
Evaluation of accessibility standards on Ugandan e-government websites

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Abstract: In spite of the efforts made by the Government of Uganda through the National IT Authority Uganda (NITA-U) to provide many of the government services online, web accessibility is still not considered as a major factor by the developers of the e-government websites. As a result, people with disabilities cannot use websites as effectively as people without disabilities. Therefore, the main objective of this study was to evaluate the extent by which Ugandan e-government websites meet the internationally accepted WCAG 2.0 standards. The analysis was done for 63 websites belonging to government ministries, departments and agencies. Website accessibility assessment was carried out using two automatic evaluation tools: *TAW* and *AChecker*. The results presented in this paper indicate that all the websites do not satisfy the level AA accessibility guidelines. Although NITA-U has developed guidelines for building websites, there is still great need to improve accessibility on e-government websites.

Keywords: accessibility; e-government; WCAG 2.0; ministries, departments and agencies; MDAs; developing country; Uganda.

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1 Introduction

There has been a rapid growth in the use of information and communication technologies (ICTs) for delivery of information and services to citizens in developing countries. Governments have also taken keen interest in the use of ICTs and through e-government, services can be delivered to citizens via the internet (Akgul and Vatansever, 2016). The Government of Uganda (GoU) through its National Information Technology Authority-Uganda (NITA-U) has made it its mandate to ensure the delivery of government services to citizens through the use of ICTs (NITA-Uganda, 2014). Consequently, the GoU requires all government ministries, departments and agencies to put their services online where possible. Several steps have been taken by NITA-U to enable smooth transition and provision of government services electronically. One of the steps was for NITA-U to develop guidelines for the development, management and maintenance of Government websites (NITA-Uganda, 2014). Such websites belong to the various ministries, departments and agencies (MDAs) within the government. The developed standards were based on the Web Content Accessibility Guidelines (WCAG) of the World Wide Web Consortium (W3C) (WCAG 2.0, 2017).

Successful e-government delivery, access and use is dependent on various challenges. One of the major government concerns is ensuring equitable access to online services. For instance, in order for the services provided by government to be accessible electronically, government websites have to be accessible by all citizens even those with various forms of disability. Secondly, according to a survey carried out by the Uganda voice matters (UReport), 49% of the respondents stated that the biggest frustration that people faced in accessing government services was time delays (UReport Uganda, 2017). This implies that it is crucial that government services are provided in a convenient, timely and accessible way. According to the Uganda Population and Housing Census, one in every 14 persons in Uganda has a disability, which is a considerable part of national population (UBOS, 2016). Any form of disability can be a barrier for people who would want to access a government service over a website.

According to Verkijika and De Wet (2017), there have been several researchers (Asiimwe and Lim, 2010; Kuzma, 2010; Olalere and Lazar, 2011; Youngblood, 2014; Abanumy et al., 2005; Adepoju et al., 2016; Al Mourad and Kamoun, 2013) that have carried out studies in e-government accessibility in order to find out the compliance and usability levels of several e-government websites. However, from their findings it is evident that there are still several government websites that are non-compliant. In fact, several of these websites are actually not even used by both people with disabilities and those without disabilities. To address this research gap, this paper aims at evaluating the extent to which Uganda e-government MDA websites meet the internationally accepted WCAG 2.0 standards.

The remainder of the paper is organised as follows. First, an overview of related work is provided in Section 2. Section 3 gives a discussion of the evaluation framework and standards used for website accessibility. Section 4 provides the methodology used in this paper. Section 5 provides a discussion of the results from the web accessibility tools. Finally, Section 6 concludes the paper.

2 Related work

This section discusses related studies carried out in the area of web accessibility. In the first section, a discussion of the approaches used for web accessibility analysis is provided. Then work that has been done to access accessibility in African websites is given in the next subsection. Finally, a discussion is provided on related studies that has been carried out to evaluate websites in Uganda.

2.1 Approaches used in web accessibility analysis

Over the past years, several authors have carried out evaluation studies of e-government websites in a number of countries to assess conformance of these websites. This analysis has focused on several issues that include: accessibility (Akgul and Vatansever, 2016 in Turkey; Abanumy et al., 2005 in Saudi Arabia and Oman; Adepoju et al., 2016 in Nigeria), usability (Asiimwe and Lim, 2010 in Uganda; Noe, 2017 in Tanzania), findability (Kopackova et al., 2010 in Czech Republic), page loading speeds, broken links, security and vulnerabilities (Noe, 2017 in Tanzania), and errors caused by the development language, e.g., HTML (Alshamari, 2016 for Arabic countries).

Initial studies on e-government accessibility checks were based on WCAG 1.0 (e.g., Noe, 2017; Kuzma et al., 2009; Ismailova, 2017). Al Mourad and Kamoun (2013) evaluated accessibility standards of 21 Dubai e-government websites based on WCAG 1.0 guidelines and found that many of the websites did not meet the minimum accessibility conformance level. Kuzma (2010) carried out an assessment of 130 websites of the UK members of parliament based on the WCAG 1.0 guidelines. From this assessment, it was reported that 82 of those websites did not meet the legal requirements regarding web accessibility. Other authors have also carried out accessibility checks based on the improved WCAG 2.0 guidelines (Alshamari, 2016; Adepoju et al., 2016; Ahmi and Mohamad, 2016; Verkijika and De Wet, 2017). For example, Alshamari (2016) evaluated three e-commerce websites using five automated accessibility checking tools. From the results, the conclusion was that navigation,

readability, input assistance and timing were the main accessibility problems observed with these websites.

Many of the authors reported have used both automated and manual tools to carry out the evaluation. For example, Hong et al. (2008) used both automated tools and manual-based assessment to evaluate accessibility of Korean e-government websites. It was observed that manual evaluation highlighted few accessibility errors than those found using automated evaluation.

2.2 Web accessibility in Africa

In Africa, authors have also attempted to evaluate government websites to determine their conformance levels to WCAG guidelines. Verkijika and De Wet (2017) evaluated 217 government websites in Sub Saharan Africa (SSA) and based on their findings, none of the websites adhered to all the WCAG 2.0 guidelines. There were several factors that affected the accessibility of the websites across several countries in SSA. Noe (2017) examined the accessibility, usability and web security of 79 e-government websites in Tanzania. Using several automated tools it was observed that all the selected websites had accessibility errors and violated the WCAG 1.0 guidelines.

Furthermore, the authors in Adepoju et al. (2016) evaluated websites for 36 states in Nigeria using the two automated tools based on WCAG 2.0 guidelines. The results here show that many websites do not even adhere to the minimum guidelines set up by the Nigerian government. Kuzma et al. (2009) also carried out an exploratory evaluation of EU, Asian and African websites (South Africa, Liberia, Kenya and Namibia). The evaluation results showed that there were much higher errors in African websites compared to the websites in EU and the majority of worldwide government websites did not meet the WCAG 1.0 guidelines.

2.3 Web accessibility in Uganda

Uganda recognises the need for a conducive policy and regulatory environment to support and guide the development of government websites. To this end, the Ugandan government has through NITA-U developed guidelines for the development and management of government websites (NITA-Uganda, 2014). The main objective of the website development guidelines is to offer guidance on the development and management of government websites in terms of quality, reliability, accuracy and accessibility of online information on government MDAs as well as ensuring a consistent experience for all users. To achieve this need the document provides guidelines on the national government identity, recommended levels of functionality and information provision, and website and content design. It also urges MDAs to follow WCAG guidelines when developing their websites in order to ensure equitable access to these websites even for people with various disabilities. The aim here is to make web content more accessible to a wider range of users including those with disabilities such as the blind, visual impairment, deafness, hearing loss, learning disabilities, cognitive limitations, limited movement, speech difficulties, photo-sensitivity and combinations of these. The GoU is also in the process of developing an ICT for Disability policy (Ministry of ICT and National Guidance, 2018). The draft ICT for disability policy particularly notes the lack of a web accessibility framework for persons with disabilities.

In as far as web accessibility studies are concerned, Asiimwe and Lim (2010) conducted an in-depth examination of the usability of four government ministry websites in Uganda. They established that these websites were partially usable in terms of possessing appropriate design layouts and navigation, but did not perform well on the requisite legal policies. Baguma et al. (2007) also examined the practice and perceptions of webmasters in Uganda on the accessibility of government websites. The results of their study showed that all government websites were not accessible even though 33% of the webmasters were familiar with one or more of the WCAG guidelines. Moreover, this work also highlighted that government websites fail to cater for the the people with disabilities.

The related work discussed in this section shows that tests done have similar evaluation criteria and most of the research employed a number of techniques for the testing, for example, the use of automatic, manual or a combination of both. The guidelines that were used for the accessibility checks were mainly WCAG 1.0, WCAG 2.0 and Section 508 and some are also using country specific guidelines (e.g., Hyun et al., 2007).

This paper is the first one to examine web accessibility standards for Ugandan e-government websites. This study considered websites for government MDAs which are key service providers in Uganda. The GoU is through NITA-Uganda centralising access to various online government resources. For example the Uganda National Government Web Portal (2017) provides access to available government MDA websites; the eCitizen Portal (2017) that provides centralised access to government provisioned online services; and the government has recently launched a one stop centre electronic business portal – eBiz Portal (2017). The results of this paper will facilitate the web masters at NITA-Uganda and at the different government MDAs to focus and address the relevant web accessibility issues on their websites before government services are fully provided electronically.

3 Evaluation framework and standards for website accessibility

The W3C is an international community that develops standards to ensure the use of the web. In particular, the W3C has developed a set of standards for accessibility particularly to help disabled people. In 1999, the first accessibility standard, WCAG 1.0 was developed by the WCAG working group (Kuzma et al., 2009). These standards evolved to WCAG 2.0 standards (WCAG 2.0, 2017; WUHCAG, 2018) which comprises of twelve guidelines organised under four principles. More recently, the guidelines have been updated to WCAG 2.1 (WCAG 2.1, 2018). WCAG 2.1 have been developed further from the WCAG 2.0 with the goal of improving accessibility guidance for three major groups: users with cognitive or learning disabilities, users with low vision, and users with disabilities on mobile devices (WCAG 2.1, 2018). Under WCAG 2.0 standards, websites must be perceivable, operable, understandable, and robust. Each guideline has testable success criteria (61 in total) (WCAG 2.0, 2017; WCAG Success, 2018). Each of these principles are briefly explained below:

- 1 Principle 1: Perceivable – requires that users are able to perceive all information being presented on the website whether text or multimedia files. It is all about the senses people use when browsing the web. The guidelines ensure that websites

support three senses including sight, sound and touch. This principle has *four* guidelines.

- 2 Principle 2: Operable – requires that users must be able to operate the website’s interface, e.g., through appropriate navigation and search functions. It focuses on the different ways in which users browse the web. This principle has *four* guidelines.
- 3 Principle 3: Understandable – requires that users are able to understand the information as well as the operation of the user interface. The website must use clear terms and have simple instructions where necessary. This principle has *three* guidelines.
- 4 Principle 4: Robust – requires that users are still able to access the website content as technologies such as web browsers advance. This principle has *one* guideline.

Each of these guidelines has a number of check points which are used as a basis for conformance to meeting the web accessibility needs of people with disabilities (Kuzma et al., 2009; WCAG 2.0, 2017). Each guideline is assigned a conformance to determine the impact on accessibility, with the following three levels of conformance:

- Level A (basic accessibility): The minimum level of conformance that must be satisfied by the web page.
- Level AA (intermediate accessibility): The web page satisfies all the level A and level AA success criteria. This conformance level should be met in order to remove any significant barriers to access information from the website.
- Level AAA (high accessibility): The web page satisfies all the three levels, i.e., level A, Level AA and level AAA. This conformance level status may be addressed by Web developers to improve access to website documents.

It is important that web developers satisfy the basic level A conformance criteria. However, it is not recommended that level AAA conformance be required as a general policy because it is not possible to satisfy all the standards in this level. However, if websites do not satisfy level AA, they may not address all the necessary features that are important for accessibility across all disabilities (Friedman and Bryen, 2007; Akgul and Vatansever, 2016). Based on these guidelines, its important to note that this paper presents results of website assessment based on the level AA requirements of WCAG 2.0 guidelines which were the intermediate accessibility requirements that enabled any disabled person to use the website.

According to Friedman and Bryen (2007), it is important that individual countries do not only rely on the standards that have been setup for checking websites but should also enact their own legislations. In fact, governments in the developed world continually enforce laws to mandate accessibility of their websites (Verkijika and De Wet, 2017; Kuzma et al., 2009). As highlighted earlier, NITA-U has come up with guidelines for the development and management of government websites (NITA-Uganda, 2014). These guidelines are supposed to guide the development of government websites for the MDAs. These standards are not only limited to accessibility but also cover other web standards including security and usability. Although the standards developed by NITA-U and the web accessibility standards do exist, there has not been any research carried out to analyse the conformance levels of Ugandan e-government websites to these standards.

4 Methodology

This research focused on checking the accessibility of Ugandan e-government websites. Particularly, this study focused on establishing the accessibility errors based on the WCAG 2.0 guidelines. In order to carry out this assessment, appropriate online tools were selected to analyse the accessibility of the e-government websites. It was important that these tools were assessing the websites based on the latest WCAG 2.0 guidelines. There are several automatic accessibility tools available to assess the accessibility of websites. A comprehensive list of the Web accessibility evaluation tools can be obtained at the Web Accessibility Evaluation Tools (2017) list.

According to Kuzma et al. (2009) and Akgul and Vatansver (2016), accessibility tools differ from one another in many aspects including: cost (some are open source while other have to be bought), goal of the tool (for accessibility conformance or fixing accessibility violations), the nature of the interaction form (on-line or stand-alone applications), the effectiveness, breadth and depth of accessibility reports, the conformance guideline support provided by the tool (e.g., WCAG 1.0, 2.0, Section 508 standards, the Stanca Act, BITV, RGAA or a combination of them) and conformance levels supported (A, AA, AAA). As the authors in Akgul and Vatansver (2016) and Vigo et al. (2013) highlighted, it is important that when carrying out accessibility checks, such checks do not rely on only one automatic evaluation tool since none of the tools can be used to obtain the best scores in all the dimensions. The work discussed in this paper was carried out using two web accessibility testing tools:

- a TAW3 Standalone User's Guide (2017)
- b Web Accessibility Checker (2017).

The tools were selected for the assessment because they are widely used and are also based on the WCAG 2.0 guidelines. TAW gives a detailed report of the accessibility problems classified into automatic problems and human review problems (Kuzma et al., 2009; Akgul and Vatansver, 2016). Automatic problems are the ones that the tool has checked against the WCAG guidelines and have been found to violate these guidelines while the human review problems are the warnings that are not measured by the tool and require to be reviewed by an expert. The assessment in this study was limited to the automatic problems not the human review problems.

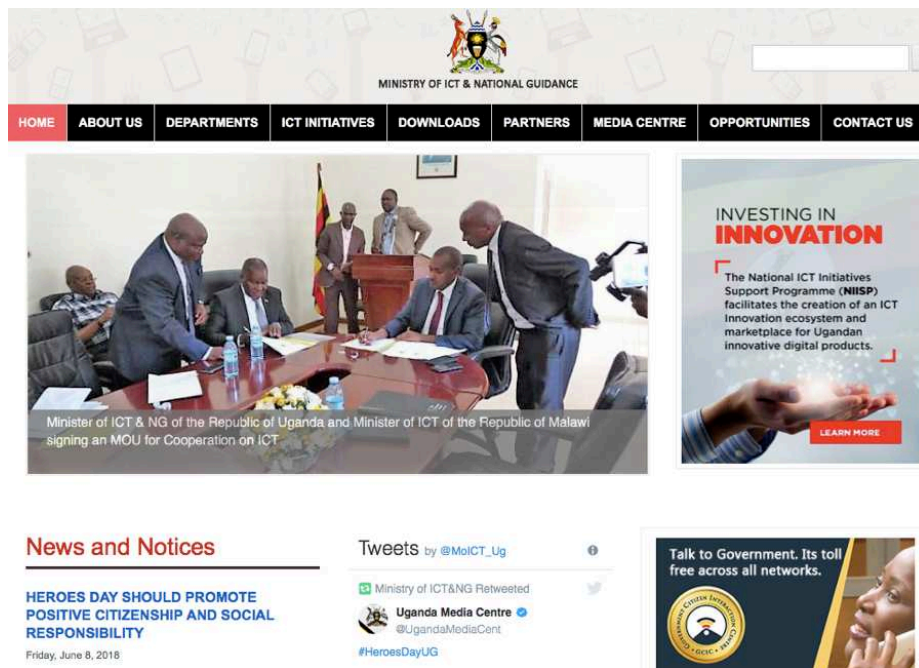
The Web Accessibility Checker (AChecker) also gives a detailed report of the accessibility problems classified as: known, likely and potential. The known problems are those identified to be hindrances to accessibility, the likely problems are the problems that have been identified as probable hindrances to accessibility, but require manual inspection of the website for confirmation. The potential problems are the ones that the AChecker is not able to recognise and require manual checking by a human (Ahmi and Mohamad, 2016). Using the AChecker, only the known problems were considered in the review of the websites since these did not require human intervention.

The work in this paper was limited to 63 e-government websites as illustrated in Table 1. These websites were selected from Uganda's eCitizen Portal (2017). 21 of the selected websites were for the government ministries, 20 websites were for the government departments and 22 websites belonged to the agencies within the government.

Table 1 Number of government websites under each category

Type of website	Number
Ministries	21
Departments	20
Agencies	22

Figure 1 Home page for the Ministry of ICT and National Guidance (2018)
(see online version for colours)



Government ministries provide strategic oversight in terms of supporting the establishment of the relevant policy and regulatory framework of a specific sector. There is not a clear distinction between the government departments and agencies. Notably the agency plays a regulatory role, overseeing the smooth implementation of policies in various sectors. For instance the agencies affiliated with the Ministry of ICT and National Guidance are: NITA-U and Uganda Communications Commission (UCC). While the former oversees the implementation of national e-governance services, the latter is in charge of telecommunications and broadcasting infrastructure within the country.

From a recently concluded National IT survey (NITA-Uganda, 2018) it was established that 98.7% of the participating MDAs offered e-government services using their institutional websites. In addition, these websites publish information about the sector, its mandate and organisational structure. They also publish the existing policies;

laws and regulations. Examples include the Ministry of ICT and National guidance which has a typical government website as shown in Figure 1. For most of the MDA websites the interactive component is a feedback form as well as embedded sections to social media platforms such as Facebook and Twitter. They use the website as an avenue to publish updates of the activities with the government MDA.

To evaluate the websites using the tools, the URL of the home pages was submitted into the two tools (TAW and AChecker). The reasons for using the home page of the websites is that the main page acts as an entry into other pages of the website and the main page usually gives a first impression of the website (Latif and Masrek, 2010). Ideally the home page should provide the best perspective of all features of the website such as navigation, use of images, colours and text. Furthermore, according to Ahmi and Mohamad (2016), the home page is the most up-to-date part of the website since it is the most frequently updated page of the website. This is also justified by the recent Uganda National ICT survey (NITA-Uganda, 2018) that established that 87% of the MDAs that participated in the survey updated their websites at least once a month. Notably the most frequently updated part of a dynamic website is the homepage mainly with news, events and social media posts. The website accessibility analysis was conducted between Monday, 4 July 2017 to Friday, 14 July 2017 and this was ensure that there were no changes on the government web pages due to updates and maintenance.

5 Results and discussion

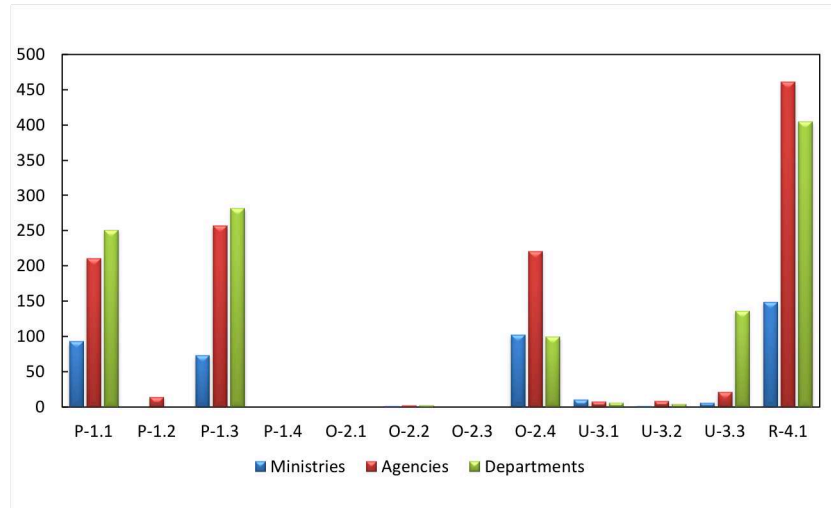
This section discusses the results of web accessibility based on TAW and AChecker tools. In this study, web content accessibility conformance to the WCAG 2.0 guidelines was assessed based on the errors present on the web pages as given by the two tools. Table 2 shows results from the TAW tool based on the level AA conformance.

Table 2 Number of government websites under each range of accessibility errors based on the TAW tool

<i>Range of errors</i>	<i>Ministries</i>	<i>Agencies</i>	<i>Departments</i>	<i>%</i>
0–5	6	2	4	19
6–25	6	3	5	22
26–50	7	7	7	33
51–75	1	3	4	13
>76	1	5	2	13
<i>Total</i>	<i>21</i>	<i>20</i>	<i>22</i>	<i>100</i>

The table highlights the number of websites for each range of errors. Overall, it is interesting to note that none of the government MDA websites passed the level AA accessibility check. The websites presented an equal distribution of the web accessibility errors. The greatest number of websites under each of the MDAs presented 33% of the errors in the range of 26–50. The websites belonging to the government agencies had the highest number of errors which were greater than 76 compared to the other government websites.

Figure 2 Distribution of the accessibility errors under each principle based on the TAW tool where P: perceivable, O: operable, U: understandable, and R: robust (see online version for colours)



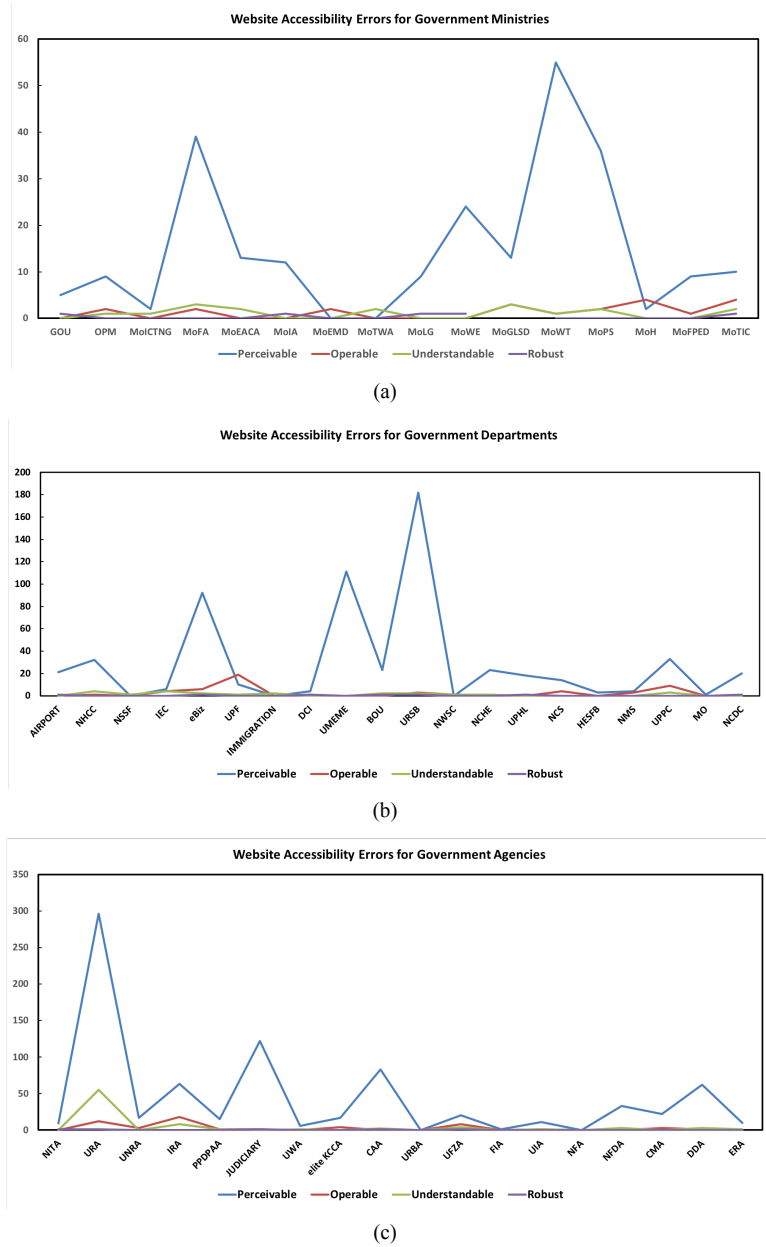
Notes: P-1.1 to P-1.4 indicate the guidelines under the perceivable principle. The colours correspond to the different websites where: blue – ministries, red – agencies, and green – departments.

Figure 2 shows the distribution of the errors under each of the four principles based on the TAW tool. In the previous section, we stated that each principle has a number of guidelines. Figure 2 expands these principles to indicate the results for each of the guidelines under each principle. It is observed that overall the websites belonging to government agencies presented the greatest number of violation errors followed by the websites for departments and then the websites for the ministries.

The guidelines that were most violated were: guideline 4.1 under the robust principle, followed by guidelines 1.3 and 1.1 under the perceivable principle and guideline 2.4 under the operable principle. Guideline 4.1 was the most outstanding across all the government websites. The guideline is about the content presented in the website which should be compatible to a range of users including assistive technologies (ATs). All user agents including ATs should be able to accurately interpret and parse content presented on the website. The implication of the results presented in Figure 2 is that many of the government websites do not support compatibility with all of the user groups.

Figure 3 shows results from AChecker for the assessment of government MDA websites. The results presented here are highlighted for each of the four principles and these are shown against the individual websites. As observed with the TAW tool, the websites for the government agencies presented the greatest number of accessibility errors compared to the ministries and departments. Based on AChecker, the most violated principle across all the MDA websites was *perceivable* while the least violated principle was *operable*. This is also consistent with the results that were obtained using the TAW tool as shown in Figure 2.

Figure 3 Graph showing the number of accessibility errors for websites belonging to government, (a) ministries (b) departments (c) agencies (see online version for colours)



Notes: Results are based on AChecker. The x-axis of each graph shows the different MDA websites.

Table 3 provides a comparison of the web accessibility errors from TAW and AChecker tools based on the level AA conformance. The results shown here are summed up across the 63 MDA websites. For both TAW and AChecker, the most violated principle was *perceivable* while the least violated principle was *understandable* for TAW, and *robust* for AChecker.

Table 3 Known problems on specific guidelines as per WCAG 2.0 (level AA) based on TAW and AChecker tools

<i>Principles</i>		<i>TAW</i>		<i>AChecker</i>	
		<i>Total</i>	<i>%</i>	<i>Total</i>	<i>%</i>
<i>Principle 1: perceivable</i>					
1.1	Provide text alternatives for all non-text content separated from presentation	935	29	546	37.5
1.2	Provide synchronised alternatives for multimedia	14	0.4	0	0
1.3	Ensure that information and structure can be separated from presentation	624	19.4	146	10
1.4	Make it easy to distinguish foreground information from its background	0	0	522	35.9
<i>Principle 2: operable</i>					
2.1	Make all functionality operable via a keyboard interface	0	0	32	2.2
2.2	Allow users to control time limits on their reading	3	0.1	1	0.1
2.3	Allow users to avoid content that could cause seizures due to photosensitivity	0	0	0	0
2.4	Provide mechanisms to help users find content, orient themselves within it	424	13.2	79	5.4
<i>Principle 3: understandable</i>					
3.1	Make text content readable and understandable	23	0.7	18	1.2
3.2	Make the placement and functionality of content predictable	14	0.4	1	0.1
3.3	Input assistance: help users avoid and correct mistakes	163	5.1	92	6.3
<i>Principle 4: robust</i>					
4.1	Support compatibility with current and future user agents	1,024	31.8	18	1.2
<i>Total</i>		<i>3,224</i>	<i>100</i>	<i>1,455</i>	<i>100</i>

5.1 Discussion on how the e-government websites perform on the WCAG 2.0 principles

From the previous section, it is evident that many of the Ugandan e-government websites have sufficiently large accessibility errors especially on the guideline of providing text alternatives for all non-text content, the guideline of making it easy to distinguish foreground information from its background, and finally the principle of supporting compatibility with current and future user agents. These are highlighted in Table 4 that shows the most violated principles and their implications.

Table 4 The most violated principles and the implications of these violations

<i>Violated principle and guideline</i>		<i>Implication of violation</i>
<i>Principle 1: perceivable</i>		
1.1	Provide text alternatives for all non-text content separated from presentation.	Limited text alternatives for conversions to other forms as may be required.
1.4	Make it easy to distinguish foreground information from its background.	Foreground information and background colour are not distinguishable.
<i>Principle 4: robust</i>		
4.1	Support compatibility with current and future user agents.	Content not robust and cannot support user agent in changing ATs.

The violations of these guidelines are significant in these areas, it is also important to note that other violations have also presented on other guidelines however not that significant as these three guidelines. Out of the 12 guidelines, 3,224 violations were registered using the TAW tool and 1,455 violations were observed using ACheker while reviewing the 63 Ugandan e-government MDA websites.

Table 3 presented accessibility errors that were generated by both the TAW and the ACheker tools. Under the WCAG 2.0 (level AA), one of the main highlighted issues from the TAW tool was *guideline 4.1* under the *robust* principle which recommends the support of compatibility with current and future user agents especially AT. There were about 1,024 errors or 31.8% reported for this guideline. This guideline can be achieved by ensuring the use of well formed markup and not build websites using unconventional code. This implies that most of the government websites do not meet recognised markup standards like the use of HTML, XHTML, JavaScript and CSS. Several websites do not follow given conventions and they can not be compatible with APIs and ATs. Hence, several websites can not easily work with new technologies. Since technologies change quickly AT developers have much trouble keeping up with these rapidly changing technologies. This is one of the main areas that webmasters for MDA websites have to take into consideration when building websites.

The other most violated guideline according to Tables 3 and 4 is *guideline 1.1* which recommends the use of text alternatives for all non-text content. This implies that content should be changed into other forms that people need, such as large print, braille, speech, symbols or simpler language. From Table 3, there were about 935 errors or 29% reported for this guideline based on the TAW tool. The same guideline is the most violated as reported by the ACheker which has 37.5% of errors. The purpose of this guideline was text alternatives be provided through other sensory means like: visual, audio or tactile in order to meet the needs of the users. The provision of input assistance is important for users, e.g., a person who cannot see an image can have the text alternative read aloud using synthesised speech or one who cannot hear an audio file can have the text alternative displayed so that they can read it. As a result, information rendered in electronic text cannot be presented in whatever form best meets the needs of the user. Text should be easily enlarged, spoken aloud and also make it possible for people with reading disabilities to understand, or rendered in whatever tactile form will meet the needs of a user. This is a good success criteria to assess whether a website matches the needs of disabled people. However, based on the results it is one of the

most violated guideline and should also be taken into consideration by the relevant government officers and webmasters.

Another outstanding guideline that was violated based on the AChecker was *guideline 1.4* that had about 35.9% of the errors. This guideline was focused on making default presentation as easy to perceive as possible for people with visual and hearing disabilities. This is because such people have problems separating foreground from background information. Although this is a very important guideline, this has not been followed by webmasters for MDA websites. Suggestions to enforce this principle are: for visual presentations, ensure that information presented on top of a background contrasts well with the background information. For audio presentations, that the foreground sounds are sufficiently louder than the background sounds.

The TAW findings in this study are comparable to those of a similar study conducted in Nigeria (Adepoju et al., 2016). The results from the study in Nigeria also indicate that the most violated principle was *perceivable*, while the least was *understandable*. Similar to MDA websites in Uganda, websites for various states in Nigeria were also characterised by missing linked images, missing alternate text, empty links and form controls without labels. In another study (Verkijika and De Wet, 2018), it was observed that majority of the 279 websites in 31 countries in SSA (of which Uganda is one), scored less than 75% on functional accessibility. Nearly all assessed websites (96.3%) had either an almost incomplete or an incomplete accessibility implementation status. Furthermore, the SSA e-government websites violated almost all WCAG 2.0 guidelines at conformance levels A and AA. Notably similar results on accessibility were observed outside Africa (e.g., Akgul and Vatansver, 2016; Akram and Sulaiman, 2017; Verkijika and De Wet, 2017). This poor performance on accessibility has been attributed to three macro factors namely human development index (HDI), corruption perception index (CPI), and percentage of the active population (15–64 years). It has further been noted that the poor performance on accessibility may explain why the region has been consistently ranked the worst in e-government development index.

5.2 Implications of the findings and comparative assessment with NITA-U guidelines

This study revealed that while the GoU has made an effort in ensuring that all government MDAs have an on line presence, there is still inequitable access by persons with disabilities. This may be attributed to various issues such as the lack of awareness and requisite skills on the part of the developers or webmasters; as well as the limitations of the relevant policy and regulatory framework. Uganda has made attempts on all fronts, however there is still room for improvement.

For example in June 2016 the United Nations Educational Scientific and Cultural Organization (UNESCO) in collaboration with NITA-U created awareness and equipped government officials with necessary skills of how to make government websites accessible to persons with disabilities in Uganda (UNESCO, 2016). There is need to follow-up on how this impacted on the existing websites. Furthermore regularising such activities with a monitoring and feedback mechanism will ensure that the websites are improved to meet the WCAG 2.0 guidelines.

Previous studies have established that the existence of a strong technical assistance legal and policy framework is key in ensuring that government meets the web accessibility needs of people with disabilities (Kuzma et al., 2009; Rubaii-Barrett and Wise, 2008). They further note that the way the policy is formulated and enforced also plays an important role. Some countries have gone ahead to developing accessibility laws to ensure compliance. Although as earlier mentioned Uganda has policy documents that highlight the need for government websites to meet the requirements of persons with various disabilities, they are not explicit on the implementation guidelines. The Draft policy for persons with disabilities also mentions the need for a web accessibility policy for persons with disabilities explicitly addressing implementation, training and monitoring compliance. The government web development and management guidelines could also be revised to explicitly offer implementation guidance on designing websites for persons with disabilities. Government should also consider local contextualisation of the guidelines for example through the provision of tools that convert from English to the local languages. The development of such tools can be some of the considerations in the current government efforts towards developing local and relevant innovative solutions to national development problems. The above efforts combined, and implemented in a phased approach would improve equitable access to the government MDA websites.

6 Conclusions

This paper has presented results from an assessment carried out to evaluate the extent by which Ugandan e-government websites meet the internationally accepted WCAG 2.0 standards. The assessment was done based on two automated tools: TAW and AChecker. Results obtained in this paper show that all the government websites belonging to the MDAs do not meet the intermediate WCAG level AA standard. Therefore, it is crucial that the webmasters of the government websites pay special attention to accessibility of their websites. It is recommended that NITA-U should ensure that all the e-government websites do adhere to the internationally accepted WCAG 2.0 guidelines.

The main limitation of this work is the exclusive reliance of our accessibility analysis on automated testing results. Although the results presented in this paper provide very useful information about web accessibility, they do not substitute user testing. 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. Our future research will involve the testing of the websites with the webmasters of the government websites and also carry out the testing with the disabled people. This is important because it provides first hand information necessary to build better websites. A future plan is to also carry out an in depth analysis of the Ugandan e-government websites to include other pages besides the home page.

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