The Navigability Validation for Middle East E-governments Websites

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Abstract

The current study aimed to guarantee websites quality, we should evaluate them depending on certain criteria, this is to achieve the best service. This work aimed to build a platform to evaluate the navigability validation for some e-government websites. As a contribution to the field of websites evaluation, this study evaluates the quality of e-government portal website for 15 countries in the Middle East by using common automatic website evaluation tools. The proposed websites evaluation approach is conducted according to certain metrics based on five automatic website tools which are: Link checker, Xenu, page rank, Alexa, and TAW, those tools are freely available for evaluation purposes. The assessment of these websites helps their developers for improving them and following the quality principles. We tested accessibility, usability and page rank as three criteria of websites quality assessment. Our findings may improve some standards when building and developing Middle East E-government websites, finally, they presented some recommendations to avoid the weak points in these websites.

Keywords: E-government portals, website evaluation tools, quality, accessibility, usability, wcag 2.0.

1. Introduction

A huge number of websites are found daily on the internet regardless of their purpose, for entertainment, education, or even governmental websites transition from paper-based transactions to electronic transactions required to build and design an accessible website for everyone wishes to use it. The e-government website is one of the most critical websites that needs a big effort to reflect good services for others. The main aspect key is to give all users equal access to data and information on the website.

The modern trend in the web world is developing websites that satisfy the accessibility principles and rules for all clients' regardless of the health status, geographical area, used technology, or other criteria. Although there is a necessary need to apply the accessibility and usability principles, there are many common websites developed without taking these issues into the consideration.

The World Wide Web (W3C) established the Web Accessibility Initiative (WAI), which is specialized to define the principles and guidelines that make websites accessible to people. To achieve the accessibility and usability rules, the web content should perceivable, operable and understandable wide range of end users and compatible with modern technologies either hardware or software. Regarding [1], we should consider some important elements in websites such as good web surfing, clear visual design, significant content, well-planned interface, clear images and other multimedia audio-video applications. All these elements were taken into consideration during a few years ago to achieve high levels in supporting data and services to the users of some websites. Although it is difficult to evaluate the quality of E-Government websites, we need to test those rules carefully using significant and satisfied techniques. Here, the accuracy, quality, and reliability take into consideration. In this study, we tend to go in deep with some E-government websites in the Middle East and study them according to some metrics such as accessibility, usability, and ranking with attention to the elapsed time.

Website developers work hard to improve the quality of their websites by using various methods, those methods consist of a number of metrics and criteria that evaluates the quality of building websites. Website developers must pay attention to these criteria because of its importance and impact on end client. Measuring website quality has many of dimension and each measure concerns with a particular website criterion [2] such as ensure that websites links are working properly. Many tools based on these metrics were built and used in the process of website quality evaluation.

A large number of websites were ignored due to the low level of efficiency and services provided to users, because of the weakness of quality standards, this is leading to heavy substantial fund losses to the governments concerned with the design of those websites.

This research focuses on the structural metrics that takes into account the broken links through websites as well as the Page Rank of websites. The rest of this paper organized as follows: section 2 expresses the related works, section 3 clarifies the methodology for the evaluation, section 4 describes and illustrates the results, and finally section 5 includes the conclusion and the future work.

2. Related work

There are many studies gave special attention to assess the E-Government websites. One of these studies was performed by Mustafa and Al- Zoua'bi [3] they studied and evaluated the usability of the websites of nine universities in Jordan. They found that the size of HTML pages is improper, and the total size and number of images isn't suitable too. Finally, they found that the downloaded time for every tested page wasn't enough appropriated. Whereas Jati and Dominic [4] applied this study to five Asian E-eovernment websites, they used online diagnostic tools. Their results were almost the same for Mustafa and Al-Zoua'bi, they found that the Asian e-government websites are inappropriate.

The authors in [5] studied the accessibility for some Arabic websites by using a set of WCAG 2.0 evaluation tools in their experiments, and they categorized the evaluation tools into two categories; (1) General tool to evaluate most of the guidelines and (2) Special tool pares the results of different websites according to WCAG 2.0 (Level) A by a set of selected tools, and in their results they noticed that there were a variation in the number of violation problems for the same success criteria by different tools, and they attributed this to the evaluation tool, since not all of the tools support the Arabic language, and faced some language problems by present some problems as invalid language code, also, they explained that some tools like ACHECKER and TAW considered the HTML markup error where others not. In the automated evaluation tools, they couldn't evaluate all the WCAG 2.0 guidelines, since some of these guidelines need human reviewing.

In [6] a new approach was applied the Case-Based Reasoning (CBR) which is an artificial intelligent technique. This model used the previously solved cases to discover and solve the current cases. Tuan H.G [7] discussed two types of web pages; HTML client pages and server source pages such as PHP and ASP. We should be aware that the WCAG guidelines are only applied to HTML client pages. Therefore, the authors presented an approach to check and correct the server source pages in order to apply the accessibility metrics. The input of this model included both client and server pages, and then made some process to get their needs. Next, client' nodes were checked according to WCAG tools and non-consistent client nodes mapped to the server nodes. Finally, the violation of server nodes was fixed by using CHECORSER tool, which was the first tool, specialized to check the accessibility of server-side scripting language. They made many experiments to compare the proposed server tool with the famous WCAG 2.0 tools such as ACHECKER, Prompt, Vischeck and WAMI Toolkit. The results demonstrated the superiority of the CHECORSER tool of all the HTML client tools and the time needed to create an accessible website was decreasing.

In [8] a sample of 20 private Arabic and 20 Non-Arabic hospitals websites was taken, in order to be tested for certain criteria to measure website quality. These criteria are content, design organizing, and usability quality. The test was conducted by examining a list of fifty-one questions encompassing the most significant criteria of the website quality, depending on SPSS-11.5. The writers came up with the result that the quality of Arabic hospitals websites is low in comparison with Non-Arabic hospitals. Tashtoush et al. [9] during their research developed a framework (XD TRank) for predicting a formula for credibility which is an indicator for the level of confidence and trust of websites. This framework built by collecting 25 different metrics using various tools and methods, and then applying Stepwise regression method in order to analyze them. Then these metrics used to test 40 selected websites. They concluded that 14 of these metrics affected the credibility and adopted them.

Yuan et al [10] in their article proposed an evaluation framework for government portal websites regarding their content, function, and construction and applied it in China e-government website, to explore the characteristics of the current level of e-government development. The researchers

found that China had implemented advanced e-government services. Alsmadi et al. [11] focused on evaluating the structural matrix of websites such as size, complexity, and speed of loading, which indicated the complexity of the website. They developed crawler to gather the in-links and out-links metrics in order to estimate the popularity of the website, the data they used was selected from four different websites domains, from different countries.

Kaur and Dani [12], in their paper, made an evaluation of websites of public and private banks in India use structural metrics. The authors used Alexa rank to measure the website popularity, and Google Page Rank to check the importance of websites. Also, they investigated the distance which calculates the number of hyperlinks followed in order to navigate between two randomly selected nodes through the websites, and the complexity of the website.

The study conducted by Jaime et al. [13] tested the usability of e-commerce websites, in order to improve those websites; the study adopted a heuristic evaluation of usability for people from different cultures. The results of the study proved that it's difficult to use e-commerce websites that did not take into account in their design differences in cultures between users, researchers have suggested four ways Hofstede's cultural dimensions for solving cultures variation challenge and increasing the usability.

Hasan et al in 2017 [14] carried out a comprehensive survey of the usability of main international e-commerce websites in the Arab world, moreover, this work presented many recommendations to solve the usability problems to make them more competitive. The study was conducted on three international e-commerce websites and four Arab e-commerce websites. Essential and minor problems were identified and evaluated for each website before categorizing them regarding problem type. The results of the study proved that most of these problems were related to content and usability with both the international and Arab e-commerce websites. There are also many problems appeared in the Arab e-commerce websites, in particular, on Arabic websites, there appeared 22 websites with content problems and 85 websites with usability problems, however, the international websites, the study detected 12 and 55 websites with content and usability, respectively.

Many studies such as ([3] [15] [16] [17] [18] focused on estimating the quality of different domain websites, using one or more of different quality metrics as content, functionality, reliability, design, accessibility, portability, and usability.

Then, this study aims to:

- Evaluate some E-government websites in the Middle East, according to some metrics such as accessibility, usability, and ranking.
- Examine the most suitable criteria to develop the websites.
- Give some suggestions to develop and improve the E-government websites.

3. Websites Evaluation

3.1. Common Websites evaluation measures

- Usability criteria: According to The ISO 9241-11, the usability is one of the most important aspects that help us to deal with the web pages easily and to achieve our goals by following some criteria. One of these criteria is a checklist which includes nineteen criteria categorized into 4 sections. This criterion is used by CNET designers [19] After many years, Mustafa and Al-Zoua'bi [3] made many studies in that issue and added some categories to conclude twenty-three usability evaluation criteria and each one of these criteria related to a specific section. Their study explained these criteria in details, starting by Navigability, Content Quality, Website Accessibility, Browser Compatibility, and Transparency.

- Navigability: [20] identified it as "The usability and operability which a website must offer its customers that help the customers to move from one page to another, and in which they can use the back buttons". This criterion is designed to obtain four goals: categorize the content of the websites, address the information in the websites, help the users to find the needed information and build new models of navigation systems. It varies from one person to another, so it is considered as a personal measure.

- Content Quality: To satisfy the users, we should give a special attention to the content of the website, which is considered as a very important component. The content of the website should contain some features to satisfy the users such as, good organization of the content, the related and appropriate content which makes it easier to the users to link the ideas, the accurate content to be trusted from the users. Accessibility, speed, navigability, and content are some categories to evaluate the quality of the website [8]

- Website Accessibility: This criterion takes a special interest of the developers of websites. [21] defined the accessibility as "the level of the ability to access the websites by all kinds' humans and nonhuman". And to have the best results in this field, they proposed many principles to put the accessibility under controlling. According to the W3C recommendations, they had three main categories and fourteen principles, each principal should include within one of the main categories. Mostly, this research concentrated on many attributes to be assessed by the selected tool, for example, the total number of objects (i.e. HTML files, images, Cascading Style Sheets (CSS) elements, multimedia elements, and script elements all in totals). Also, the total page' sizes, the previous objects size and total HTML errors within the websites were taken into consideration.

- Browser Compatibility: This criterion is presented to test the ability of a Web browser to display the HTML code in a useful way, this test helps the different users in different fields to open and use any web page by any browser.

### 3.2 Automatic Website Evaluation Tools

One of the used tools for checking websites broken links is **Linkchecker** 9.2 which parses the whole website links regardless of their type searching for broken links, and providing a description of the content types of the website with URL length statistics. Another tool used for checking the broken links is **Xenu**; both of them check the internal and external links of websites. There are specific websites for checking **Page Rank** of websites, within this research five of them were used, the first one was that checks page rank of websites referring to Google rank, another online tool for getting page rank was Google **Page Rank**, and finally **TAW3** accessibility traffic is used to return the traffic to the website globally and locally in addition to the number of websites that's linked to the tested sites.

Website accessibility is an essential factor that affects a user's intentions to use e- government services; website accessibility is the degree of which citizens can access web information. The success of e- government adoption by the users depends on the quality of information presented on the sites and service quality. We selected **TAW** tool (http://www.tawdis.net/ingles.html) to analyze accessibility problems with the selected websites. TAW was developed by a non-profit group (CTIC) in Spain; this product is based on WCAG 2.0 guidelines.

4. The Methodology

Within this research, we proposed a framework of three assessing website quality metrics which are; Accessibility, Usability, and Ranking, all the selected website metrics were evaluated using online diagnostic tools; the methodology that we followed is summarized in figure 1.
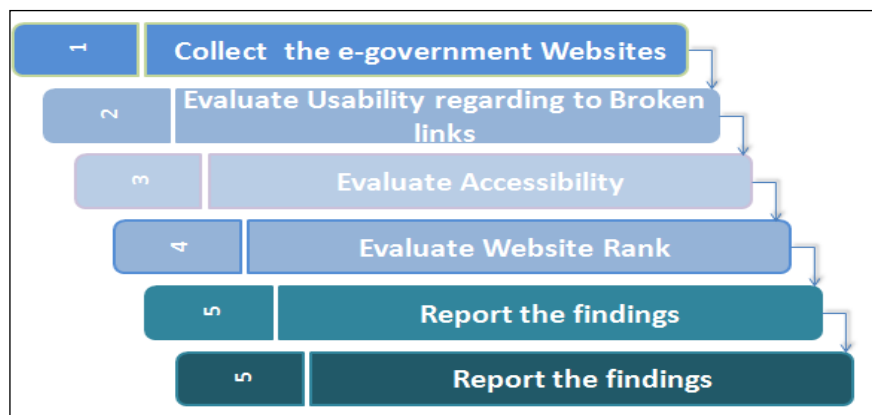
Figure 1:   Steps of the proposed method

4.1. Our Approach

Within this research, a proposed framework of some tools was used to evaluate the percentage of broken links throughout a number of selected websites. A comparison between the results obtained from the two tools applied in order to check their reliability. Also, the page rank of each one of the selected websites was done using online diagnostic tools. Finally, accessibility will be tested using one online tool and results will be analyzed.

4.2. The Selected E-Government Websites

This study found large peak around the world from the researchers and the users of the e-government sector. Middle East government websites were included in this study to be developed and improved in this term. Many agencies and sectors applied e-government websites in the Middle East to supply the citizens with the needed information and various services. We took some samples of websites to be studied. Table (1) below listed the selected links. The data used through this paper collected from some of Middle East e-government portal websites, the following are the list of countries and their link addresses that were used as a case study:

Table 1: Middle East E-government Selected Websites

No.	Website URL	Country
1	(http://www.e.gov.kw/sites/KgoEnglish/portal/Pages/PortalMain.aspx)	Kuwait
2	(http://www.dawlati.gov.lb/home/)	Lebanon
3	(http://www.maroc.ma/)	Morocco
4	(http://www.ita.gov.om/ITAPortal/ITA/default.aspx)	Oman
5	(http://www.sudan.sd/)	Sudan
6	(http://egov.teacharabia.com/)	Syria
7	(http://www.ministeres.tn/)	Tunisia
8	(https://www.turkiye.gov.tr/)	Turkey
9	(http://www.yemen.gov.ye/portal/).	Yemen
10	(http://www.jordan.gov.jo)	Jordan
11	(http://www.cg.gov.dz/ /)	Algeria
12	(http://www.dubai.ae/en.portal)	Dubai
13	(http://www.egypt.gov.eg/english/home.aspx)	Egypt
14	(http://www.egov.gov.iq/)	Iraq
15	http://www.pm.gov.ly/	Libya

We experimentally test the e-government websites using three metrics; accessibility, usability and ranking, furthermore, we compare our approach with other studies regarding the used metrics and tools. We conducted the experiments from 10 November 2016 to 1 January 2017; the time of evaluation is between 10 am and 2 pm.

5. Experiments and results

There are many online tools used to determine the rank of websites, within this study two of them were applied, the first one is (http://www.seomastering.com/pagerank-prediction.php), for getting Google page rank and the second one is the Alexa traffic (http://www.alexa.com/), which returns the traffic of the website globally and locally and the number of websites that's linked to the tested website. It's worth mentioned here that the most popular ranking website is Alexa.

Table 2: Testing websites Page Ranking

Country	Google Page Rank	Alexa	Total site linking in
Algeria	6	1,116,447	258
Dubai	6	58,346	1,094
Egypt	7	10,653	1,490
Iraq	5	2,262,292	6
Kuwait	7	47,454	454
Lebanon	0	1,572,316	9
Libya	2	857,512	3
Morocco	6	269,803	851
Oman	7	376,278	149
Sudan	0	3,206,682	18
Syria	0	4,383,884	30
Tunisia	7	1,945,524	325
Turkey	9	9,193	1,950
Yemen	6	359,655	229
Jordan	7	836,657	841

Table 2 shows the Page ranks of e-government websites according to Google ranks and Alexa traffic; also it explores the number of links to each website. The results above are depressed for specific websites such as Lebanon, Syria, and Sudan with page rank equal to 0, using Google Page Rank, while an admirable rank was gained from Turkey website with the rank nine out of ten. It clearly is seen that Alexa traffic is very large in most of the countries and the number of linking websites is very small. The results proved that those countries need a lot of work to improve their e-government website quality, the web developers have to work according to the quality guideline criteria.

The main concept behind any development process is testability, the same thing applied in website development to make sure if it achieved success criteria or not. In this section, we test the accessibility according to the Link checker tool on the mentioned websites, in order to test them for broken links; a set of results was gained. The following table explores these results.

Table 3: Broken links percentages using Linkchecker and Xenu.

Number	Country	Linkchecker 9.2			Xenu		
		Total number of links	Total number of broken links	Percentage of broken links	Total number of links	Total number of broken links	Percentage of broken links
1	Algeria	129	3	**02.3%**	130	3	**02.3%**
2	Dubai	313	9	**02.8%**	323	9	**02.7%**
3	Egypt	573	107	**18.6%**	469	98	**20.8%**
4	Iraq	7928	832	**10.4%**	11619	1354	**11.6%**
5	Kuwait	489	18	**03.6%**	286	135	**47.2%**
6	Lebanon	106	13	**12.2%**	104	6	**05.7%**
7	Libya	317	60	**18.9%**	365	51	**16.7%**
8	Morocco	26936	514	**01.9%**	32810	709	**02.1%**
9	Oman	170	15	**08.8%**	166	5	**03.0%**
10	Sudan	577	233	**40.3%**	579	239	**41.2%**
11	Syria	641	43	**06.7%**	688	35	**05.0%**
12	Tunisia	415	31	**07.4%**	406	32	**07.8%**
13	Turkey	4981	112	**02.2%**	4244	127	**02.9%**
14	Yemen	37667	12658	**33.6%**	37111	11121	**29.9%**
15	Jordan	30722	14903	**48.5%**	30212	13999	**46.3%**

The above table shows that Yemen has the highest number of links. This leads to the notion that its website is very large compared to the other tested websites. A big number of links in the websites could mean a large amount of information that could be a cause for internet users to be lost within these websites whiles the search for a specific piece of information. On the other hand, huge websites might have a large number of links with the possibility to be broken. Also, the results show that Lebanon has the smallest total number of links within its website. Moreover, it is obvious that Kuwait and Sudan have the largest amount of broken links through their websites, and the percentages of broken links for them are clearly high.

The table also shows the results obtained after applying the Xenu tool on the selected websites for evaluating them for the number of broken links. The results using this tool are clearly close to the Linkchecker results. It's clear that Yemen occupied the first place with the largest amount of links and Lebanon website comes in the bottom with the smallest number of links. The difference that clearly visible is with the results gained from Kuwait website, in Xenu, the number of links was larger than the one obtained from applying the Linkchecker 9.2, so the percentage of broken links in Xenu is less than the one in the Linkchecker 9.2, which refers to the used language for building that website, or might be the type of links that the tool could parse.

Table 4: Accessibility results of the selected Websites.

Country	Problems	Warnings	Not reviewed
Algeria	5	20	17
Dubai	5	1	18
Egypt	14	186	15
Iraq	129	623	17
Kuwait	115	775	15
Lebanon	23	313	15
Libya	45	265	17
Morocco	64	469	16
Oman	134	609	17
Sudan	2	3	18
Syria	4	1	17
Tunisia	105	121	15
Turkey	0	314	18
Yemen	7	245	13
Jordan	169	545	14

The total accessibility report of e-government websites is evaluated using TAW tool as shown in table 4. In our accessibility evaluation approach, we evaluated 15 e-government websites. TAW tool has been carried out in order to evaluate the accessibility of the selected websites. We have classified this e-government website in terms of web accessibility report generated by TAW tool (problems, warnings, not reviewed). The results show that Jordan e-government website has the most number of problems, whereas Turkey had no problems, this difference may result from the number of the hyperlinks on the website, or maybe a reason of the number of broken links.

Finally, our study is compared with the previous studies based on standards and used tools. Table 5 displays a comprehensive comparison between studies that use online tools to check the quality of different websites. Most of the researchers focused on the accessibility standard because it is very important in evaluating websites [19] [22]. However, usability is evaluated by other researchers, such as [8] [23].

Table 5: A comparison between previous studies and ours.

Cite	Title of the study	Case study	Used tools	Quality criterion
[8]	Towards Improving Quality of E-Commerce	Arabic and Non-Arabic	Questionnaire and SPSS for analysis	Usability, Organization,

		Websites in Hospitals.	hospitals		design, Content,
[23]		Usability Evaluation of Web Support Frameworks (2016)	17 web frameworks	Analytical method	Usability
[19]		Quality Evaluation of E-Government Websites of Turkey.	51 Government websites of Turkey	Fast Link Checker web page speed analyzer HTML Validator HTML code	Usability Accessibility
[12]		Analysis of Website Usability Evaluation Methods.	Educational Universities of Punjab	Site Analyzer Qualidator tool	Usability.
[22]		Accessibility, Quality, and Performance of Government Portals and Ministry Web Sites: A View Using Diagnostic Tools.	19 e-government websites	TAW HTML Toolbox W3C Web Validators	accessibility
[24]		PEQUAL - E-commerce websites quality evaluation methodology.	10 E-commerce websites	EQUAL method	Usability Site design Information quality Trust Empathy

The evaluation shows that the e-government website designers should pay attention to usability and accessibility guidelines in order to improve ease of use and access to these sites. However, when we examined these websites, we have noticed that it does not take into account the features of a good website. Our study found that web designers should rebuild trust with users of e-government websites by raising the effectiveness and update according to the needs of the user.

5. Conclusion and Recommendations

This paper presented a quality assessment model for e-government websites in some Middle East countries. This model was built based on three evaluation measures which are accessibility, usability and page rank. For this purpose, we used several websites diagnosis tools. Through this study, we aware the importance of evaluating the websites to exploit the time for users so as to provide high accuracy information in shortest possible time. The results were disappointed for some the tested websites, the research came up with recommendations for the web developers of these websites to follow the quality principles, also, we hoped from those countries to take real directions to the e-government portals, and improve the services they provide. In the future, we

plan to enlarge the number of the tested websites and involving more criteria in estimating the quality of websites, one more direction is to give the websites a certificate to be used before considering them as a universal website. Finally, we decide to change the study area to other areas such as educational websites.

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