Evaluating Accessibility of Malaysian Ministries Websites using WCAG 2.0 and Section 508 Guideline

Aidi Ahmi, Rosli Mohamad
Audit and Information Systems Department, Tunku Puteri Intan Safinaz School of Accountancy, Universiti Utara Malaysia, 06010, Sintok Kedah, Malaysia.
aidi@uum.edu.my

***Abstract*—Although e-government practice in Malaysia shows considerable progress, accessibility of the government websites has been cited as the next key concern that deserves further attention. It is therefore essential to ensure greater compliance of the government websites with established web accessibility standards and guidelines. This is in line with an initiative to promote better delivery system of the government. In response, this paper reports accessibility status of 25 Malaysian ministries websites as outlined in Web Content Accessibility Guidelines 2.0 (WCAG 2.0) and United States Rehabilitation Act 1973 (Section 508). Using AChecker and WAVE as automated accessibility evaluation tools, the results suggest relatively low compliance of the standards amongst the ministries websites examined. Further improvements are recommended, particularly on the contrast view requirement as well as the use of input and image-related elements. The report can be a meaningful guidance for webmasters to locate and address the errors accordingly. Fully complying with the stipulated guidelines, therefore, ensures equal experience among citizen on accessing government related information and services.**

***Index Terms*—Web Accessibility; WCAG 2.0; Section 508; Public Sector.**

I. INTRODUCTION

Internet penetration substantially increased to 38% of total population or 2.7 billion users in 2013 with a compound annual growth rate of 10% since 2008 [1]. In response to the continuous growth on Internet usage, various organisations, with no exception the government institutions, have established the website as one of the possible means to disseminate information for various stakeholders. The government institutions, particularly, will benefit from Internet-based technology by extending their delivery system to the citizen and other relevant stakeholders [2]. Thus, providing accessible website is attributed to an efficient web-based delivery system. On top of that, having an interactive website promote better transparency, accountability and openness of government delivery system [3].

Nonetheless, the website must be designed in such a way to be flexible and adaptable for users with diverse background, physical capabilities and technological constraints. This include, among others, people with different types of disabilities, the device and the browser used to browse the website, type of the Internet connection or size of the bandwidth. Incorporation of various users accessibility attributes therefore ensure equal opportunities to information and services made available online amongst the citizen [4].

Web accessibility refers to a website that put no restriction for disabled person to perceive, to understand, to navigate, to interact and to contribute via the web [6]. On another respect, accessible website should be navigable and understandable even when users are accessing the website with limited conditions or constraints [5]. As a sum, apart from enhancing web experience of more than 1 billon disabled people worldwide [7], web accessibility also play crucial role to ensure smooth navigating experience among normal users whom are suffering from various temporary or short-term constraints. These constraints might include slow Internet connection, temporary disabilities (e.g. a broken arm), or reduced abilities due to ageing factor. The website must be designed in a manner to meet user needs at various circumstances, preferences or abilities [8]. As such, meeting web accessibility requirement should be seriously taken into consideration as one of the aspects of web design.

To facilitate organizations or individual on web accessibility issues, World Wide Web Consortium (W3C) has instigated Web Accessibility Initiative (WAI), which was later translated into Web Content Accessibility Guidelines (WCAG 1.0) in 1999. WCAG 1.0 concerns on various design elements that affect web accessibility for users with different kinds of disabilities and constraints [10]. The guideline has been widely accepted as the preferable web accessibility standard worldwide [11]. There are three categories of web accessibility classifications indicate in the standard, namely; Level A, Level AA and Level AAA. Every website is expected to comply with at least Level A requirements as it indicates mandatory web elements that make the web accessible to the people with disabilities. Complying with all provisions specified for Level AA enable wider accessibility of the web to the people at large. Meanwhile, inclusion of items in the highest level (Level AAA) assures widest number of people with disabilities to access to the web content (w3c.org).

Extending prior standard with substantial enhancement, WCAG 2.0 had taken place in 2008 [12]. The revised version,

complemented with extensive manual and documentation supports, is claimed to be more user oriented guideline [13].

Other than WCAG 2.0, Section 508 of the United States Rehabilitation Act, has been well-accepted as a complimentary standard of web accessibility. Focusing on protecting the right of people with disabilities, Section 508 prohibits any kinds of discrimination on disabled people in US. Section 508 specifically indicates the need to address issues in all kinds of access to Information technology and electronic media (including Internet and website) by all citizen with physical, sensory or cognitive disabilities. The section spells out 16 standards of maintaining web accessibility. The standards that were initially meant for US federal agencies, have put forward suggestions for integrating various design components for better web accessibility (WebAiM, 2013).

While inspecting web accessibility elements is relatively complicated process, availability of various automated tools has made the evaluation process easier. Using WCAG 2.0 and Section 508 as the primary guidelines, most of the tools offer quick and convenient way of locating and rectifying flaws related to the web accessibility [15]. In fact, it is the most reliable technique to objectively evaluate web accessibility [16]. Among the popular free applications available include AChecker, WAVE, TAW, FAE and Eval Access. Nevertheless, as automated tools have incorporated varying standards as the basis of evaluation, users may anticipate some variations across different tools in terms of the comprehensiveness of the assessment and details of the reporting.

Growing importance of web accessibility has attracted many studies worldwide. Assessment of web accessibility have been carried out on various organization types/sectors, which include higher institution [17-20], library [21], hotels [16], and Small Medium-sized Enterprises [22].

In line with initiative to promote electronic government (e-government), attempts have been reported on accessibility of the government-related websites. To illustrate, a study on 60 Romanian municipal council websites using automated assessment software found lower compliance on WCAG 2.0 guidelines [4]. Study on ministries websites of Pakistan [23] revealed similar results, particularly on Priority 2 compliance (Level AA). Meanwhile, manual investigation developed country indicated 65% compliance rate among the Korean government institutions [24]. Application of TAW assessment tool on selected Dubai government agencies also suggest that many government websites are still far behind the WC3 conformance levels [25]. Application of web accessibility standard on mobile web of four Brazilian public institutions also found substantial accessibility problems [2]. Taken as a whole, most of the earlier studies indicate somewhat low or moderate compliance on web accessibility standards.

In addition to the use of automated tools, several attempts have been reported to employ multiple evaluation strategies. For example, a cross-country comparison between South Korea and USA government's websites has employed both automated tools and manual-based assessment [26]. Similarly, evaluation of Iranian ministries websites was carried out using automated tools, manual-based assessment as well as user experience [15]. Both studies have concluded that combination of multiple approaches may be useful to provide richer perspective on web accessibility analysis.

With respect to assessment tool, earlier works have employed either single or combination of several tools to objectively evaluate the government-based websites. Among the automated tools employed include Webxact [15], Total Validator [4, 23], Web Acc Checker [16], Bobby [29], and TAW [25]. Thus, it is essential to combine multiple automated assessment tools to obtain more comprehensive assessment reports.

Looking from a local context, several studies have indicated positive improvement on electronic government practice in Malaysia [27]. On the same vein, a content analysis on state government portals and websites using MGPWA criteria revealed higher maturity of the government portals and websites [28]. However, several other works on web accessibility of public sectors have suggested otherwise. To illustrate, a longitudinal study on accessibility of the Malaysian public higher institutions websites showed that none of the websites examined was fully accessible with limited improvement over the two years [18]. Similarly, the study that examined accessibility of nine Malaysian e-government websites based on WCAG 1.0 showed none of the websites met the W3C Priority 1 accessibility checkpoints [29]. These indicate the need to have continuous assessment of the government-related websites as to ensure the web accessibility requirement is met.

Consequently, while previous studies have been focusing on different scopes of web accessibility, deploying different tools or examining different kinds of organisation types, this paper sheds light on the web accessibility amongst Malaysian ministries; the highest agencies in federal government administration. This is timely choice in view of the growing importance of website and portal in government delivery system. The government has recently initiated Malaysian Government Portals and Websites Assessment (MGPWA), spearheaded by Multimedia Development Corporation (MDeC), as part of its continuing effort to improve delivery system via web portal. More importantly, the recent report of MGPWA urges all government portals/websites to conform to the W3C Disability Accessibility standard [9] to ensure equal experience on the web particularly for people with disabilities. The outcome of this paper would also facilitate web developers at various ministries to address relevant web accessibility issues.

The paper is organised into four sections. The next section describes research method that have been employed in carry out the study. The third section reports the results of web accessibility assessment and provides discussion on the study outcome. Following the discussion, the final section offers conclusion of the study, limitations and future research directions.

II. METHODOLOGY

This study has evaluated the web accessibility of 25 federal government's website in Malaysia based on the WCAG 2.0 guidelines. Some of the criteria in WCAG 2.0 has been adapted by MDeC in formulating Provider-Based Evaluation (ProBE 2015) for Malaysian organizations. Specifically,

ProBE 2015 covers two main components. Mandatory component includes site performance, content and online transparency. Meanwhile non-mandatory component includes, among others; functionality, navigation and look and feel of the website. Although web accessibility appears only as one of the non-mandatory components, provision of accessible website not only helps to increase web usage among citizen but to enhance user experience while navigating the website. Under this criteria, the websites are required to comply with Level A requirements of WCAG 2.0, which enables a disabled person to use the website.

For the purpose of this study, the main homepage has been evaluated as the basis to have quick insight on the web accessibility. The main page could be the most up to date section of the website and the most frequently maintained by the webmaster [31]. To facilitate objective assessment of each website, AChecker and WAVE automated tools were employed.

The website accessibility analysis has been conducted from Friday, January 1, 2016 to Saturday, January 2, 2016. Restriction of data collection process is to ensure no substantial changes on the ministries webpage that might resulted from regular maintenance or update activities.

III. RESULTS AND DISCUSSION

A. Web Accessibility Results based on AChecker

Table 1 summarises the result of the web accessibility test and the number of issues detected by AChecker. This tool identifies and reports three types of problems; Known Problems, Likely Problems and Potential Problems. Known problems refer to the problems that have been identified with certainty as accessibility barriers. Likely problems include all problems that have been identified as probable barriers, but requires manual inspection of the web for confirmation. Meanwhile, potential problems are the problems that AChecker is not able to recognise and requires manual check by human.

The website passes the accessibility evaluation if no error found for all three problem categories. The website is considered as conditional passed if there is no errors reported on known problems category but had certain issues with the likely problems and/or potential problems categories. Otherwise, the website status is considered as failed the web accessibility test in case of any errors found for known problems category despite no errors reported in other problems categories.

As indicated in Table 1, most of the Ministry websites failed to fulfil the web accessibility requirements as stipulated by AChecker test based on WCAG 2.0 and Section 508. Out of 25, only three websites (KKR, MOE and MOHE) have completely passed the test. MOD classified as conditional pass for all web accessibility guidelines. PMO got conditional passed for all levels under WCAG 2.0 except for Section 508 while KKMM only got conditional passed for WCAG 2.0 (A) but failed to meet all other requirements. Nevertheless, AChecker unable to generate report for one of the websites (KPDNKK) for WCAG 2.0 level AA and AAA.

Table 1
A Checker Results Summary by Ministry based on WCAG 2.0 and Section 508 Guidelines

Ministry	Section 508				WCAG 2.0 A				WCAG 2.0 AA				WCAG 2.0 AAA			
	R	K	L	P	R	K	L	P	R	K	L	P	R	K	L	P
KBS	F	6	32	100	F	1	2	573	F	12	2	581	F	12	2	587
KETTHA	F	20	23	202	F	6	0	881	F	38	0	891	F	38	0	896
KKLW	F	38	64	150	F	71	12	1316	F	214	12	1329	F	131	12	1334
KKMM	F	9	33	211	C	0	20	922	F	20	20	947	F	29	20	952
KKR	P	0	0	0	P	0	0	0	P	0	0	0	P	0	0	0
KLN	F	36	67	182	F	21	1	633	F	38	1	656	F	38	1	664
KPDNKK	F	8	37	647	F	2	4	3462	X	X	X	X	X	X	X	X
KPKT	F	31	64	267	F	4	0	939	F	15	1	1062	F	15	1	1065
KPWKM	F	13	26	202	F	8	0	837	F	8	0	858	F	8	0	864
KWP	F	15	36	198	F	71	1	958	F	106	1	987	F	117	1	995
MITI	F	45	67	296	F	8	1	1283	F	8	1	1329	F	10	1	1334
MOA	F	8	25	191	F	2	1	740	F	33	1	799	F	33	1	816
MOD	C	0	7	25	C	0	1	83	C	0	1	92	C	0	1	97
MOE	P	0	0	0	P	0	0	0	P	0	0	0	P	0	0	0
MOF	F	11	36	168	F	2	1	736	F	2	1	759	F	2	1	767
MOH	F	32	45	238	F	16	2	1071	F	44	2	1092	F	45	0	1097
MOHA	F	22	19	159	F	16	0	922	F	16	0	947	F	16	0	980
MOHE	P	0	0	0	P	0	0	0	P	0	0	0	P	0	0	0
MOHR	F	6	46	210	F	7	0	657	F	7	0	672	F	7	0	677
MOSTI	F	40	54	208	F	184	2	709	F	198	3	59	F	198	3	758
MOT	F	43	43	267	F	42	0	1138	F	132	1	1210	F	90	1	1213
MOTAC	F	2	9	77	F	1	1	727	F	18	1	742	F	18	0	747
MPIC	F	8	18	158	F	7	1	861	F	10	1	892	F	10	1	897
NRE	F	10	49	201	F	2	0	779	F	6	0	803	F	6	0	808
PMO	F	15	21	52	C	0	0	389	C	0	0	394	C	0	0	417
TOTAL		418	821	4409		471	50	20616		925	49	17101		823	46	17965

Legend: R=Result, K=Known Problems, L=Likely Problems, P=Potential Problems, F=Fail, P=Pass, C=Conditional Pass, X=Website cannot be evaluated

Under Known Problem component, AChecker inspects 12 primary issues as specified in WCAG 2.0 guidelines. For each of the issue inspected, there are several criteria specified in order to evaluate the accessibility of the content. Those issues require immediate attention of the web developer to rectify. Table 2 presents issues generated by AChecker for all levels of WCAG 2.0 specification. Under the WCAG 2.0 (Level A), one of the issues that deserves attention is keyboard accessibility. About 138 errors or 29 percent were reported for this issue. This type of errors could be due to two primary concerns: (1) Any element that contains an onmouseover attribute must also contain an onfocus attribute and (2) Any element that contains an onmouseout attribute must also contain an onblur attribute. Both of these errors are easily can be repaired by adding an onfocus handler to the script that performs the same function as the onmouseover handler or by adding an onblur handler to the script that performs the same function as the onmouseout handler. There are also higher number of errors found in level AA and AAA for the same issue.

Table 2
Known Problems based on WCAG 2.0

Known Problems*		WCAG2.0 (Level A)		WCAG2.0 (Level AA)		WCAG2.0 (Level AAA)	
		Total	%	Total	%	Total	%
1.1	Text Alternatives: Provide text alternatives for any non-text content	114	24	253	27	117	14
1.2	Time-based Media: Provide alternatives for time-based media.	n/a	n/a	n/a	n/a	n/a	n/a
1.3	Adaptable: Create content that can be presented in different ways (for example simpler layout) without losing information or structure.	92	20	93	10	93	11
1.4	Distinguishable: Make it easier for users to see and hear content including separating foreground from background.	0	0	291	31	335	41
2.1	Keyboard Accessible: Make all functionality available from a keyboard.	138	29	137	15	137	17
2.2	Enough Time: Provide users enough time to read and use content.	0	0	0	0	0	0
2.3	Seizures: Do not design content in a way that is known to cause seizures.	n/a	n/a	n/a	n/a	n/a	n/a
2.4	Navigable: Provide ways to help users navigate, find content, and determine where they are.	27	6	51	6	40	5
3.1	Readable: Make text content readable and understandable.	1	0	1	0	1	0
3.2	Predictable: Make Web pages appear and operate in predictable ways.	n/a	n/a	n/a	n/a	n/a	n/a
3.3	Input Assistance: Help users avoid and correct mistakes.	94	20	93	10	93	11
4.1	Compatible: Maximize compatibility with current and future user agents, including assistive technologies.	5	1	6	1	7	1
TOTAL		471	100	925	100	823	100

*Known Problems listed are as per WCAG 2.0 (Level AA). In other levels, it might be described differently based on the requirements of a particular level.
**n/a = not applicable

Under WCAG 2.0 Level AA and AAA, the criteria that requires serious attention is on distinguishability of the web contents. It supposed to be easier for users to see and hear the content by separating foreground from the background. However, the contrast detected between the colour of text and its background is not sufficient. Under WCAG 2.0 Level AA, the contrast ratio requirement for this level is 5:1 while in WCAG 2.0 Level AAA the contrast ratio must be at least 7:1 for easily distinguishable contents. Lower colour contrast will make it difficult for some visitors to see or read the content [30].

Other issue concerns as per the Table 2 is on the use of text alternatives for non-text content. WCAG 2.0 recommends the provision of text alternatives for any non-text content such as image, area, embed and input elements.

While the above issues highlighted the highest rank of error in all levels of the WCAG 2.0, there are also other problems that need attention as well such as adaptability, input assistance, navigability, and compatibility. Adaptability issue is essential in which the web administrator must ensure that information and structure can be separated from presentation. Provision of input assistance can help users to avoid and correct mistakes. The website also must be navigable in which it can provide ways to assist users to navigate, to find content, and to determine where they are. Compatibility feature ensures the website to support current and future user agents, including assistive technologies. The other issues that have been marked as not applicable (n/a) are the issues that have not been categorised as known problem. These issues are therefore classified as likely or potential error type instead.

Table 3
Known Problems as per Section 508

Known Problems	Total	%
A - text equivalents	105	25
B - multimedia equivalents synchronized	0	0
C - colour also available without colour	0	0
D - stylesheets in use	0	0
E - text links for server-side image map	0	0
F - client-side image maps instead of server-side	0	0
G - row/column headers for data tables	0	0
H - associate data cells and header cells	0	0
I - frames shall be titled	0	0
J - avoid flicker	0	0
K - text-only page	0	0
L - script must have functional text	309	74
M - applets etc. must comply	0	0
N - accessible forms	4	1
O - skip repetitive navigation links	0	0
P - timed response	0	0
Total	418	100

With respect to specific requirements of accessibility as outlined in Section 508, AChecker reports three issues out of 16 standards listed (see Table 3). The first issue that requires attention is about the script that must have functional text. A total of 309 errors or 74 percent of the total errors under Section 508 have been discovered for non-compliance to this standard. The standard stresses that every script element occurs within the body must be followed by a noscript section.

The second issue is about the text equivalent in which all images must have alternate text. Similar findings as reported under WCAG 2.0. People who are not able to view the image requires this feature to be embedded on the web. Image element also should not have alternate attribute value of null or whitespace if the image element is contained by an A element and there is no other link text. In case of the image is used as a link, then it must provide alternate text that describes the link destination.

B. Web Accessibility Results based on WAVE

Table 4 shows the summary of web accessibility results generated by WAVE accessibility tool that has been embedded in Google Chrome browser. This tool provides visual feedback about the accessibility of the web content by injecting icons and indicators into the page. All analysis is done entirely within the browser. WAVE analyses the web accessibility errors, alerts, features, structural elements, HTML5 and Accessible Rich Internet Applications (ARIA) and contrast errors based on the WCAG 2.0 (Level A), WCAG 2.0 (Level AA) and Section 508.

All of the website can be evaluated using WAVE, however there are two websites in which its contrast errors cannot be analysed. Overall results revealed that six ministries websites reported no errors although the websites have some other issues which is related with other elements. Most of the websites examined reported less than 20 errors except for MOSTI which have the total of 112 errors.

Table 4
WAVE Results Summary

Ministry	Errors	Alerts	Features	Structural Elements	HTML5 and ARIA	Contrast Errors
KBS	17	188	28	50	9	47
KETTHA	0	36	58	7	3	29
KKMM	5	93	77	68	0	127
KKR	5	28	19	87	0	9
KKW	18	61	78	59	30	136
KLN	0	20	43	22	0	26
KPDNKK	7	90	427	183	7	240
KPKT	0	27	64	67	34	24
KPWKM	8	192	177	71	17	38
KWP	0	251	47	56	0	35
MITI	8	27	66	80	18	31
MOA	4	81	87	53	1	18
MOD	7	100	34	62	17	110
MOE	1	166	62	49	3	9
MOF	0	30	53	38	0	61
MOH	6	144	256	57	23	45
MOHA	2	160	305	64	165	59
MOHE	13	92	76	48	0	41
MOHR	12	65	58	28	3	74
MOSTI	112	16	1	37	16	7
MOT	21	47	71	76	14	**
MOTAC	0	22	32	51	6	44
MPIC	5	32	54	81	4	166
NRE	2	59	52	29	56	**
PMO	11	19	20	25	6	2
Total	264	2046	2245	1448	432	1378

* Findings as at 2nd January 2016
**Contrast Errors cannot be evaluated by WAVE

Table 5 reports detail errors detected by WAVE. The highest errors found by WAVE is empty form label in which each label must have a content. There are about 86 occurrences which is equivalent to about 33 percent of total errors found for this type of error.

The second most commonly found errors amongst the websites is an empty link i.e. the link provided on the website contains no text. To rectify this error, the webmaster should provide text within the link that describes the functionality and/or target of the link. Type of error with the third highest frequency is missing alternative text for linked images. Basically, alternative text provides a textual alternative to non-text content in website and it becomes a barrier to accessibility especially for screen reader users [14]. The remaining errors together with its description and importance are presented in Table 5.

Table 5
WAVE Errors Details

Errors	What It Means	Why It Matters	Total	%
Empty form label	A form label is present, but does not contain any content.	A <label> element that is associated to a form control but does not contain text will not present any information about the form control to the user.	86	33
Empty link	A link contains no text.	If a link contains no text, the function or purpose of the link will not be presented to the user. This can introduce confusion for keyboard and screen reader users.	85	32
Linked image missing alternative text	An image without alternative text results in an empty link.	Images that are the only thing within a link must have descriptive alternative text. If an image is within a link that contains no text and that image does not provide alternative text, a screen reader has no content to present to the user regarding the function of the link.	35	13
Missing alternative text	Image alternative text is not present.	Each image must have an alt attribute. Without alternative text, the content of an image will not be available to screen reader users or when the image is unavailable.	24	9
Empty button	A button is empty or has no value text.	When navigating to a button, descriptive text must be presented to screen reader users to indicate the function of the button.	13	5
Invalid longdesc	The longdesc attribute is not a URL.	The longdesc attribute of an image must be a valid URL of a page that contains a description of the image content. A longdesc value that contains image description text will not provide any accessibility information.	10	4
Missing form label	A form control does not have a corresponding label.	If a form control does not have a properly associated text label, the function or purpose of that form control may not be presented to screen reader users. Form labels also provide visible descriptions and larger clickable targets for form controls.	7	3
Empty heading	A heading contains no content.	Some users, especially keyboard and screen reader users, often navigate by heading elements. An empty heading will present no information and may introduce confusion.	2	1
Broken skip link	A skip navigation link exists, but the target for the link does not exist or the link is not keyboard accessible.	A link to jump over navigation or jump to the main content of the page assists keyboard users only if the link is properly functioning and is keyboard accessible	1	0
Empty table header	A <th> (table header) contains no text.	The <th> element helps associate table cells with the correct row/column headers. A <th> that contains no text may result in cells with missing or incorrect header information.	1	0
Total			264	100

IV. CONCLUSION

In line with government effort to promote better service delivery to the citizen, having effective is getting paramount. Having said that, web accessibility is one of the aspects that receive greater attention. Web accessibility ensures equal access to information and service delivery to all citizen including people with disabilities. This paper reports web accessibility of 25 Malaysian ministries as generated by two automated assessment tools. The assessment that was carried out based on WCAG 2.0 and Section 508 guidelines suggests low compliance to the stipulated standards/guidelines. Improvements should be given priority particularly in the aspects of contrast view, the use of scripting, navigation assistance, empty link, empty form label and use of text alternatives for presenting non-text elements.

No studies being carried out without limitations. As this study focuses on Malaysian federal ministries website, readers should not extrapolate the findings to other government agencies due to differing nature and objective of the agencies. Nevertheless, the results and recommendations are of relevance to webmasters of other organisations as far as web accessibility is concerned. In addition, the tools used were restricted to AChecker and WAVE. Other automated tools may cover slightly different aspects of the accessibility standards.

Future research may be ensued on different levels of government agencies i.e. state government agencies or local government agencies. Longitudinal assessment of the websites instead of cross-sectional approach may also help to examine web accessibility improvement. Details level assessment of the accessibility report on other type of problems and errors could also offer better insight on the web accessibility issues. Finally, application of different automated tools or combination of multiple tools could be another possible extension of the present study to enrich the reported results.

REFERENCES

[1] Internet Society, Global Internet Report. 2015. http://tinyurl.com/oq8zx9c.
[2] Serra, L. C., Carvalho, L. P., Ferreira, L. P., Vaz, J. B. S. and Friere, A. P. "Accessibility Evaluation of E-Government Mobile Applications in Brazil". *Procedia Computer Science*. Vol. 67, pp. 348 – 357, 2015.
[3] Pina, V., Torres, L. and Royo, S. "E-Government Evolution in EU Local Governments: A Comparative Perspective". Online Information Review. Vol. 33 (6), pp. 1137–1168, 2009.
[4] Pribeanu, C. Marinescu, R-D., Fogarassy-Neszly, P. and Moisii. M. G. "Web Accessibility in Romania: The Conformance of Municipal Web Sites to Web Content Accessibility Guidelines". *Informatica Economică*. Vol. 16 (1), pp. 28–36, 2012.
[5] Shawn, L. H. 2006. Web Accessibility: *Web Standards and Regulatory Compliance*, Friend of Ed.
[6] World Wide Web Consortium (W3C). 2009. [Online]. http://tinyurl.com/jyvrddt.
[7] World Health Organization. 2011. *World Report on Disability*, WHO Press, Geneva.
[8] World Wide Web Consortium (W3C), Introduction to Web Accessibility, [Online]. http://tinyurl.com/jzxf4cy.

[9] Multimedia Development Corporation. 2013. *Malaysia Government Portals and Websites Assessment (MGPWA).* Multimedia Development Corporation, Cyberjaya.

[10] Adam, A. and Kreps, D. "Enabling or Disabling Technologies? A Critical Approach to Web Accessibility". *Information Technology & People*. Vol. 19(3), pp. 203-218, 2006.

[11] Rømen, R. and Svanæs, D. 2012. "Validating WCAG Versions 1.0 And 2.0 Through Usability Testing With Disabled Users". *Universal Access in the Information Society*. 11 (4): 375 – 385.

[12] World Wide Web Consortium [W3C], Web Content Accessibility Guidelines (WCAG) 2.0. Retrieved September 9, 2015, [Online]. http://tinyurl.com/5zhpyd

[13] Ribera, M., Porras, B. M. Termens, M., M., Sule, A. and Paris, P. "Web Content Accessibility Guidelines 2.0". *Program: Electronic Library and Information Systems*, vol. 43 (4), pp. 392-406, 2009.

[14] WebAiM, Accessibility Evaluation Tools, 3 October 2013. [Online]. http://tinyurl.com/jd9d636.

[15] Hassanzadeh, M. and Navidi, F. "Web Site Accessibility Evaluation Methods in Action". *The Electronic Library*, vol. 28 (6): pp. 789–803, 2010.

[16] Williams, R. R. R. "UK and US Hotel Web Content Accessibility". *International Journal of Contemporary Hospitality Management*, vol. 17(1), pp. 78-87, 2015.

[17] Abdul Aziz, M. Wan Mohd Isa, W. and Nordin, N. "Assessing the Accessibility and Usability of Malaysia Higher Education Website". *Proceeding of the 2010 International Conference on User Science Engineering (i-USEr)*: pp. 203 – 208. 2010.

[18] Abuaddous, H. J. M. Z. and Basir, N. "Study of the Accessibility Diagnosis on the Public Higher Institutions Websites in Malaysia". *Proceedings of the 4th International Conference on Computing and Informatics* (ICOCI 2013), Kuching, Sarawak: pp. 412–417, 2013.

[19] Chacón-Medina, A., Chacón-López, H., López-Justicia, M. D. and Fernández-Jiménez, C. "The State of Web Accessibility in Spanish Universities according to WCAG 2.0". *Revista Española de Documentación Científica*, vol. 36 (4), pp. 1-13, 2013.

[20] Laitano, M. I. 2015. Web Accessibility in the Argentine Public University. *Revista Española de Documentación Científica*. Vol. 38 (1), pp. 1 – 9.

[21] Comeaux, D. and Schmetzke, A. 2013. Web Accessibility Trends in University Libraries and Library Schools. *Library Hi Tech*, vol. 31(1), pp. 457–477.

[22] Isa, M., Abdul Aziz, M. and Abdul Razak, M. "Evaluating the Accessibility of Small and Medium Enterprise (SME) Websites in Malaysia". *Proceedings of 2011 International Conference on User Science Engineering (i-USEr)*: pp. 135 – 140, 2011.

[23] Bakhsh, M. and Mehmood, A. "Web Accessibility for Disabled: A Case Study of Government Websites in Pakistan. *Proceeding of 10th International Conference on Frontiers of Information Technology*: pp. 342-347, 2012.

[24] Noh, K.R. Jeong, E.S. You, Y.B. Moon, S.J. and Kang, M.B. "A Study on the Current Status and Strategies for Improvement of Web Accessibility Compliance of Public Institutions". *Journal of Open Innovation: Technology, Market, and Complexity*. Vol. 1(4), pp. 1–17, 2015.

[25] Kamoun, F. Almourad, M. B. "Accessibility as an Integral Factor in E-Government Web Site Evaluation: The Case of Dubai E-Government". *Information Technology & People*, vol. 27 (2), pp. 208 – 228, 2014.

[26] Hong, S. Katerattanakul, P. and Lee, D. "Evaluating Government Website Accessibility". *Management Research News*, vol. 31(1), pp. 27 – 40, 2008.

[27] Abdul Rashid, M. A. Othman, M. N. A. and Hassan, N. "Discovering Malaysian State e-Government Maturity Stage: Implementation Process and Progress". *Gading Business and Management Journal*. Vol. 18 (2): pp. 51-75. 2014.

[28] Multimedia Development Corporation (MDeC). Malaysia Government Portals and Websites Assessment 2010. Multimedia Development Corporation (MDeC): Cyberjaya.

[29] Abdul Latif, and Masrek, M. "Accessibility Evaluation on Malaysian E-Government Websites". *Journal of e-Government Studies and Best Practices*. pp. 1 – 11, 2010.

[30] Roggio, A. 2016. *Common Web Accessibility Problems on Leading Ecommerce Sites*. Retrieved on 16 May 2016 from http://tinyurl.com/zmxnrva

[31] Providenti, Zai III, R., "Web accessibility at Kentucky's academic libraries", *Library Hi Tech*, vol. 25 (4), pp. 478–493, 2007. doi: 10.1108/07378830710840446