civil ID fines e-payment	https://www.e.gov.kw/sites/kgoEnglish/Pages/eServices/PACI/FinesEPayment.aspx
16	Ministry of Interior	Inquiring about travel violations	https://www.e.gov.kw/sites/kgoenglish/Pages/eServices/MOI/EnviolationPlateNumber.aspx

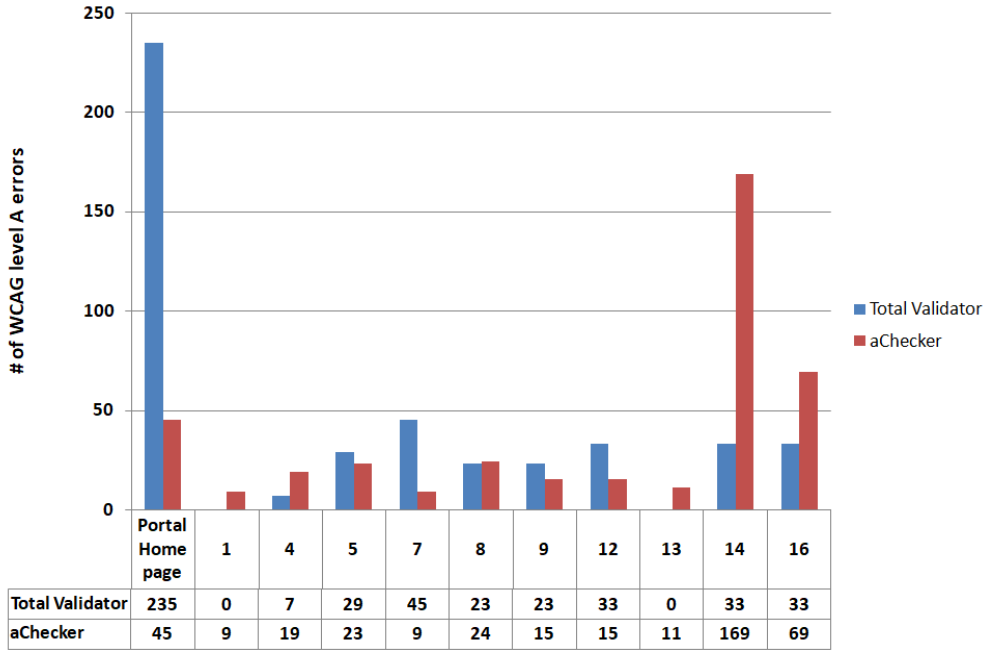

Figure 1. Failed WCAG 2.0 (level A) success criteria for Kuwaiti governmental websites using automatic tools.

Table 4. Failed WCAG (level A, AA and AAA) success criteria for Kuwaiti governmental websites using ACheker automatic tool.

			Known problems		
No.	Task Name	Ministry	A	AA	AAA
	E-gov. Portal Homepage		45	75	556
1	Inquiring about Civil ID status	Public Authority for Civil Information	9	24	327
4	Inquiring about phone bill and e-payment	Ministry of Communication	19	29	313
5	Electricity and water bills enquiry and e-payment	Ministry of Electricity and Water	23	37	331
7	Request appointment for food checkup	Ministry of Health	9	19	314
8	Mobile bill payment and recharge services	eNet Company	24	36	319
9	Results of staff inward and outward transfer	Ministry of Education	15	29	324
12	Multi-civil renewal and payments	Public Authority for Civil Information	15	26	332
13	Inquiring about travel ban	Ministry of Interior or Ministry of Justice	11	21	314
14	Personal inquiry about MOI	Ministry of Interior	169	179	346
16	Inquiring about travel violations	Ministry of Interior	69	79	326

link to the service or the access is prohibited. In order to investigate the usage of ARIA standards in the Kuwaiti government websites, the WAVE tool is utilized.

ARIA is usually used to enhance the Web content to be more accessible for screen reader users by placing landmarks, indicating the dynamically updated content and providing more semantic to the used Web widget through properties [45]. The results in Table 5 show that five (i.e., 50%) of the evaluated sites do not use ARIA standards.

4.2 HTML and CSS Evaluation

The conformance of the performed tasks to the HTML and CSS standards is verified using HTML and CSS validation services. Table 6 shows the total number of HTML and CSS validation errors in the evaluated Kuwaiti E-government services. The unavailable services are removed from the table. Note that the error "504 Gateway timeout" happened after providing the link to the online service and it seems that the requested page was not loaded successfully.

The total number of errors is calculated by validating HTML and CSS in each visited page when completing the defined task. We could not validate some of the tasks due to the inability to access the E-service; such errors are explained accordingly in the table.

As shown in Table 6, all the tasks have errors in HTML and CSS. The HTML validation errors range from 4 to 38 errors. On the other hand, the highest number of CSS validation errors is 129 and the lowest is zero. The Kuwaiti government portal homepage alone has 34 errors in both HTML and CSS. Such errors indicate a problem for the assistive technologies when they are utilized by people with disabilities to use the website.

4.3 Expert Review

The same set of tasks evaluated using automatic tools were evaluated by checking WCAG 2.0 level A

Table 5. The number of used ARIA in the evaluated Web pages. Highlighted rows are for unavailable.

No.	Task eService Name	Ministry	No. of Used ARIA
	E-gov. Portal Homepage		6
1	Inquiring about Civil ID status	Public Authority for Civil Information	7
2	Violation Payment (Traffic & Immigration)	Ministry of Interior	Error accessing page
3	Inquiring about lawsuits filled against you	Ministry of Justice	e-service unavailable
4	Inquiring about phone bill and e-payment	Ministry of Communication	0
5	Electricity and water bills enquiry and e-payment	Ministry of Electric and water	0
6	Renew work permit	Public authority of manpower	Server error 404 File or directory not found
7	Request appointment for food checkup	Ministry of Health	7
8	Mobile bill payment and recharge services	eNet company	0
9	Results of staff inward and outward transfer	Ministry of education	0
10	Inquiry into status of an application (altarasul system)	Civil Service Commission	No link to eservice found
11	Reserve a hall	Ministry of social affairs and labor	No link to e-service
12	Multi-civil renewal and payments	Public Authority for Civil Information	Error - page not publicly available
13	Inquiring about travel ban	Ministry of Interior	Error accessing page
14	Personal inquiry about MOI	Ministry of Interior	Error accessing page
15	Civil ID fines e-payment	Public Authority for Civil Information	2
16	Inquiring about travel violations	Ministry of Interior	0
17	Inquiring about arrest warrants	Ministry of Justice	Prohibited access

Table 6. Total number of HTML and CSS validation errors.

No.	Ministry	Task	# HTML errors	# CSS errors
		E-gov. Portal Homepage	34	34
1	Public Authority for Civil Information	Inquiring about Civil ID status	34	34
2	Ministry of Interior	Violations Payment (Traffic & Immigration)	I/O Error	504 Gateway timeout
4	Ministry of Communication	Inquiring about phone bill and e-payment	4	1
5	Ministry of Electricity and Water	Electricity and water bills enquiry and e-payment	38	0
7	Ministry of Health	Request appointment for food checkup	15	3
8	eNet Company	Mobile bill payment and recharge services	4	1
9	Ministry of Education	Results of staff inward and outward transfer	6	129
12	Public Authority for Civil Information	Multi-civil renewal and payments	I/O Error	I/O Error
13	Ministry of Justice	Inquiring about travel ban	I/O Error	504 Gateway timeout
14	Ministry of Interior	Personal inquiry about MOI	18	1
15	Public Authority for Civil Information	Civil ID fines e-payment	8	2
16	Ministry of Interior	Inquiring about travel violations	18	1

The experts were not able to complete the following tasks: 3, 6, 10, 11, 15 and 17 (see Table 1). This is because either the service was unavailable (3, 6 and 11; an example is shown in Figure 7) or the service was not found in the government portal (10, 15 and 17). Note that these tasks are removed from the results.

In each one of the tasks, the expert starts from the portal homepage and uses NVDA screen reader and keyboard only to complete the task. All the tasks require moving between different web pages. Some tasks need from the expert to fill text fields or forms. The task is considered completed when the expert receives the output from the service. The web browser Google Chrome is used to open the web pages.

Figure 2 presents the number of WCAG 2.0 failed success criteria for each task. The homepage of the government portal breaks three of the WCAG 2.0 level A success criteria, as shown in Figure 2, which are: "non-text content" as 15 images have no alternative text, "page titled" as the page title is not descriptive and "labels or instructions" as the text is spoken by the screen reader when the user reaches the search box on the Web page in a way that is not understandable (the screen reader reads the following text: "table L search e-payment civil employment insurance traffic electricity residency and immigration education service directory edit blank").

Figure 5 shows the percentage of WCAG 2.0 failed success criteria from all the evaluated tasks. Clearly, "non-text content" success criteria failed on all the tasks. In addition, "labels or instructions" success criteria failed for around 80% of the tasks. The following is a description of the reasons for failed success criteria:

- **On Focus**: the E-service page contains form elements and the focus is not inside the first element to insert the data (i.e., textbox). In addition, for all the E-services, the new page is opened in a new window when the user clicks the start E-service button.
- **Labels or Instructions**: the forms in the Web pages have no labels and the user cannot know what to enter. Also, when trying to submit the form information, inaccessible Captcha is required to continue the submission (Figure 6 is an example of this case).

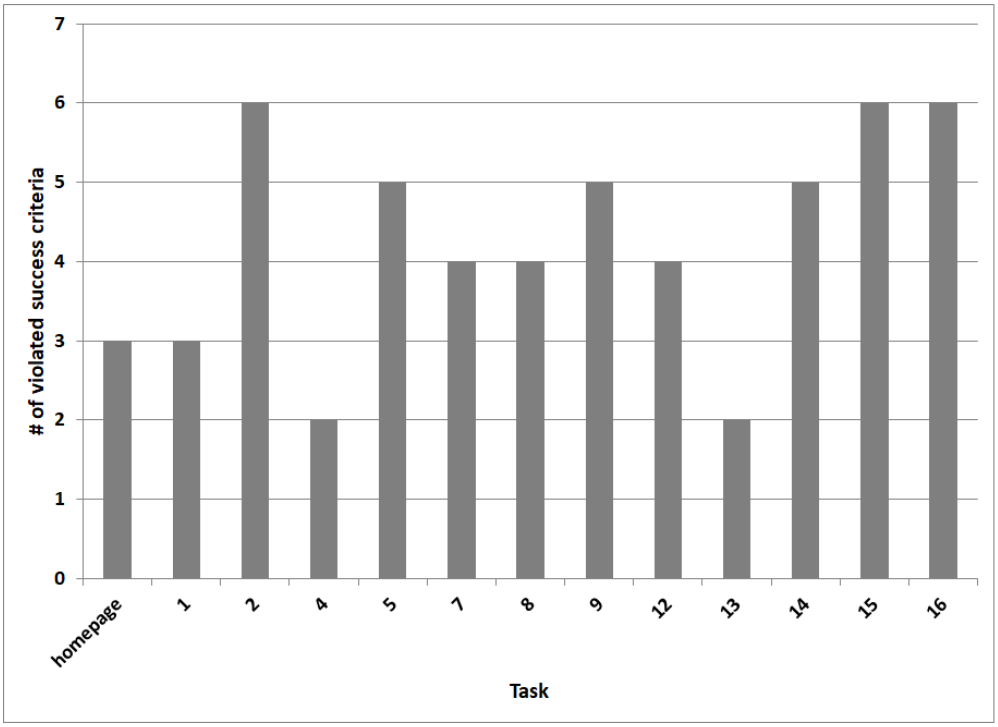

Figure 2. The number of violated guidelines per task using expert evaluation**.**

- **Meaningful Sequence**: when a link in the English section of the website takes the user to the Arabic homepage.

Figure 3. A link in the English site for the task violation payment (traffic & immigration) takes the user to the Arabic homepage.

- **Link Purpose**: for all the evaluated tasks, the button to start the service has a general label (i.e., Start E-service).
- **Keyboard**: the "Frequently Used" service tab found in different pages when performing the tasks is not accessible using the keyboard.
- **Page Title**: a large number of the Web pages when completing the tasks have a title that is general and does not describe the current E-service page.

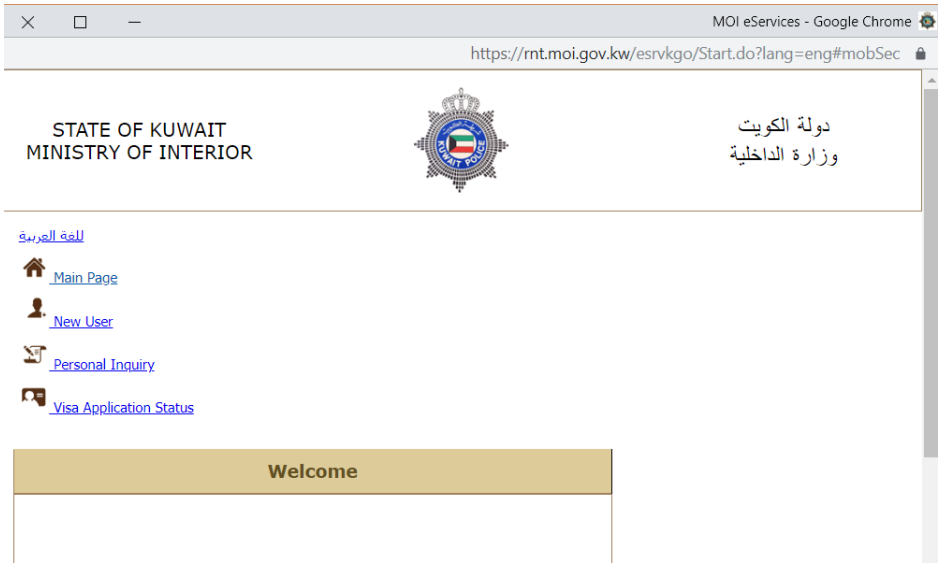

Figure 4. The E-service page for inquiring about travel violations with a general title which does not describe the E-service.

The experts' evaluation when performing different tasks based on time, the number of tabs and the difficulty when completing the tasks are shown in Table 7. The difficulty level in the Table takes the values: Medium (M), Difficult (D) and Impossible (I). Only four tasks out of the 17 are considered not impossible (i.e., 76% of the tasks are considered as impossible).

The task is rated as impossible in different situations which include: the service is not available (i.e., the service is down); the service is only keyboard accessible; while we are in the English site, it opens an Arabic page which cannot be read by screen reader; inaccessible Captcha needs to be used to

submit the form and no labels available for the form presented to the user. Table 8 summarizes the tasks that were found impossible and their percentage from all the impossible tasks (see Table 6 for task name).

On the other hand, Figure 2 shows the number of failed success criteria on each of the validated tasks by the experts.

Table 7. Time, number of tabs and difficulty of each task (row in bold font is for impossible task).

Task No.	Time	Number of tabs	Difficulty
1	4:10	28	M
2	**NA**	**NA**	**I**
4	**NA**	**NA**	**I**
5	**NA**	**38**	**I**
7	**NA**	**56**	**I**
8	2:40	31	D
9	**NA**	**32**	**I**
12	2:40	32	M
13	**NA**	**NA**	**I**
14	4:15	24	D
15	**NA**	**NA**	**I**
16	**NA**	**37**	**I**

Table 8. Analysis of impossible tasks (see Table 6 for task name).

Reason	Tasks	% from impossible tasks
The service is down or not available	3, 6, 10, 11 and 17	38%
The service is only keyboard accessible	4 and 13	15%
The English site opens an Arabic Web page	2, 5, 7, 9, 15 and 16	46%
Inaccessible Captcha needs to be used to submit the form	2, 7, 15 and 16	30%
The form has no labels	2, 7, 8, 9, 15 and 16	46%

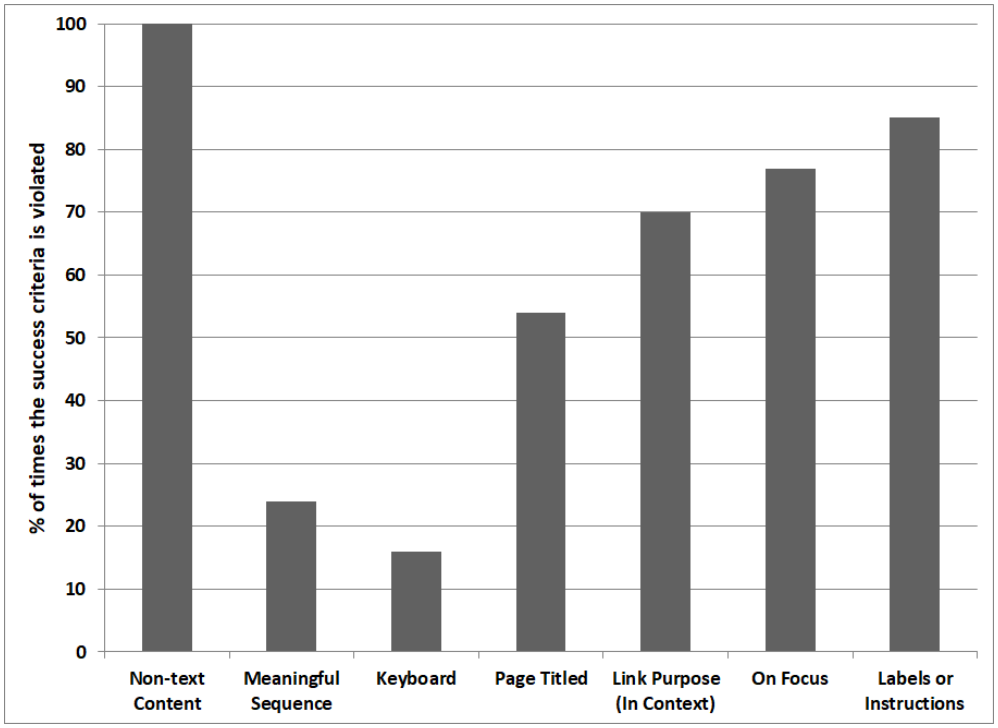

Figure 5. How many times the success criteria are violated.

4.4 Discussion

The findings suggest an urgent need to improve the accessibility of the Kuwaiti government portal. They reveal that a large number of the E-services are inaccessible. Violations of the WCAG 2.0 success criteria include: non-text content, link purpose (in context), on focus and labels or instructions.

Several of the basic citizen E-services tested were impossible to use. As shown in Table 6, 46% of the target E-services were down or not available and 46% of the E-services contain forms with no labels (a major reason for the inaccessibility of the E-services).

Figure 6. Violation payment (traffic & immigration) service asking user to enter inaccessible Captcha.

In addition, some of the English pages open as Arabic pages with no way to reach the English text, which is excluding a large number of citizens in Kuwait who speak only English. These violations have relatively simple solutions, but the knowledge and awareness of how to cater for people with disabilities in Kuwait remain relatively low.

Note that the following tasks are considered reachable by the automatic tools as the first page of the service is tested (1, 4, 5, 7, 8, 9, 12, 13, 14 and 16). On the other hand, the following tasks: (4, 5, 7, 8, 9, 13 and 16) are considered impossible when tested by the experts, as shown in Table 6.

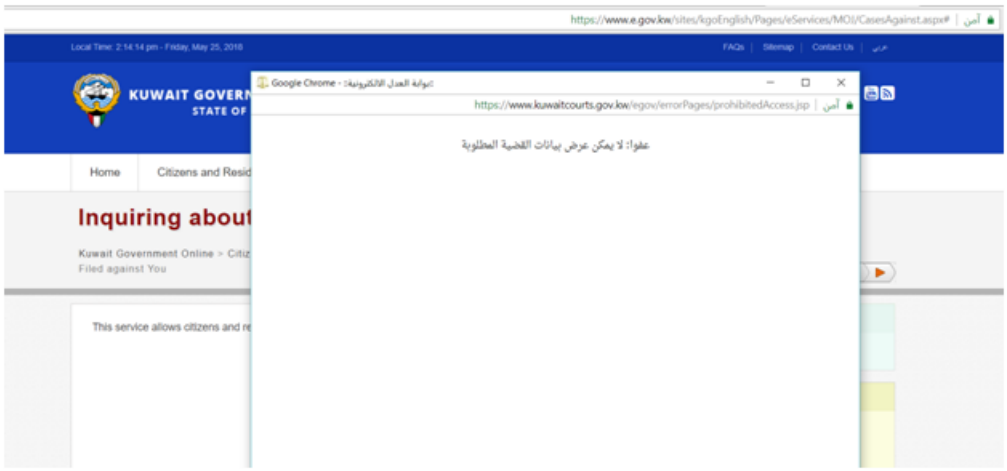

Figure 7. Inquiring about lawsuits service is not available.

4.5 Policy, Legislation and Awareness

The Kuwait National Framework for Digital Accessibility suggests that for the Web and documents to be accessible, they should conform to the basic criteria of the Web Content Accessibility Guidelines (WCAG 2.0). Following the official announcement in 2018 [10], the government failed to offer a plan for implementation at the national and organizational levels.

To be able to effectively assess the conformance of the government portal and sustain it, its host CAIT

should be required to establish an accessibility policy of its own, set conformance milestones and monitor and review the website on a regular basis. Some entities in Kuwait have begun to implement elements of the WCAG 2.0 and the Framework by enhancing the user experience with the goal of growing the margin of profit.

Kuwait Vision 2035 in accessibility is about how to make Kuwait accessible to everyone, including people with disabilities, in different fields, such as physical and digital ones. Physical accessibility is enhanced by using universal design to be applied to make the environment more accessible. Digital accessibility is achieved by using Kuwait National Framework for Digital Accessibility to be implemented on the digital technology and not only on the Web.

In addition, the national accessibility framework is merely a policy, not a law. The next step should be to pass a law through the parliament, so that the government can setup a legal framework that will hold people accountable if it is violated. Without policies and laws or fear of prosecution, there are no incentives for the government or private entities to begin enhancing their websites, applications and services to engage people with disabilities.

Finally, E-government services should be available for all the citizens in the country no matter what their language, ability or age is. With the impending adoption of cloud-based services, there is a need to re-structure the E-government landscape to facilitate user tasks, which will help elicit more e-service usage. This puts a strain on Web developers who should be aware of the national framework and trained on accessibility standards.

Developers should make accessibility a core part of all their development projects, particularly the E-government services.

5. CONCLUSION AND FUTURE WORK

In this paper, the accessibility of Kuwaiti E-government services is evaluated. We tested the accessibility of 17 of the top used E-services in 2018 against WCAG 2.0 level A. The study applies different technical dimensions to investigate accessibility problems using automatic tools and experts' manual review.

The overall results show that most of the evaluated E-government websites lack accessibility. Unfortunately, thirteen out of seventeen (i.e., 76%) of the evaluated E-services are impossible to use. The most commonly failed accessibility success criteria are: "non-text content" and "labels or instructions".

Furthermore, Web accessibility guidelines are not mentioned in the government portal or by the public authority of the disabled which is responsible for people with disabilities in Kuwait. There is a need to further develop appropriate policies and laws and set a national level plan to enforce the adoption of the national accessibility guidelines and WCAG standards for better inclusion of all residents and citizens in Kuwait.

In most of the studies that evaluate the accessibility of E-government, only the homepage is used to check whether or not it complies with WCAG [46]. In this study, a task-based technique is used which navigates different pages to evaluate the accessibility of the provided E-service. This helps in checking the accessibility of the provided E-service in a situation similar to what the user encounters in the real life. Furthermore, this enables the checking of the ease of navigation between the pages to complete the service.

Future assessments may involve users with disabilities in the testing of the site, as they can provide a more realistic assessment of the website's accessibility. In addition, performance indicators for Web accessibility need to be used to watch the country improvement in terms of Web accessibility and an analysis of Web developer awareness of accessibility standards is needed.

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ملخص البحث:

تستخدم الشبكة العنكبوتية من أجل توفير أنواع مختلفة من الخدمات للناس. وفي هذا الشأن، يجب أخذ احتياجات الأشخاص ذوي الإعاقة في الاعتبار عند تطوير الحكومة الإلكترونية. ويهدف هذا العمل الى تقييم قابلية الوصول الى المواقع الإلكترونية والعقبات التي تعترض الأشخاص ذوي الإعاقة في الوصول الى تلك المواقع الخاصة بالحكومة الإلكترونية في الكويت، وذلك في محاولة لتحديد المشكلات وزيادة الوعي لدى الحكومة بتلك المشكلات وتحسين شمول الأشخاص ذوي الإعاقة بالخدمات المقدمة. ولتقييم قابلية الوصول الى خدمات الحكومة الإلكترونية في الكويت، تم تطبيق التقييم الآلي وتقييم الخبراء على أبرز سبع عشرة خدمة إلكترونية مستخدمة عام 2018 في الكويت. وبينت النتائج التي تم الحصول عليها أن 13 من الخدمات هي غير ممكنة الاستخدام؛ الأمر الذي ينم عن ضعف شديد في التقيد بإرشادات الوصول الى محتوى الشبكة العنكبوتية (WCAG 2.0) المستوى A لغالبية المواقع الخاضعة للتقييم. وأظهرت الدراسة أهمية اتباع نهج قائم على المهام عند تقييم قابلية الوصول الى المواقع الإلكترونية، نظراً لأن الإبحار بين الصفحات المختلفة بعد الانتهاء من كل مهمة يمكن أن يساعد في اكتشاف قضايا أخرى تتعلق بقابلية الوصول.