Web Accessibility Evaluation of Government Websites for People with Disabilities in Turkey

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***Abstract*—The Web is a progressively more important resource in many aspects of life: government, commerce and more. As governments to continue to provide businesses and citizens with new value-added e-services, citizens with disabilities are still being deprived from taking full advantage of these services. While the proportion of people with disabilities (visual impairment, hearing impairment, cognitive disability etc.) in society has been rapidly increasing due to the demographic trends long documented by many researchers, governmental leaders have paid little attention to their needs when planning and implementing Web projects. Therefore, it is essential that all citizens must have equal accessible opportunities to all e-government recourses. This research evaluates the accessibility of each of the 25 e-Government websites in Turkey by people disabilities based on the Web Content Accessibility Guidelines (WCAG) 1.0 and 2.0 and using automated testing tools. The results of study indicate that the prevalent priority-1 accessibility barriers identified in this study were related to the absence of text equivalents for non-text elements, and the failure of the static equivalents for dynamic content to get updated when the dynamic content changes.**

***Index Terms*—web accessibility, disability, e-government**

I. Introduction

The rapid growth of new Information and Communication Technologies (ICTs) imposes the adoption of these technologies in different parts of the modern life, including the governmental side. EGovernment can be defined as the process by which the government can deliver services and information to its citizens via the internet [1]. Access to government through Web interfaces has become commonplace in recent times as a consequence of pervasive use of the Internet for access to information and services [2]. The use of information and communication technology (lCT) has been playing a vital role in the 21st century due to globalization and the governments of the countries are being encouraged to adapting with the coming future. Turkey has declared the "Vision 2023", which targets establishment of a resourceful and modern country by 2023 through effective use of information and communication technology [3]. The government of Turkey has realized the importance of ICT to improve the delivery of information and services to disabled citizens. And now the changes are being seen in government initiatives [4]. The websites of all the ministries and divisions are developed under the technical assistance of Republic of Turkey E-Transformation Turkey Prime Ministry State Planning Organization Interoperability Principles Project Guide and are in working for the last five years [5].

A considerable number of users of the Web have various types of disabilities such as vision, hearing, motor and cognitive impairments [6]. Studies show that presently most of the government websites are inaccessible for the impaired users [7]. However, more than one billion people in the world are disable and this number is increasing day by day as the population increases [8]. Turkey has an estimated population of 76 million, out of which about 8, 5 million are disable [9].

The accessibility of these web sites, especially by the people with disabilities, has not been evaluated to date. This has motivated us to assess the accessibility of e-government web sites for people with disabilities using automatic testing tools for checking of target websites. The purpose of this study is limited to the accessibility assessment of the central government websites and to find out whether the web based public services are provided in equitable manner to all the citizens.

The rest of the paper is organized in six sections: In Section 2 presents we review the relevant works. Section 3 presents W3C standards and guidelines. Section 4 describes web accessibility evaluation tools. Section 5 describes the adopted methodology to make the complete analysis of selected websites of government. Section 6 presents the results and their detailed description. Section 7 presents limitations and future work. Section 8 concludes the paper with recommendation.

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II. Related Works

Many studies have been carried out in the field of Web accessibility. These studies used different techniques and different measures for assessing the accessibility of different Websites, especially the government ones. Also these studies found that large percentage of Websites have serious problems in their accessibility. In this section we briefly mention some work that has been done in the field of Web accessibility. Definition of accessibility is "making web content available to all individuals, regardless of any disabilities or environmental constraints they experience" [10]. The provision of physical access to appropriate hardware and software to enable access to the web; it can mean the provision of add-on technologies to widen access to the web, for example through the use of assistive technologies such as screen reading software, screen magnification, alternative mouse and keyboard devices, alternative pointing devices, refreshable Braille displays and voice input [11], [6].

Abdul Latif and Masrek [12] undertaken with the purpose of identifying the accessibility of Malaysian e-government websites based on the World Wide Web Consortium (W3C). The result of the analysis indicated that there were no single Malaysian e-government websites that passed the W3C Priority 1 accessibility checkpoints. Dominic *et al*. [13] have used diagnostic to evaluate the Asian egovernment websites in terms of technical aspects such as loading time, page rank, frequency of update, traffic, mark-up validation, accessibility errors, etc. Baowaly and Bhuiyan [14] concentrated on mainly two things; firstly, it briefly examined accessibility guidelines, evaluation methods and analysis tools. Secondly, it analyzed and evaluated the web accessibility of e-Government websites of Bangladesh according to the "W3C Web Content Accessibility Guidelines". Baowaly *et al.* [15] analyzed and evaluated accessibility of government websites' in perspective of developing countries. They taked Bangladesh as a case study. Bakhsh and Mehmood [16] evaluated the websites of central government in Pakistan including all ministries and divisionsusing accessibility evaluation tools based on World Wide Web Consortium's (W3C) web accessibility standards. The results showed that most of the web sites were not developed according to the accessibility standards for disabled persons. Kuzma [17] assessed the accessibility of e-Government websites for 12 developing and developed countries. She identified serious accessibility issues for the tested e-Government sites, even for websites belonging to governments who stated adherence to W3C accessibility standards and UN legislations. Goodwin *et al.* [18] conducted a global web accessibility analysis of e-Government websites from the United Nations member states. The study revealed that, with few exceptions, government websites of developed countries are more accessible than those of developing countries. The study also found that e-Government websites that are recognized as mature and of high quality are more likely to be accessible. Isa *et al.* [19] who used several automated testing tools and identified many usability and accessibility issues related to Malaysia e-Government websites. Al-Radaideh *et al.* [20] evaluated the accessibility of major E-government Websites in Jordan by people with disabilities with conformance to Web Content Accessibility Guidelines (WCAG) 1.0. Results showed that all tested Websites did not address the issue of disability-accessibility and they have many Web accessibility problems. Abu-Doush *et al.* [21] evaluated a set of Jordan e-government websites using 20 blind and visually impaired volunteers and at the same time conducted a survey on e-government websites developers. Al Mourad and Kamoun [22] evaluated the accessibility of each of the 21 Dubai e-Government websites based on the Web Content Accessibility Guidelines (WCAG) 1.0 and using automated testing tools. The results of research revealed that many Dubai e-Government sites did not meet the minimum W 3C accessibility conformance level. AbuAli *et al.* [23] evaluated Jordan E-Government Website from the accessibility perspective. The results from the evaluation process showed that Jordan E-Government Website lacks accessibility and needs further improvements to improve its quality. Luj án-Mora *et al.* [24] analysed the accessibility of a group of e-government websites of all South American countries and Spain. The results of research showed that the majority of e-government websites do not provide adequate levels of web accessibility.

Some similar studies on accessibility of web sites and web contents were also conducted by Mankoff *et.al* [10], Lazar *et.al* [6], Venter *et.al* [25], Choudrie *et al.* [26], Shi [27], Potter [28], Abanumy *et al*. [29], Rowena Cullen and Caroline Houghton [30], Salon *et al*. [31], Kuzma [32], Kuzma *et al.* [33], Kuzma *et al.* [34], Hong *et al.* [35], Hong et al.[36], Basdekis *et al*.[37], Kurniawan and Zaphiris [38], Choi *et al*.[39], Johnson and Kent [40], Evans-Cowley [41], Freire *et al*. [42], Paris [43], Goette *et al.* [44], Jaeger [45], Jaeger [46], Shi [47], Rabaiah and Vandijck [48], Huang [49], Jati and Dominic [50], Loiacono *et al*. [51], Mehmood [52], Baguma ve Lubega [53], Baguma *et al*. [54] and give suggestions for improvements.

III. Web Accessibility and Guidelines

Web accessibility can be defined as the degree to which a site is accessible to the largest possible range of people. The more people are able to access a website, the more accessible is the site. At its core, Web accessibility emphasizes making website accessible to persons with disabilities and involves removing potential barriers to access caused by inconsiderate website designs [55]. Web accessibility primarily benefits people with disabilities. However, as an accessible website is designed to meet different user needs, preferences, skills and situations, this flexibility can also benefit people without disabilities in certain situations, "such as people using a slow Internet connection, people with temporary disabilities such as a broken arm, and people with changing abilities due to aging" [56]. The World Wide Web Consortium (W3C) is an international organization

dedicated to the standardization of the World Wide Web (WC3). In 1996, W3C established the Web Accessibility Initiative (WAI) campaigning for a more accessible Web for persons with disabilities. For the consortium, Web accessibility was defined as "access to the Web by everyone, regardless of disability" [55].

In 1999, the Web Accessibility Initiative (WAI), a Project by the World Wide Web Consortium (W3C) published the Web Content Accessibility Guidelines (WCAG) version 1.0 [56]. These guidelines were widely accepted in many countries around the world as the definitive guidelines on creating accessible websites. The WAI approach to Web accessibility revolves around three interrelated fronts: (i) the content accessibility of websites for persons with disabilities to perceive, understand, and use; (ii) making Web browsers and media players usable for persons with disabilities by making them operable through assistive technologies and (iii) Web authoring tools and technologies to support production of accessible Web content and sites, so that persons with disabilities can use them effectively. An accessible web site is very similar to an accessible building. An accessible building offers curb cuts, ramps, and elevators to allow a person with disabilities to enter and navigate through the building with ease. Hence, an accessible web site offers similar functionality [12]. However, on 11 December 2008, the WAI released the WCAG version 2.0 to be up to date while being more technology neutral [57].

Currently, there are a number of guidelines and tools Web designers and webmasters can use to make their websites accessible to people with disabilities. Such guidelines include the Web Content Accessibility guidelines (WCAG) developed by the World Wide Web Consortium (W3C), the US government's Section 508 Initiative, Americans with Disabilities Act (ADA), Australians with Disabilities Act and the National Institute on Ageing Guidelines (NIA). Similar guidelines exist in Canada, UK and Portugal. In addition to the guidelines, automated software tools that help in finding accessibility flaws in websites before the sites are publicly posted, are available. Such tools include bobby, ramp, infocus and a-prompt. More so new versions of web development tools such as dream weaver and front page include tools that assist developers with accessibility related issues [6]. The most common standards Based website Design and development are W3C Web Content Accessibility Guidelines 1.0 or 2.0 (WCAG 1.0 or WCAG 2.0). WCAG 2.0 was approved as an ISO/IEC 40500 International accessibility standard in October 2012 [58]. The meaning of that more countries can formally adopt WCAG 2.0 and many countries are updating their laws to the new version. The W3C Web Accessibility Initiative (WAI) defines three possible accessibility conformance levels, as illustrated in Table I.

TABLE I. WAI CONFORMANCE CLAIMS

Conformance Level	Website Accessibility Checkpoint
WAI-A (basic accessibility)	All priority 1 checkpoints are met. This is the minimum (basic) W3C requirement. Otherwise one or more groups of people will find it impossible to access information from the website. This is the minimum requirement and must be met.
WAI-AA (intermediate accessibility)	All priority 1 and 2 checkpoints are satisfied; otherwise one or more groups of people will find it difficult to access information from the website. This conformance level status should be met, as it will remove significant barriers to accessing Web documents.
WAI-AAA (high accessibility)	All priority 1, 2 and 3 checkpoints are satisfied; otherwise one or more groups of people will find it somehow difficult to access information from the website. This conformance level status may be addressed by Web developers to improve access to Website documents.

IV. WEB ACCESSIBILITY EVALUATION TOOLS

After Web accessibility evaluation tools are software programs or online services that are used to check your website's accessibility level under web accessibility guidelines. There is a huge number of accessibility tools for commercial purposes or freely available on the web such as Watch Fire Bobby, AChecker, Cynthia Says, EvalAccess, Accessibility Valet Demonstrator (WebThing), AccMonitor Online (HiSoftware), Torquemada (WebxTutti), Wave 3.5 (WebAIM) and Tawdis etc. Some good free web-based website accessibility evaluation tools are linked in [59], [60], [61], [62]. A complete list of accessibility evaluation tools is in W3C [63]. These tools are very useful for programmers and designers to determine whether or not their sites follow WCAG. During the design, implementation, and maintenance phases of Web development if these tools are used carefully, it can help the targeted users in preventing accessibility barriers, repairing encountered barriers, and improving the overall quality of Web sites [64].

This study will use Automatic evaluation tools such as AChecker, eXaminator, TAW, Total Validator, WAVE, Web AccessibilityAssessment Tool, EvalAccess 2.0, Cynthia Says, MAGENTA, HERA, Amp and Sort Site which is considered as the web accessibility test tool which able to provide relatively complete analysis of website accessibility and have been the pioneers and are the most well-known, due to their usability, ease of use and its quick results.

V. METHODOLOGY

In this study, the 25 the official website of the governments have been analysed. The home page of each one of the websites has been analysed from three points of view: HTML and CSS validity; web accessibility; and,

current use of HTML5 and ARIA. The home page of a website is the first contact a user has with the website. If the home page shows problems or is not accessible, it would be very difficult that a disabled user can access other pages of the website. Therefore, it is essential to ensure the accessibility of the home page of a website. All the tests of a web page were conducted during the same day in order to avoid changes in its content.

A. HTML and CSS Validity

Two automatic evaluation tools have been used to evaluate the validity of the HTML and CSS of the websites. The first automatic tool is the Markup Validation Service, a free service by the W3C [65]. This automatic tool checks the markup validity of web pages in HTML, XHTML, SMIL, MathML, etc. According to the W3C [66], "Validating web documents is an important step which can dramatically help improving and ensuring their quality, and it can save a lot of time and money". The result of the Markup Validation Service is summarized in the number of errors and warnings in a web page. The second tool is the CSS Validator Service, another free service by the W3C [67]. Not only, this tool evaluates the style sheets of a web page its conformance with W3C open standards and the CSS specifications. It can also detect when CSS poses some risks in terms of usability. It can find errors, typos, or incorrect uses of CSS.

B. Web Accessibility

Thirteen automatic evaluation tools have been used to evaluate the accessibility of the websites analysed in this study: AChecker, eXaminator, TAW, Total Validator, WAVE, Web AccessibilityAssessment Tool, EvalAccess, Cynthia Says, MAGENTA, HERA, Amp and Sort Site

AChecker [68] is an online free service that produces a report of accessibility problems according to different guidelines (Section 508, WCAG 1.0 and WCAG 2.0). AChecker classifies accessibility problems into three categories: known problems (problems that have been identified with certainty as accessibility barriers), likely problems (problems that have been identified as probable barriers, but require a human to make a decision) and potential problems (problems that AChecker cannot identify, that require a human decision). AChecker also provides an Application Programming Interface (API) that allows remote accessibility analysis. eXaminator is an online free service to check the accessibility of a web page developed by Carlos Benav´ıdez [69]. eXaminator checks the application of the WCAG 2.0 [57] on the HTML and CSS contents in a web page and summarizes the results in an overall score from 1 to 10 that is quite easy to understand by everybody. Of course, the score calculated by eXaminator is a fast check of accessibility, but automatic evaluation does not cover all of the success criteria in WCAG 2.0. TAW is a limited online free service to check the web accessibility against WCAG 1.0 and 2.0 [70]. TAW classifies accessibility problems into automatic problems, those in which the tool is certain that the problem violates the guidelines and manual problems, those that need to be reviewed by an expert. Total Validator is an HTML validator, an accessibility validator, a spell checker, and a broken links checker, all included into one tool [71]. This tool is provided in two versions: the basic tool for free and the professional tool that must be purchased. Finally, WAVE is an online automatic evaluation tool that helps web developers to make their web content more accessible [72]. However, WAVE cannot completely state if a web page is accessible, only a human can determine true accessibility. WAVE detects HTML5 and Accessible Rich Internet Applications (ARIA) features, such as header, footer, ARIA landmarks and roles, and so on. Besides, WAVE also provides an API that allows automated and remote accessibility analysis of web pages using the WAVE processing engine. Web Accessibility Assessment Tool is a Java application developed by the EU FP7 ACCESSIBLE project [73]. It evaluates a website according to WCAG 2.0 (level A, level AA, and level AAA). Providing an option for the users to select among the success criteria they want to check. Another option is saving a report on the user computer as a PDF file. This tool can evaluate more than one page; users can define the number of pages for evaluation. The results of the evaluation are categorized into: errors and warnings. EvalAccess is being developed by the Laboratory of HCI for Special Needs at the University of the Basque Country (UPV-EHU). EvalAccess web service checks web pages accessibility, based on the WAI's WCAG 1.0 guidelines. It has been implemented as a web service to allow any other application to use it [74]. Cynthia Says tests your page against predefined checkpoint groups to validate it against the US Access Board's Section 508 or the W3C's WCAG 2.0 A-AAA Accessibility Guidelines [75]. M.A.G.EN.T.A. 2.0 (Multi-Analysis of Guidelines by an Enhanced Tool for Accessibility) is a system to evaluate accessibility of Web sites by checking their HTML and CSS code through guidelines, which are to be specified through an XML-compliant specification language called G.A.L. (Guideline Abstract Language) that maintains the guidelines separated from the underlying logic. M.A.G.EN.T.A. 2. 0 is able to validate the accessbility of web pages in relation to the following guidelines: WCAG 2.0 (Level A, AA, AAA), Stanca Act, Visually Impaired [76]. HERA is a tool to check the accessibility of Web pages accoridng to the specification Web Content Accessibility Guidelines (WCAG 1.0). HERA performs a preliminary set of tests on the page and identifies any automatically detectable errors or checkpoints met, and which checkpoints need further manual verification [77]. The Accessibility Management Platform (AMP) provides the infrastructure to facilitate all aspects of a successful accessibility compliance program. AMP's powerful testing engine and work flow, reporting support, accessible development best practices, and extensive training course library allow organizations to quickly and efficiently incorporate accessibility compliance into existing development processes. This ensures that organizations have the infrastructure to rapidly conform to Section 508, the Web Content

Accessibility Guidelines (WCAG), the Americans with Disabilities Act (ADA), and other leading accessibility requirements [78].SortSite checks sites against the W3C WCAG 1.0 and 2.0 accessibility standards, and compliance with Section 508 of the Rehabilitation Act [79].

C. Current Use of HTML5 and ARIA

HTML5 is the latest standard and which is an example of modern technology. The first draft of HTML5, was published by the W3C in January 2008 [80], HTML5 is expected to be completed and published at the end of 2014. Unfortunately, six years later the use of the new version of the markup language of the Web is not very common yet. HTML5 updates the specification to include latest advances and best practices in web development. HTML5 also includes new accessibility features that will improve the accessibility of websites. ARIA, another standard of the W3C, addresses the lack of accessibility of many web pages. Complex web applications become inaccessible when assistive technologies cannot determine the semantics behind portions of a document or when the user is unable to effectively navigate to all parts of it in a usable way. WAI-ARIA divides the semantics into roles (the type defining a user interface element) and states and properties supported by the roles. ARIA defines ways to make Web content and Web applications (especially those developed with Ajax and JavaScript) more accessible to people with disabilities. It especially helps with dynamic content and advanced user interface controls developed with Ajax, HTML, JavaScript, and related technologies. ARIA enhances accessibility of interactive controls (such as tree menus, drag and drop, sliders, sort controls, etc.), provides content roles for identifying page structure (navigation, search, main content, etc.), areas that can be dynamically updated (called "live regions" in ARIA), better support for keyboard accessibility and interactivity, and much more. ARIA is a set of special accessibility attributes which can be added to any markup, but is especially suited to HTML. The role attribute defines what the general type of object is (such as an article, alert, or slider). ARIA is supported by most up-to-date browsers and screen readers. It is also supported by many scripting libraries. Usage of HTML 5 and ARIA together make web content and web applications more accessible to people with disabilities [81], [82].

VI. Results

A. HTML and CSS Validity

Fig 1 shows the HTML and CSS validity results. Acolour code is used to clarify the results. An anomalous situation detected during the analysis: one website could not be analysed, the website of the Prime Ministry of Turkey. Only the website of the Republic of Turkey Ministry of Justice website had 0 validation errors. The following websites with the less number of HTML errors were: Republic of Turkey Ministry of Family and Social Policy with 2 errors, Republic of turkey ministry of defense with 4 errors. The worst results were obtained with the website of the Republic of Turkey Ministry of Youth and Sports, with 525 errors, and the Republic of Turkey Ministry of Economy, with 306 errors. Regarding the CSS validation, thebest results were the website of the Presidency of the Republic of Turkey, Republic of Turkey Ministry of Justice, Republic of turkey ministry of defense, Republic of Turkey Ministry of Interior, Republic of Turkey Ministry of Transport, Maritime Affairs and Communications with 0 errors. On the opposite side, Republic of Turkey ministry of development web site presented the highest number of errors with 353.

B. Web Accessibility

Due to the lack of space, we cannot include the whole results of the web accessibility analysis. Therefore, Fig. 2 summarizes the number of problems detected with automatic evaluation tools and some information has to be discarded. Unfortunately, the home pages of all the websites have accessibility issues. In Fig. 2, column "AChecker" represents the number of "known problems" that have been detected. According to AChecker, these problems should be fixed. "Likely" and "potential errors" have not been included in the figure. Column "eXaminator" shows the global score provided by this tool, a value from 1 to 10: the higher the value, the better the accessibility of the web page. Column "TAW 1.0 P1" indicates the number of issues to pass the WCAG 1.0 priority 1 (A level) requirement that can be automatically detected. The manual errors have been discarded because they required additional human intervention. Column "TAW 2.0 Problems" provides the number of problems that should be corrected because there is a certainty about them. "Warnings" and "Not verified problems" have also been discarded and they are not showed in the figure. Column "TV" Errors WCAG 2.0 A" shows the number of errors of WCAG 2.0 priority 1 (A level) detected by Total Validator. The other errors have been discarded. Column "WAVE Errors" provides the number of errors detected by WAVE. "Alerts" have also been discarded. Column "Web Accessibility Assessment Tool" shows the number of errors of WCAG 2.0 priority 1 (A level) requirement that can be automatically detected. "Warnings" have been discarded. Column "EvalAccess 2.0" indicates the number of errors to pass the WCAG 1.0 priority 1 requirement that can be automatically detected. "Warnings" have not been included in the figure. Column "Cynthia Says" provides the number of failures of WCAG 2.0 priority 1 (A level) requirement that can be automatically detected. "Warnings" have been discarded. Column "MAGENTA" shows the number of errors of WCAG 2.0 priority 1 (A level) requirement that can be automatically detected. Requirement that can be automatically detected. Column "HERA" indicates the number of errors to pass the WCAG 1.0 priority 1 requirement that can be automatically detected. Column "Amp" provides the global percentage provided by this tool, a value from %1 to %100: the higher the value, the

better the accessibility of the web page. Finally, Column "Sort Site" shows the number of issues WCAG 2.0 priority 1 requirement that can be automatically detected.

In general, the worst results regarding web accessibility were obtained with the websites of Republic of Turkey Ministry of Culture and Tourism, Republic of Turkey Ministry of Economy and Republic of Turkey Ministry of Youth and Sports. On the other side, the best results were obtained with the websites of Turkish Armed Forces/Turkish General Staff, Republic of Turkey Ministry of Justice and Republic of turkey ministry of defense.

Website	HTML Errors	HTML Warns	CSS Errors	CSS Warns
Presidency of the Republic of Turkey	55	49	0	0
The Grand National Assembly of Turkey	97	26	17	64
Prime Ministry of Turkey				
Turkish Armed Forces/Turkish General Staff	97	16	16	0
Ministry of Justice	0	0	0	1
Ministry of Defense	4	4	0	0
Ministry of Interior	20	28	0	33
Ministry of Foreign Affairs	33	8	79	7
Ministry of Finance	297	193	57	720
Ministry of National Education	134	75	51	58
Ministry of Environment and Planning	36	12	11	46
Ministry of Health	39	0	5	0
Transport, Maritime Affairs and Comm.	18	0	0	0
Ministry of Food, Agriculture and Livestock	165	5	64	740
Ministry of labor and social security	212	72	95	55
Ministry of Science, Industry and Technology	212	171	10	41
Ministry of Energy and Natural Resources	283	424	2	4
Ministry of Culture and Tourism	14	3	54	13
Ministry of forest and water	13	2	16	5
Ministry of Family and Social Policy	2	2	4	18
Ministry for EU Affairs	76	112	2	0
Ministry of Economy	306	173	123	49
Ministry of Youth and Sports	525	0	130	89
Ministry of Customs and Trade	81	2	33	57
Ministry of Development	13	1	353	973

Figure 1 . HTML and CSS validation results

Website	AChecker	eXaminator	TAW 1.0	TAW 2.0	TV	WAVE	Web A.A.T.	EvalAccess 2.0	Cynthia Says	MAGENTA	HERA	Amp	Sort Site
Presidency of the Republic of Turkey	27	5.7	18	57	28	9	36	23	3	31	1	%59	18
The Grand National Assembly of Turkey	38	4.6	20	87	59	27	102	20	3	1	2	%58	17
Prime Ministry of Turkey	15	4.6	15	22	10	8	26		3	1	3	%50	13
Turkish Armed Forces/Turkish General Staff	26	2.9	0	26	59	21	22	18	8	46	1	%66	20
Ministry of Justice	2	3.8	6	12	8	1	18	0	27	9	0	%70	12
Ministry of Defense	3	4.7	0	5	2	3	0	0	9	1	0	%68	2
Ministry of Interior	3	4.3	1	24	5	3	6	1	4	19	1	%59	8
Ministry of Foreign Affairs	16	5.1	1	28	7	3	27	1	4	29	2	%57	13
Ministry of Finance	85	4.5	73	8	153	3		73	10	143	12	%52	15
Ministry of National Education	54	4.7	49	124	89	61	177	49	3	78	1	%59	16
Ministry of Environment and Planning	13	4.6	0	47	29	8	18	4	4	12	1	%65	10
Ministry of Health	30	3.4	27	8	66	33	111	27	11	69	1		12
Transport,Maritime Affairs and Comm.	2	6.0	1	18	1	1	24	0	16	2	0	%71	17
Ministry of Food, Agriculture and Livestock	40	4.1	33	47	52	34		31	14	54	3	%59	17
Ministry of labor and social security	60	3.9	56	164	129	60	125	54	6	111	3	%69	14
Ministry of Science,	50	3.8	55	110	77	44		37	10	101	3	%48	

Industry and Technology													
Ministry of Energy and Natural Resources	16	3.1	0	41	54	14	53	10	22	59	3	%53	16
Ministry of Culture and Tourism	10	3.9	0	46	29	6	829	0	7	28	0	%63	14
Ministry of forest and water	25	5.1	11	37	36	23	81	11	7	37	1	%59	11
Ministry of Family and Social Policy	5	5.8	0	12	26	2	68	0	6	26	1	%58	6
Ministry for EU Affairs	25	4.5	6	35	27	16	27	16	6	27	1	%58	17
Ministry of Economy	64	4.1	51	227	95	58		51	9	159	1		17
Ministry of Youth and Sports	63	4.7	50	213	160	60		41	9	169	3	%57	17
Ministry of Customs and Trade	73	3.9	67	113	118	69	156	67	8	210	1	%59	9
Ministry of Development	34	4.9	0	128	115	30	142	28	4	123	3	%53	14

Figure 2. Accessibility results

C. Current Use of HTML5 and ARIA

The DOCTYPE is a declaration that always has to appear at the very top of HTML documents. This declaration defines the type of document, tells the browser what element to expect as the top-level element, and identifies the version of the type of document. According to the results of W3C's Markup Validation Service [65], only 4 web pages (16%) have the HTML5 DOCTYPE: Republic of Turkey Ministry of Environment and Planning, Republic of Turkey Ministry of Family and Social Policy, Republic of Turkey ministry of customs and trade, Republic of Turkey ministry of development.

Regarding the use of ARIA, WAVE [72] has been used to detect ARIA features in the analysed websites. Only 5 web sites (20%) present some use of ARIA: Republic of Turkey Ministry of Family and Social Policy, Republic of Turkey Ministry of Food, Agriculture and Livestock, Republic of Turkey Ministry of Foreign Affairs and Prime Ministry of Turkey. For example, Republic of Turkey Ministry of Foreign Affairs website makes use of: one header (header), one footer (footer), one navigation sections (nav)

VII. Limitations and Future Work

Two main limitations have been found in this study. The first limitation is related to the exclusive reliance of our accessibility analysis on automated testing results. Web accessibility evaluation tools and expert inspections cannot substitute user testing, because the difficulties of understanding all the interactions between web content and assistive technology. Automatic tools generally verify the presence of a valid element or attribute, such as the alt attribute (alternative text) or the label element (description of a form control). However, human judgment is also needed, because some questions are very relevant, such as whether or not the value of the alt attribute clearly and effectively conveys the function of the image. For example, there is a big difference between the alternative text that an active or inactive image needs. Indeed, in some cases an image may not need an alternative text (null alt text). Vigo *et al.* [83] tested and compared the capabilities of six automatic current web accessibility evaluation tools, by analysing their coverage, completeness and correctness with regard to WCAG 2.0 conformance. The conclusion was that relying on only one automatic evaluation tool was an error because none of the analysed tools obtained the best scores in all the dimensions studied. For example, some tools exhibited high completeness scores and low correctness scores at the same time. Therefore, a web accessibility analysis based only on automatic evaluation tools should include the results of different tools in order to achieve reliable results.

Another limitation is the restriction of our automated accessibility testing on the home page of each tested website. In order to achieve a more accurate view of the accessibility of each website, this study is going to be extended to study hundreds or thousands of web pages in each website to have a more precise view of the accessibility. We also note that the accessibility metric, derived from an automatic accessibility evaluation approach, is a proxy indicator of Website accessibility and not a real assessment of accessibility as experienced by a person with disability. Therefore, our results may not capture all the accessibility issues that disabled individuals might encounter in real-life. However, they do pinpoint to some major accessibility issues that need to be resolved.

Throughout the whole investigation to determine the conformance level of accessibility, the researchers adopted the various evaluation tools (AChecker, eXaminator, TAW, Total Validator, WAVE, etc.), all of them were open source applications. However they are widely used and to ensure the scalability of the result we followed W3C Evaluating Accessibility [64]. Although the commercial tools (e.g. Bobby) are not freely available and expensive, we will try to apply both commercial evaluation tools and also open source and commercial assistive Technologies (NVDA, JAWS, etc) them in our next study. In addition to, in order to obtain more conclusive results, we plan to compare the results across countries and across different government websites.

Finally, another future work we plan to address is to detect the most common problems that recur in the same site and between different sites.

VIII. Conclusion and Recommendations

In this paper we addressed Turkish e-government websites accessibility for people with disabilities. 25 websites were tested using automatic tools for checking of websites. Results showed that all Turkish e-government websites do not address the issue of disability-accessibility, and it is clear that the vast majority of Turkish government websites do not meet minimum levels of web accessibility requirements. In our study it is difficult to obtain conclusive results because each automatic evaluation tool detects different types of errors. Because of this, it is difficult to say which one of the analysed websites presents the best and the worst level of web accessibility.

The most common detected accessibility issues were related to the absence of text equivalents for non-text elements and the failure of the static equivalents for dynamic content to get updated when the dynamic content changes.

As a recommendation, websites designers are encouraged to consider the w3c guidelines because of the increasing number of people with disabilities and in order to give them their right in accessing websites information equally with other. As a future work, different tools might be used to check governmental websites to see whether any differences in the accessibility degree will be captured.

Based on the work described in this paper, the authors would like to recommend the following issues as critical initial steps forwards: Government should either adapt the existing web accessibility guidelines or develop its own guidelines that are appropriate for their context. Also, government should set a policy for web accessibility together with an enforcement procedure e.g. making the accessibility of government websites a compulsory requirement. An incentive or reward for those who accommodate website accessibility may promote good web accessibility.

Finally, organizations caring for disabled people have a responsibility to spread the awareness amongst government organizations for making e-Government websites accessible. The successful implementation of e-Government websiteaccessibility would enable disabled peoples to get involved directly in the community thus making it better for all.

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