INVESTIGATING CONFORMANCE OF E-GOVERNMENT WEB SITES IN LIBYA TO W3C ACCESSIBILITY STANDARDS

A MASTER'S THESIS

IN

INFORMATION TECHNOLOGY

ATILIM UNIVERSITY

BY

HAIFA ALGHOUL

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Approval of the Graduate School of Natural and Applied Sciences, ATILIM UNIVERSITY.

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

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This is to certify that we have read the thesis "**Investigating Conformance of e-Government Web Sites in Libya to W3C Accessibility Standards**" submitted by "**Haifa ALGHOUL**" and that in our opinion it is fully adequate, in scope and quality, as a thesis for degree of Master of Science.

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ABSTRACT

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Today's people cannot bear a life without the Internet. It provides access to many things like news, email, shopping, and entertainment, at anytime and anywhere. Governments around the world have adopted the Internet as a channel to introduce their information and services to citizens, businesses and other government sectors.

The government websites work as an interface between the government and the citizens. E-government applications utilizes web technology for making information accessible online to as many people as possible regardless of their disabilities. Accessibility is essential for governments that want to create high quality websites and web tools, and not exclude citizens from using their services. This thesis investigates the status of current government websites in Libya in terms of accessibility, which is one of the World Wide Web Consortium (W3C) criteria to develop high quality web sites. It tries to find out whether e-government websites comply with the guidelines developed by W3C. In this study, several web diagnostic tools are used for investigation. Several suggestions are offered based on the results of the research.

Keywords. Web accessibility, W3C, E-Government, Web standards

ÖZ

LIBYA E-DEVLET WEB SİTELERİNİN W3C ERİŞİLEBİLİRLİK STANDARTLARINA UYGUNLUĞUNUN İNCELENMESİ

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Günümüz insanları internetsiz hayat sürdüremeyecek bir noktaya gelmiştir. İnternet, haber, e-posta, alışveriş ve eğlence gibi birçok şeye her an ve her yerde erişmemizi sağlamaktadır. Dünyadaki hükümetler, bilgi ve hizmetleri vatandaşlara, işyerlerine ve diğer devlet sektörlerine ulaştırmak için İnternet'i bir kanal olarak kabul etmişlerdir.

Hükümet web siteleri, hükümet ile vatandaşlar arasında bir arayüz olarak çalışır. E-devlet uygulamaları, devletin sağladığı bilgi ve hizmetlere özürlerinden bağımsız olarak mümkün olduğunca çok sayıda vatandaşın çevrimiçi erişebilir hale gelmesi için Web teknolojisini kullanmaktadır. Erişilebilirlik, yüksek kalitede Web siteleri ve Web araçları oluşturmak isteyen ve tüm vatandaşlarına bu hizmeti sunmak isteyen hükümetler için vazgeçilmezdir. Bu tez, yüksek kaliteli Web siteleri geliştirmek için World Wide Web Konsorsiyumu (W3C) kriterlerinden biri olan erişilebilirlik açısından Libya'daki mevcut hükümet Web sitelerinin durumunu araştırmaktadır. E-Devlet Web sitelerinin W3C tarafından geliştirilen tavsiyelere uygun olup olmadığını ortaya çıkarmaya çalışmaktadır. Bu çalışmada, araştırma için birkaç çevrimiçi Web tanı aracı kullanılmıştır. Araştırmanın sonuçlarına dayanarak çeşitli öneriler sunulmaktadır.

Anahtar kelimeler. Web erişilebilirliği, W3C, E-Devlet, Web standartları

To My Family and Friends.

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LIST OF ABBREVIATIONS

AIL	Artificial Intelligence Laboratory
ERCIM	European Research Consortium Informatics Mathematics
ICT	Information Communication Technology
IT	Information Technology
MIT CS	Massachusetts Institute of Technology Computer Science
SWI	Standards Web Initiative
UK	United Kingdom
US	United States
WAES	Website Attribute Evaluation System
W3C	World Wide Web Consortium

CHAPTER 1

INTRODUCTION

Today, the web offers a collection of services for citizens of numerous nations, and governments try to benefit from the web to convey their data and services to their citizens. The government websites work as an interface between the government and the citizens. The web has a noteworthy effect to the way in which individuals work and communicate with each other. However, it requires development to enhance the level of accessibility, especially for those people who have disabilities. It is foreseen that e-government services will keep on expanding, making it significantly more vital that all people should have access to those services.

The World Wide Web Consortium (W3C) is a global community that incorporates a full-time staff, industry specialists, and several member organizations. These groups cooperate to create principles for the World Wide Web. W3C was started in 1994 to lead the Web to its most extreme limit by developing common standards that support its improvement and interoperability. W3C has been accepted as a vital organization in the progress of the Web since it was set up in 1994. As Web technologies continue to develop, the W3C continues to develop and publish new standards. The Web standards are precisely intended to convey the best advantages to the largest number of web clients while guaranteeing the long-term usage of any record distributed on the Web.

Web standards are rules and guidelines developed by the W3C to promote consistency in the design and coding of web pages. Without getting technical details, basically, they are the rules for the markup language which decides how a web page will be shown in a user browser. Web accessibility is one of the criteria in W3C standards. W3C standards provides an open web platform for application development that empowers designers to build rich applications connected to tremendous information stores and accessible from any devices.

The intention of this thesis is to investigate web accessibility standards published by W3C, investigate conformance of the Libyan E-Government web sites to these accessibility standards, and compare the results with Tunisia, which is one of the neighbor country of Libya in Africa. This thesis investigates the status of current government website in Libya in terms of accessibility, which is one of the W3C criteria to develop high quality web sites.

More clearly, the objectives of this study can be summarized as follows:

1. Investigate web accessibility standards
2. Investigate conformance of Libyan e-Government web sites to W3C accessibility standards
3. Compare Libyan e-Government web sites with Tunisian e-Government web sites

The first chapter of this thesis establishes the rationale for conducting this research. Chapter two is a literature survey of this thesis study. Chapter three presents the research methodology. Chapter four gives the result of the thesis, and finally, Chapter five provides conclusions.

CHAPTER 2

LITERATURE SURVEY

The literature review is organized into eight sections as follows: web accessibility, definitions, web history, importance of web accessibility, web accessibility and usability, accessibility conformance levels, conformance levels criteria, World Wide Web Consortium (W3C).

2.1 Web accessibility

The Web has an increasing role in people and organization life for more than two decades. People all around the world use the Web for learning, communicating, shopping, and working regardless of where they are or what particular interests they may have. The comprehensiveness of the web lies in its capacity to be accessed by a wide range of clients, regardless of their ages, genders, race or physical capabilities. As per W3C, the web was developed to work for all individuals, whatever their equipment, language, dialect, culture, physical and mental capacity. At the point where the Web meets this objective, it will be available to individuals with different levels of hearing, movement, sight and cognitive capacity. For example, old people having limited sight capacity will be able to use the web. Because web pages will be displayed in a manner appropriate for the user abilities, that does not make a boundary to their utilization.

2.2 Definitions

E-government: It is short for electronic government and it is the utilization of electronic devices, computers and the Internet to give services to the public.

W3C: It is the world wide web consortium. It is an industry community which looks to advance principles for the development of the Web and interoperability between WWW items by developing specifications.

Web Accessibility: It can be defined as the degree which shows accessibility of a site to the largest possible range of individuals. The more individuals can get to a site, the more accessible is the website.

2.3 Web History

To understand the historical backdrop of web accessibility, we initially need to know the history of the World Wide Web. The World Wide Web (W3) was built up by Tim Berners-Lee in 1989. The aim was to make data more useful and accessible to individuals all around the world. Lee imagined the Web as "a device for communicating" and also, he expressed that the web allows you to discover what other individuals do.

The aim of the World Wide Web venture was to make the Internet accessible to everybody. However, individuals with disabilities experienced problems when exploring web sites. The web accessibility project was produced because of this need and was supported by W3C in 1996. This project had a problematic start because of varying perspectives and absence of standard rules, which restricted its capacity to support clients and developers. The historical vision of web accessibility focused on standard guidelines, ideas, and educational tools. The Web Accessibility Initiative was designed and developed by W3C in February1997 with the purpose of creating guidelines for designers, authors, developers and end users in order to make websites, videos, and other software more usable and accessible. The W3C (World Wide Web Consortium) is a non-benefit global community in which associations, staff, and people, in general, cooperate to create guidelines to make Web pages accessible to anybody utilizing Internet now and in the future. Inside their missions, the W3C has a Web accessibility initiative that contains a group of Web accessibility standards to help developers of Web pages in creating web sites with features that empower people with handicaps to access Web contents.

Figure 2.1 demonstrates the timeline of W3C and illustrates the essential activities of the W3C from 1994 to 2001.

Figure 2.1: Timeline of W3C[1]

2.4 Importance of Web Accessibility

Governments has to create e-government web sites which provide content, pictures and videos that are equally accessible by individuals with disabilities. Approximately, 15% of the worldwide population has some kind of disability which represents a significant portion of potential web clients around the world.

Innovations related to accessibility give a chance to disabled individuals to take part in and incorporate with different people and associations in the advanced world. Additionally, it helps enhancing their ability to learn and access to potential business activities. In one study done in 2003, it is clarified that accessible sites are profitable

for disabled individuals as well as for everyone. These outcomes coincide with the concepts of W3C which wants to provide equal access to websites. With accessibility, a lot of people can accomplish more things by themselves, without relying on others. The Web is also an important resource in many areas of life such as education, employment and healthcare, among others. It is necessary that the Web be easy to access in order to offer equal opportunities to people who have disabilities as this can help them be more active participants in society. Web accessibility is also important since it gives extraordinary access to data and social contacts for some individuals with disabilities. This makes it easier to overcome obstacle to access physical media such as CD or DVD using web technologies.

2.5 Web Accessibility and Usability

There is a significant relation between usability and accessibility in web sites and it is essential to evaluate them together. The aim for accessibility is to make sites available to everybody, including individuals with disabilities. However, ease of use is defined as designing products to be effective, efficient and satisfying. Usability is part of the human-computer interaction (HCI) research and design field [1].

To get benefits from the Internet, we should consider all clients when we design web sites. The visual design of sites should be accessible and interesting. In any case, most developers say that accessibility is just considered with limited variables, for example, the straightforwardness of the pages and plain text content in the sites, which does not present any obvious output in making exceedingly fascinating sites with accessibility highlights. Also, making sites straightforward with plain content does not make them accessible to everybody. Web usability has considerably more significance. Usability is all about designing easy to use website taking into account what users need from the site.

2.6 Website Accessibility Conformance Levels

The accessibility rules are divided up into three levels of conformance: A, AA, and AAA as shown in Table 2.1 and Figure 2.2. AAA is the highest level achievable, meaning it complies with the success criteria of all three levels.

***Table 2.1*:** Website Accessibility Conformance Levels

Conformance Level	**Website Accessibility**
A Basic accessibility	Criteria level A
AA Intermediate accessibility	Criteria level A and level AA
AAA High accessibility	Criteria level A, level AA and level AAA

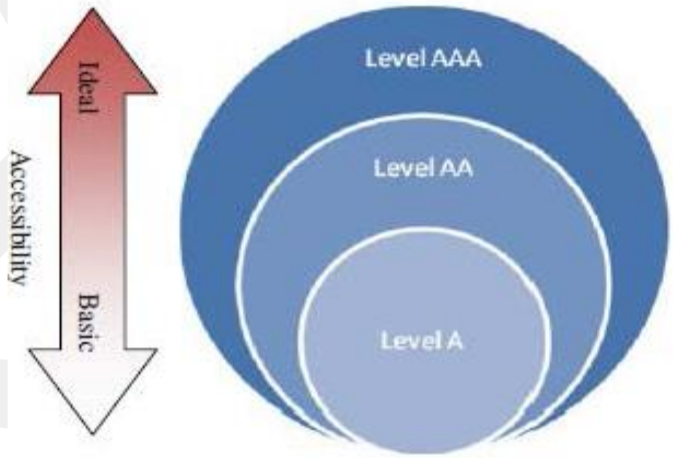

Figure 2.2: The Levels of conformance

2.7 Conformance Levels Criteria

There are a number of criteria that must be met for each conformance levels. These criteria are determined considering the following conditions:

1. All Success Criteria must be important access issues for people with disabilities.
2. All Success Criteria must also be testable.

The Success Criteria are assigned to one of the three levels of conformance [2].

Level A: For Level A, the Web page should satisfy all the Level A Success Criteria.
Level AA: For Level AA, the Web page should satisfy all the Level A and Level AA Success Criteria.
Level AAA: For Level AAA, the Web page should satisfy all the Level A, Level AA and Level AAA Success Criteria.

Table 2.2: Criteria for Level A

1	Non-text Content
2	Audio-only and Video-only (Prerecorded)
3	Captions (Prerecorded)
4	Audio Description or Media Alternative
5	Info and Relationships
6	Meaningful Sequence
7	Sensory Characteristics
8	Use of Color
9	Audio Control
10	Keyboard
11	Page Titled
12	Focus Order
13	On Focus
14	On Input
15	Labels or Instructions
16	Parsing
17	Name, Role, Value

Tables 2.2, 2.3 and 2.4 summarize the criteria needed by the level A, level AA and level AAA, respectively.

Table 2.3: Criteria for Level A

1	Captions (live)
2	Audio description (prerecorded)
3	Contrast (minimum)
4	Resize text
5	Images of text
6	Language of parts
7	Consistent navigation

Table 2.4: Criteria for Level AAA

1	Sing language
2	Extended audio description
3	Media alternative
4	Audio only
5	Low or no background audio
6	Images of text
7	Key board
8	Reading level
9	Help

2.8 World Wide Web Consortium (W3C)

The World Wide Web Consortium (W3C) is an international community of member organizations, supported by organization staff. Its mission is to lead the World Wide Web to its maximum capacity by creating guidelines and rules that guarantee the long-term development of the web. The Consortium is driven by Sir Tim Bernars LEE, who is credited with the development of the WWW. It is managed by three institutions together - the European Research Consortium for Informatics and Mathematics, the Massachusetts Institute of Technology Computer Science, Artificial Intelligence Laboratory and Keio University in Japan [4]. Starting at 10 April 2012, there were 356-member associations inside the W3C, including numerous prominent innovation organizations, for example, Microsoft Corporation [5]. Majority of the member organizations are US or UK based as shown in Figure 2.3.

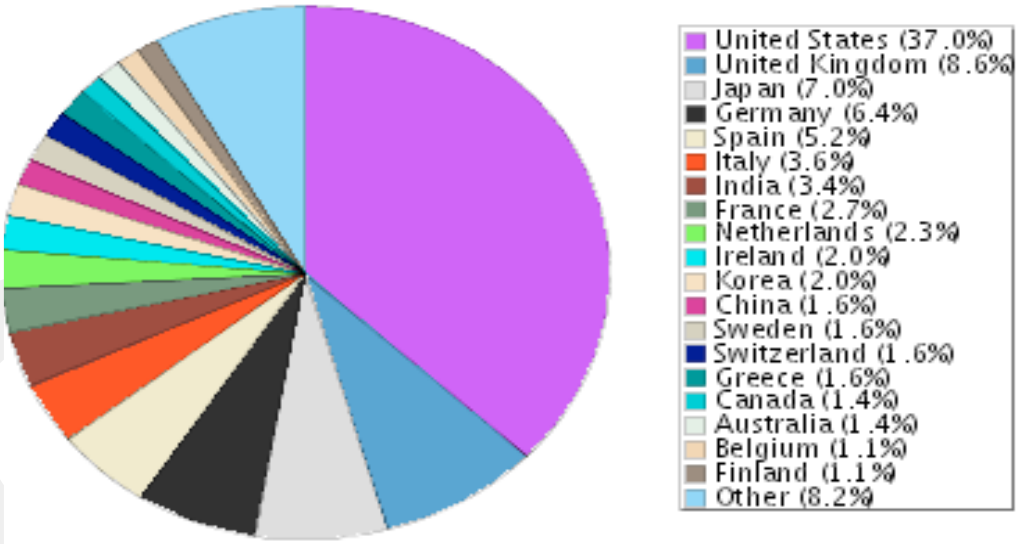

Figure 2.3: Breakdown of W3C member organizations distribution by country.

One of the core principles of the W3C is to advance an "Everything on web" logic, which is centered around guaranteeing web interoperability over a large range of internetwork empowered devices such as smart phones, TVs in addition to computers. W3C works for putting this aim into practices through developing and publishing of principles, standards and best practices in consultation with its member organizations.

CHAPTER 3

METHODOLOGY

The objectives of this study are defined as follows:

1. Investigate web accessibility standards;
2. Investigate conformance of Libyan e-Government web sites to W3C accessibility standards; and
3. Compare Libyan e-Government web sites with Tunisian e-Government web sites.

To achieve these objectives, we have followed the following steps:

1. Investigate web accessibility standards from W3C documents as well as related documents existing in the literature;
2. Determine Libyan e-Government web sites to be evaluated in terms of accessibility;
3. Determine automated tools to be used to evaluate e-Government web sites in terms of accessibility;
4. Evaluate Libyan e-Government web sites with tools;
5. Evaluate equivalent Tunisian e-Government web sites; and
6. Compare the results of two countries.

3.1 W3C Web Accessibility Standards

Web accessibility is to make web sites available to everybody including people with disabilities. It is the degree which shows accessibility of a site to the largest possible range of individuals. The more individuals can get to a site, the more accessible is the website. Since the Web has an increasing role in people and organization life, accessibility is a critical requirement to be considered during design and development.

Web accessibility criteria are given in Table 3.1 with their short explanations.

Table 3.1: Accessibility criteria

1	Non-text Content	information conveyed by non-text, for example, visual, auditory or tactile
2	Audio-only and Video-only (Prerecorded)	information conveyed by prerecorded audio-only and prerecorded video-only content available to all users
3	Captions (Prerecorded)	enable people who are deaf or hard of hearing to watch synchronized media presentations
4	Audio description or media alternative	provide people who are blind or visually impaired access to the visual information in a synchronized media presentation
5	Info and relationships	The intent of this success criterion is to ensure that information and relationships.
6	Meaningful sequence	The intent of this success criterion is to enable a user to provide a presentation preserving the reading.
7	Sensory characteristics	Some content relies on knowledge of the shape or position of objects that are not available from the structure of the content (for example writing video alternative video).
8	Use of color	Use color in web
9	Audio control	Control in audio
10	Keyboard	Use keyboard in anything
11	Page titled	Web contains a title page.
12	Focus rrder	ensure that when users navigate sequentially through content, they encounter information in an order**.**
13	On focus	Focus on title web
14	On input	Input about title
15	Labels or instructions	All page webs
16	Parsing	All parsing
17	Name, Role, Value	All website have name, role and value
18	Captions (live)	enable people who are deaf or hard of hearing to watch real-time presentations. Captions provide the part of the content.
19	Audio description prerecorded	The audio description augments the audio portion of the presentation with the information needed.

20	Contrast	Large Text: Large-scale text and images of large-scale text. Incidental: Text or images of text. Logotypes: Text that is part of a logo or brand name.
21	Resize text	The intent of this success criterion is to ensure that visually rendered text
22	Images of text	Use images of text in web
23	Language of parts	The language is written by the page
24	Consistent navigation	Each site has the title of each title specializing in the title
25	Sing language	enable people who are deaf or hard of hearing and who are fluent in a sign language use Written text
26	Extended audio description	provide people who are blind or visually impaired access to audio.
27	Media alternative	This is done by providing an alternative based media
28	Audio only	Use audio in web
29	Images of text	Use images of text in web
30	Keyboard	Use keyboard in anything
31	Reading level	Content should be written as clearly and simply as possible
32	Help	All Web should have help

3.2 Libyan E-Government Web Sites to be Evaluated

E-Government Web sites provide public services to people and government, to get information and services. In this study, we have chosen 9 Libyan E-Government Web sites to evaluate in terms of accessibility (see Table 3.2). The reason to select these sites is that they are vital sites to provide government services/information to citizens. Therefore, we think that these sites should satisfy accessibilities criteria.

***Table 3.2*:** Libyan e- government websites to be evaluated

1	Ministry of Health
2	Ministry of Justice
3	Ministry of Interior
4	Ministry of Defense
5	Ministry of Finance
6	Ministry The civil service
7	Ministry of Social Affairs and Labors
8	Ministry of Higher Education
9	Ministry of Education

3.3 Tools for Accessibility

We have selected 3 programs in this thesis: WAVE, T.A.W, and POWERMAPPER. These programs were used to test e-Government web sites in Libya and Tunisia. Web Accessibility Evaluation Tool (WAVE) is tool to help web developers make their web content more accessible. WAVE cannot decide whether a page is accessible or not. However, it helps developer to evaluate the accessibility of web content. An output of that program is given in Figure 3.1. TAW is an automatic on-line tool for analyzing website accessibility. The aim of TAW is to check the level of accessibility achieved in the design and development of web pages in order to access to all persons irrespective of their Characteristics. A screen output of the program is shown in Figure 3.2. PowerMapper Software makes easy-to-use tools for mapping, testing and analyzing web sites. **It** finds pages that are unusable by people with disabilities. It checks entire websites against W3 WCAG 1.0, WCAG 2.0 accessibility standards. An output of that program is given in Figure 3.3.

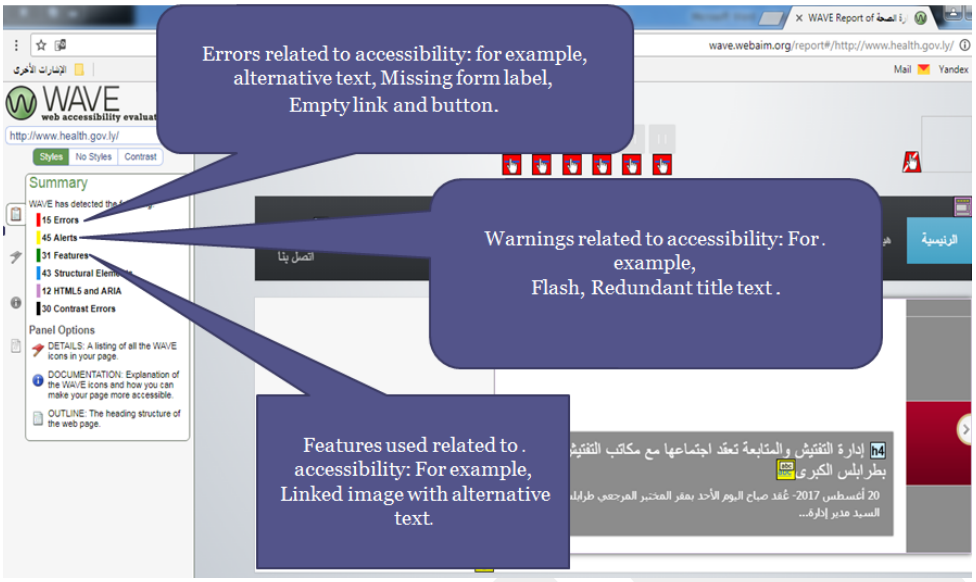

Figure 3.1: Screen view of WAVE

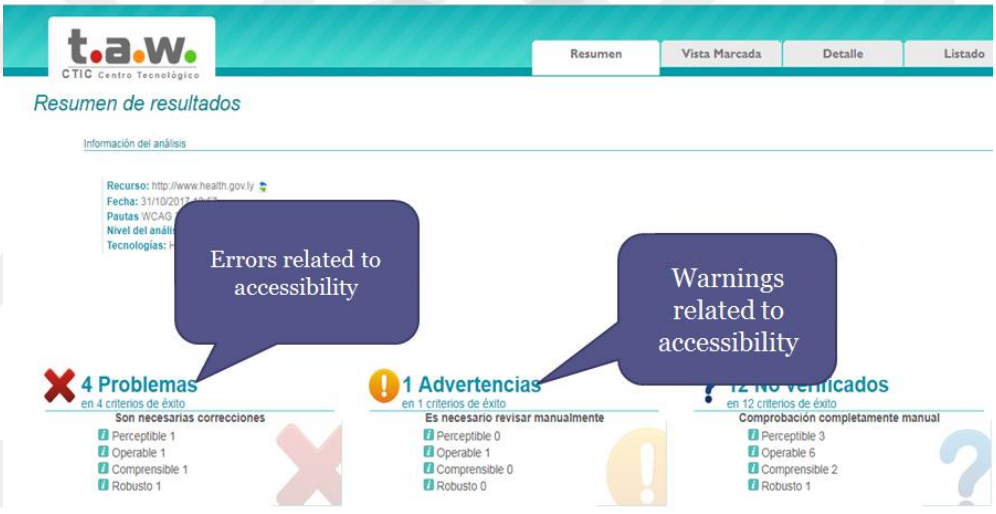

Figure 3.2: Screen view of T.A.W.

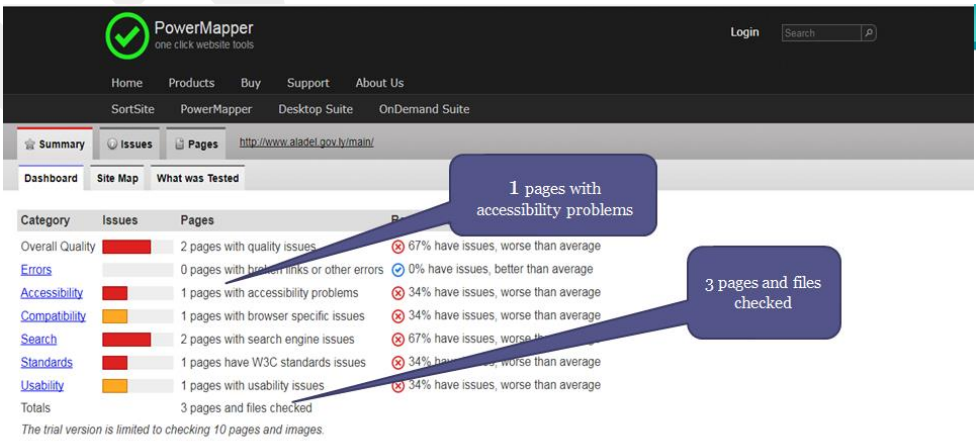

Figure 3.3: Screen view of PowerMapper

CHAPTER 4

RESULTS

4.1 Evaluation Results of Libyan E-Government Web Sites

To evaluate e-government web sites in terms of accessibility, three programs are used as explained in the previous chapter. Evaluation results are given in this chapter. Evaluated e-government web sites and their web addresses are given in Table 4.1.

Table 4.1: Libyan e- government websites and their addresses

	Organization	**Web Address**
1	Ministry of Health	www.health.gov.ly
2	Ministry of Justice	www.aladel.gov.ly
3	Ministry of Interior	www.moi.gov.ly
4	Ministry of Defense	www.defense.gov.ly
5	Ministry of Finance	www.finance.gov.ly
6	Ministry of Civil Service	www.culture.gov.ly
7	Ministry of Social Affairs and Labors	www.sa.gov.ly
8	Ministry of Higher Education	www.highereducation.gov.ly
9	Ministry of Education	https://moe.gov.ly

4.1.1 Results Obtained from Web Accessibility Evaluation Tool (WAVE)

Ministry of Health:

Figure 4.1 shows the evaluation result of the web site of the Ministry of Health in Libya obtained from the WAVE tool. Although 31 accessibility features are used, there are errors, alerts and other issues on the Web site.

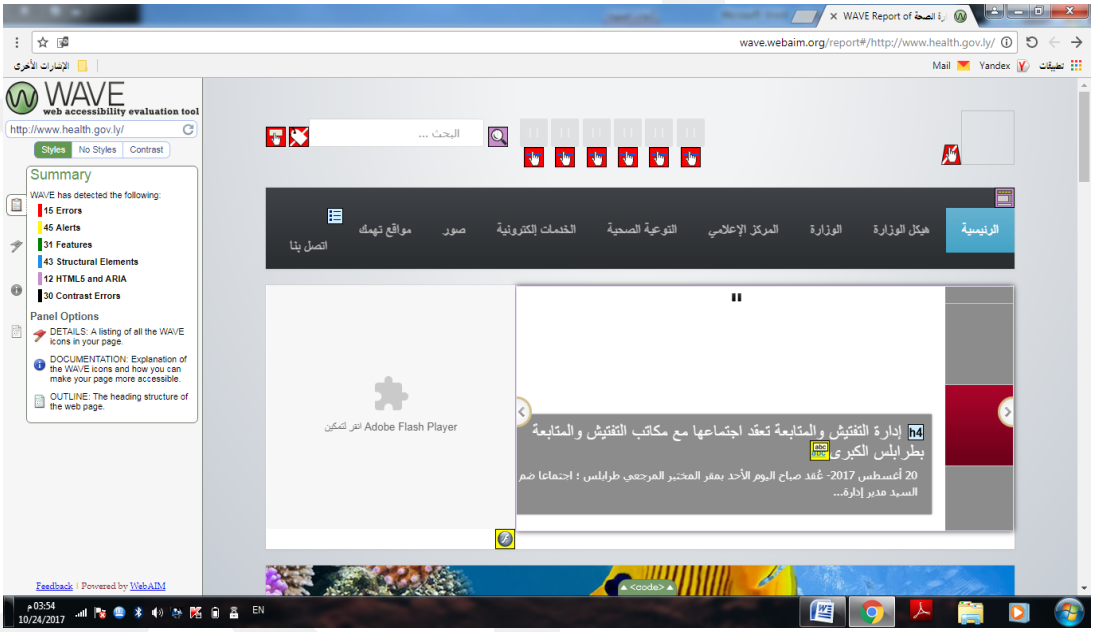

Figure 4.1: WAVE result for Ministry of Health in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 15 Errors
- 45 Alerts
- 31 Features
- 44 Structural Elements
- 12 HTML5 and ARIA
- 30 Contrast Errors

Ministry of Justice:

Figure 4.2 shows the evaluation result of the web site of the Ministry of Justice in Libya obtained from the WAVE tool. There are a few errors and alerts. However, we understand that there are very limited number of pages on the site.

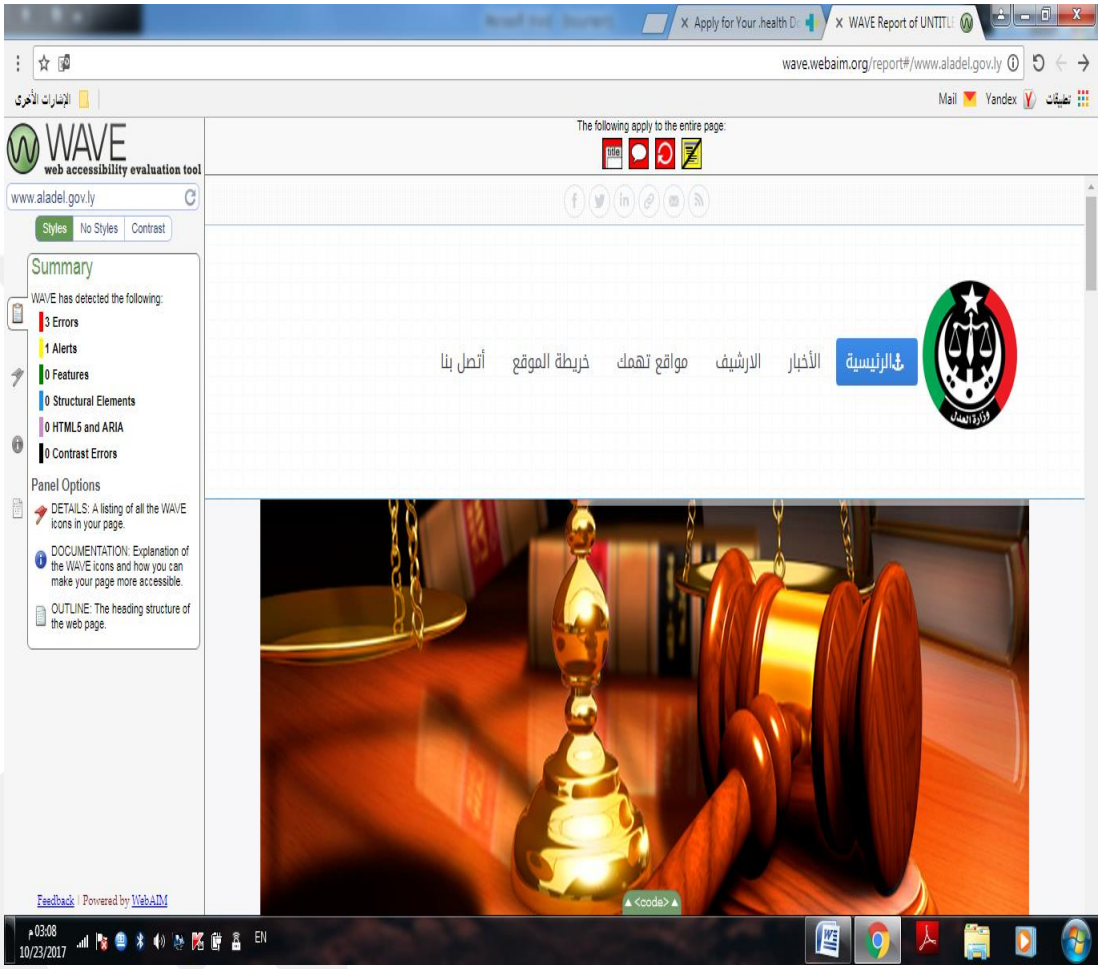

Figure 4.2: WAVE result for Ministry of Justice in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 3 Errors
- 1 Alerts
- 0 Features
- 0 Structural Elements
- 0 HTML5 and ARIA
- 0 Contrast Errors

Ministry of Interior:

Figure 4.3 shows the evaluation result of the web site of the Ministry of Interior in Libya obtained from the WAVE tool. Although 17 accessibility features are used, there are many errors, alerts and other issues on the Web site.

Figure 4.3: WAVE result for Ministry of Interior in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 20 Errors
- 34 Alerts
- 17 Features
- 62 Structural Elements
- 5 HTML5 and ARIA
- 57 Contrast Errors

Ministry of Defense:

Figure 4.4 shows the evaluation result of the web site of the Ministry of Defense in Libya obtained from the WAVE tool. Although 26 accessibility features are used, there are many errors, alerts and other issues on the web site.

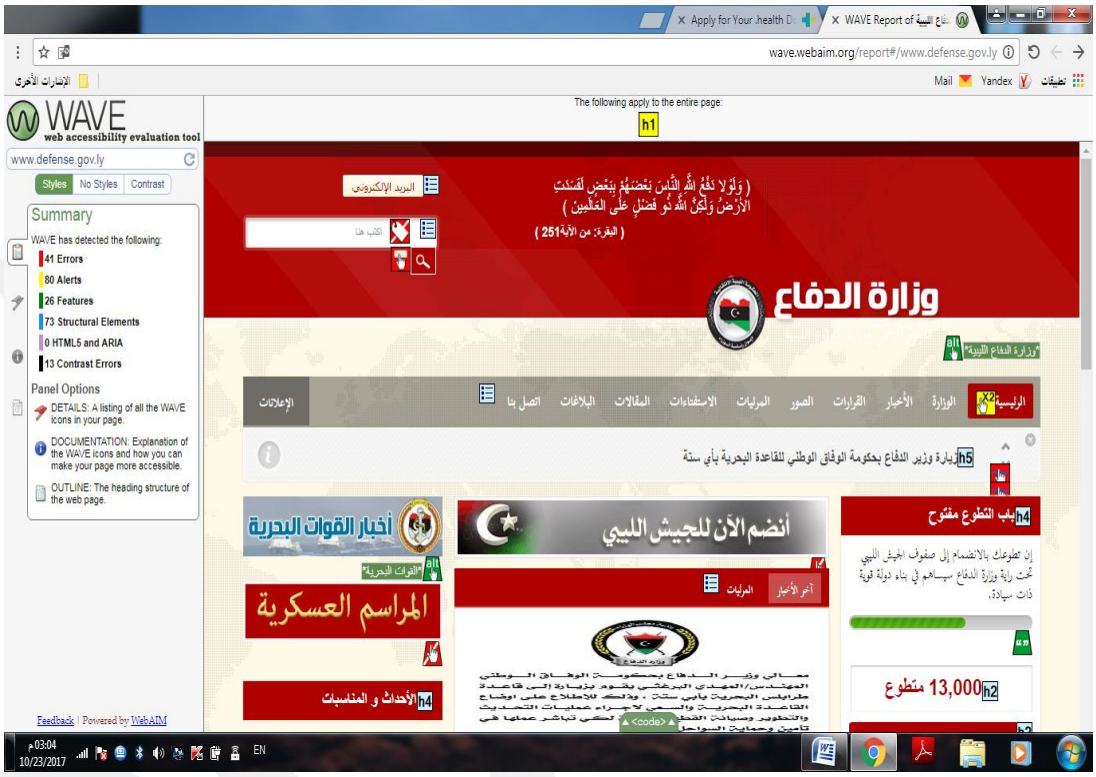

Figure 4.4: WAVE result for Ministry of Defense in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 41 Errors
- 80 Alerts
- 26 Features
- 76 Structural Elements
- 4 HTML5 and ARIA
- 13 Contrast Errors

Ministry of Finance:

Figure 4.5 shows the evaluation result of the web site of the Ministry of Finance in Libya obtained from the WAVE tool. Only 1 accessibility feature is used. There are errors, alerts and other issues on the site.

Figure 4.5: WAVE result for Ministry of Finance in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 17 Errors
- 36 Alerts
- 1 Features
- 35 Structural Elements
- 16 HTML5 and ARIA
- 16 Contrast Errors

Ministry of Civil Services:

Figure 4.6 shows the evaluation result of the web site of the Ministry of Civil Services in Libya obtained from the WAVE tool. Although 13 accessibility features are used, there are some errors, many alerts and other issues on the pages.

Figure 4.6: WAVE result for Ministry of Civil Services in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 9 Errors
- 116 Alerts
- 13 Features
- 10 Structural Elements
- 7 HTML5 and ARIA
- 17 Contrast Errors

Ministry of Social Affairs and Labors:

Figure 4.7 shows the evaluation result of the web site of the Ministry of Social Affairs and Labors in Libya obtained from the WAVE tool. There are 13 accessibility features used. There are some errors, alerts and other issues on the page.

Figure 4.7: WAVE result for Ministry of Social Affairs and Labors in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 2 Errors
- 14 Alerts
- 13 Features
- 27 Structural Elements
- 8 HTML5 and ARIA
- 23 Contrast Errors

Ministry of Higher Education:

Figure 4.8 shows the evaluation result of the web site of the Ministry of Higher Education in Libya obtained from the WAVE tool. At the time test, the related web site did not work properly. Therefore, the test was not successful.

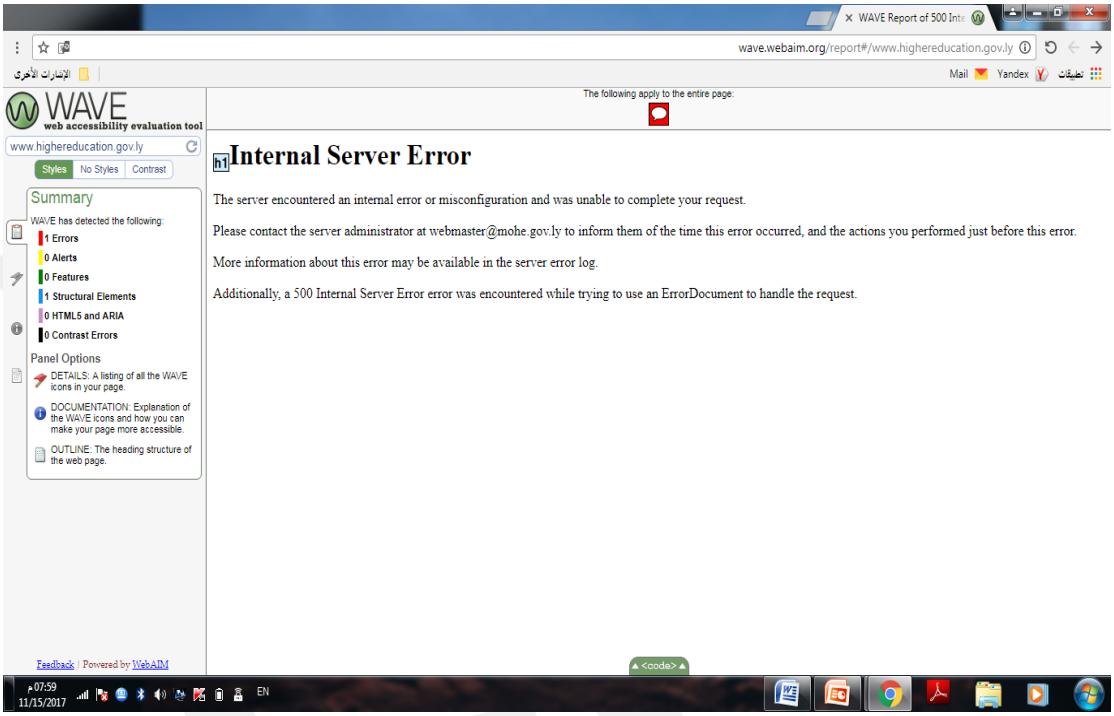

Figure 4.8: WAVE result for Ministry of Higher Education in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 1 Errors
- 0 Alerts
- 0 Features
- 1 Structural Elements
- 0 HTML5 and ARIA
- 0 Contrast Errors

Ministry of Education:

Figure 4.9 shows the evaluation result of the web site of the Ministry of Education in Libya obtained from the WAVE tool. Although 31 accessibility features are used, there are 23 errors, 56 alerts and 21 contrast errors in the web site.

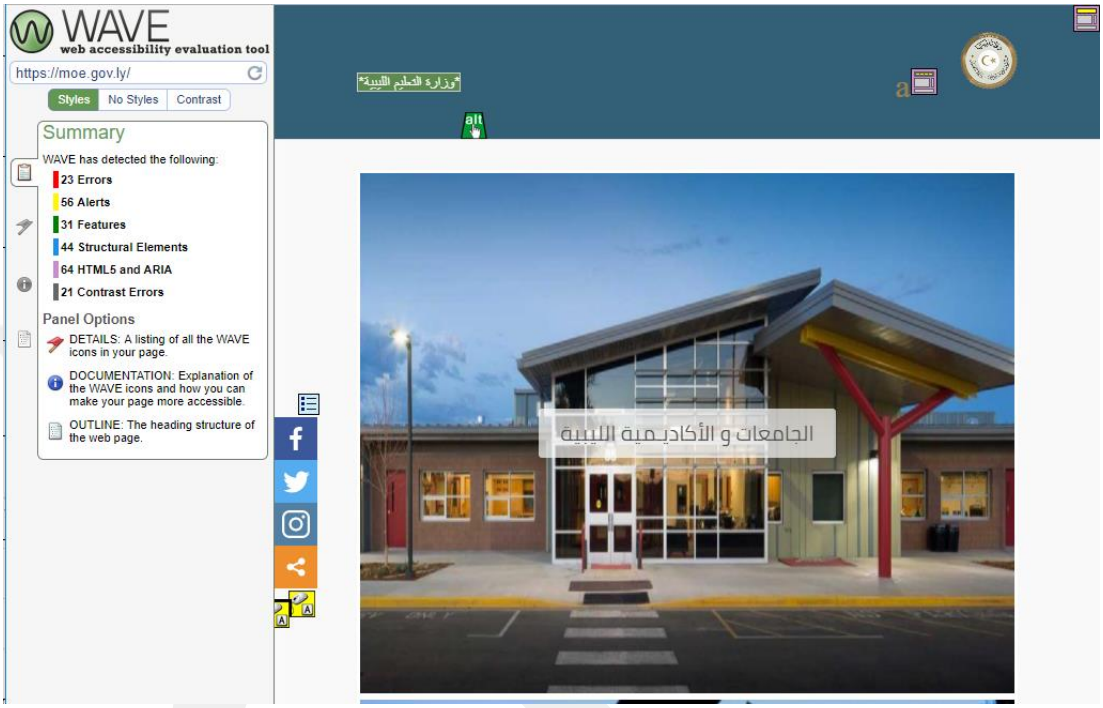

Figure 4.9: WAVE result for Ministry of Education in Libya

Summary of the evaluation result obtained from WAVE is as follows:

- 23 Errors
- 56 Alerts
- 31 Features
- 44 Structural Elements
- 64 HTML5 and ARIA
- 21 Contrast Errors

4.1.2 Results Obtained from T.A.W.

Ministry of Health:

Figure 4.10 shows the evaluation result of the web site of the Ministry of Health in Libya obtained from the T.A.W. tool. There are 4 errors and 1 warning on the page.

Figure 4.10: T.A.W. result for Ministry of Health in Libya

Figure 4.11: T.A.W. result for Ministry of Justice in Libya

Ministry of Justice:

Figure 4.11 shows the evaluation result of the web site of the Ministry of Justice in Libya obtained from the T.A.W. tool. There are 4 errors and 1warning on the page.

Ministry of Interior:

Figure 4.12 shows the evaluation result of the web site of the Ministry of Interior in Libya obtained from the T.A.W. tool. There are many errors and warnings on the Web site.

Figure 4.12: T.A.W. result for Ministry of Interior in Libya

Ministry of Defense:

Figure 4.13 shows the evaluation result of the web site of the Ministry of Defense in Libya obtained from the T.A.W tool. There are many errors and warnings on the web site.

Figure 4.13: T.A.W result for Ministry of Defense in Libya

Ministry of Finance:

Figure 4.14 shows the evaluation result of the web site of the Ministry of Finance in Libya obtained from the T.A.W. tool. There are many errors and warnings on the page as seen on the figure.

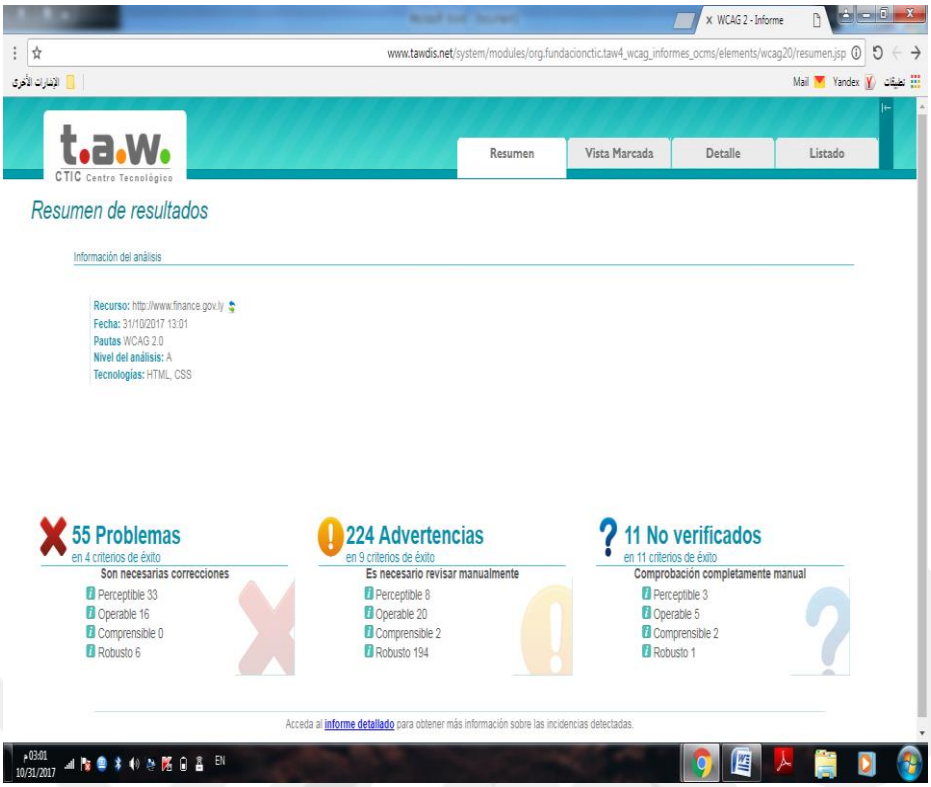

Figure 4.14: T.A.W. result for Ministry of Finance in Libya

Figure 4.15: T.A.W. result for Ministry of Civil Service in Libya

Ministry of Civil Services:

Figure 4.15 shows the evaluation result of the web site of the Ministry of Civil Services in Libya obtained from the T.A.W tool. There are many errors and warnings on the page.

Ministry of Social Affairs and Labors:

Figure 4.16 shows the evaluation result of the web site of the Ministry of Social Affairs and Labors in Libya obtained from the T.A.W. tool. There are many errors and warnings related to accessibility on the page.

Figure 4.16: T.A.W. result for Ministry of Social Affairs and Labors in Libya

Ministry of Higher Education:

Figure 4.17 shows the evaluation result of the web site of the Ministry of Higher Education in Libya obtained from the T.A.W tool. Because of problems on the web site, the evaluation could not be finilized.

Figure 4.17: T.A.W. result for Ministry of Higher Education in Libya

Figure 4.18: T.A.W. result for Ministry of Education in Libya

Ministry of Education:

Figure 4.18 shows the evaluation result of the web site of the Ministry of Education in Libya obtained from the T.A.W. tool. There are 11 errors and 111 warnings on the page.

4.1.3 Results Obtained from PowerMapper

Ministry of Health:

Figure 4.19 shows the evaluation result of the web site of the Ministry of Health in Libya obtained from the PowerMapper tool. In total, two pages are checked and one of them has accessibility problems.

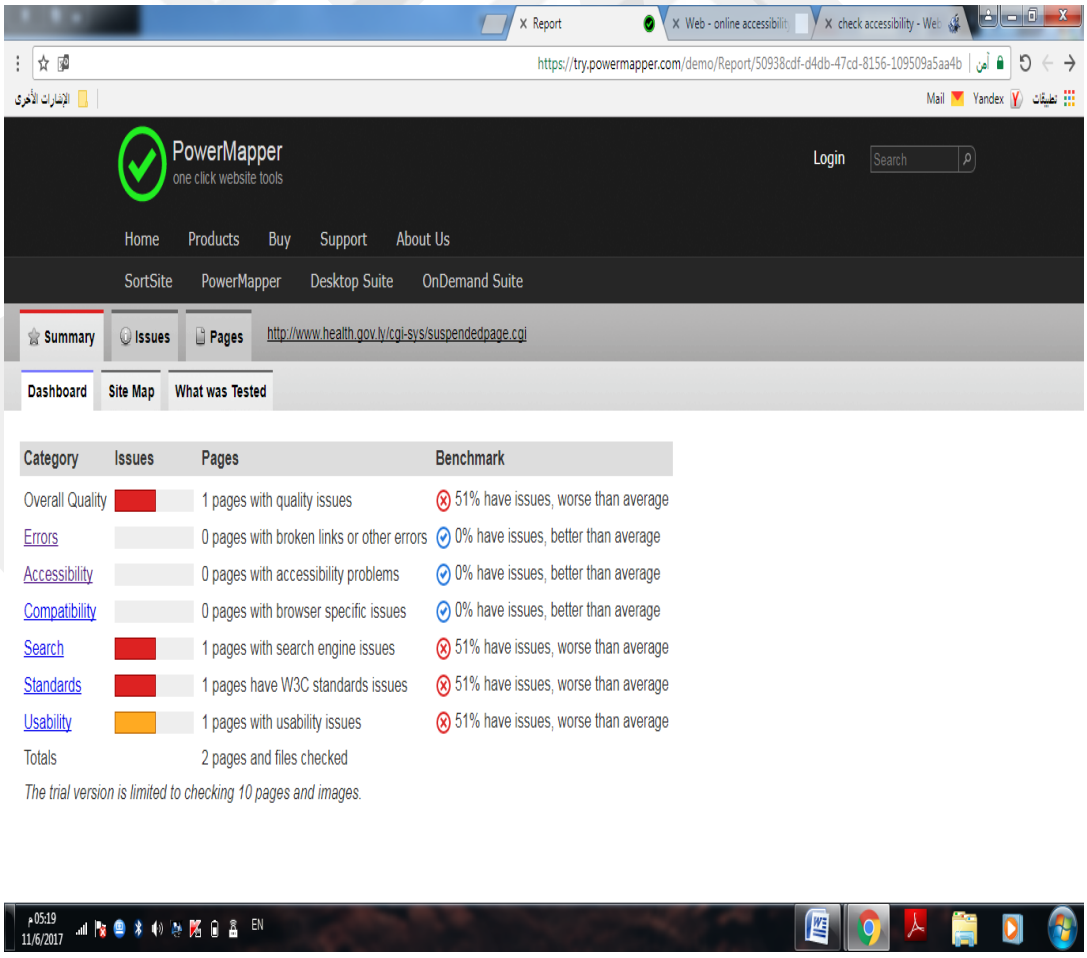

Figure 4.19: PowerMapper result for Ministry of Health in Libya

Ministry of Justice:

Figure 4.20 shows the evaluation result of the web site of the Ministry of Justice in Libya obtained from the PowerMapper tool. In total, three pages are checked and two of them have accessibility problems.

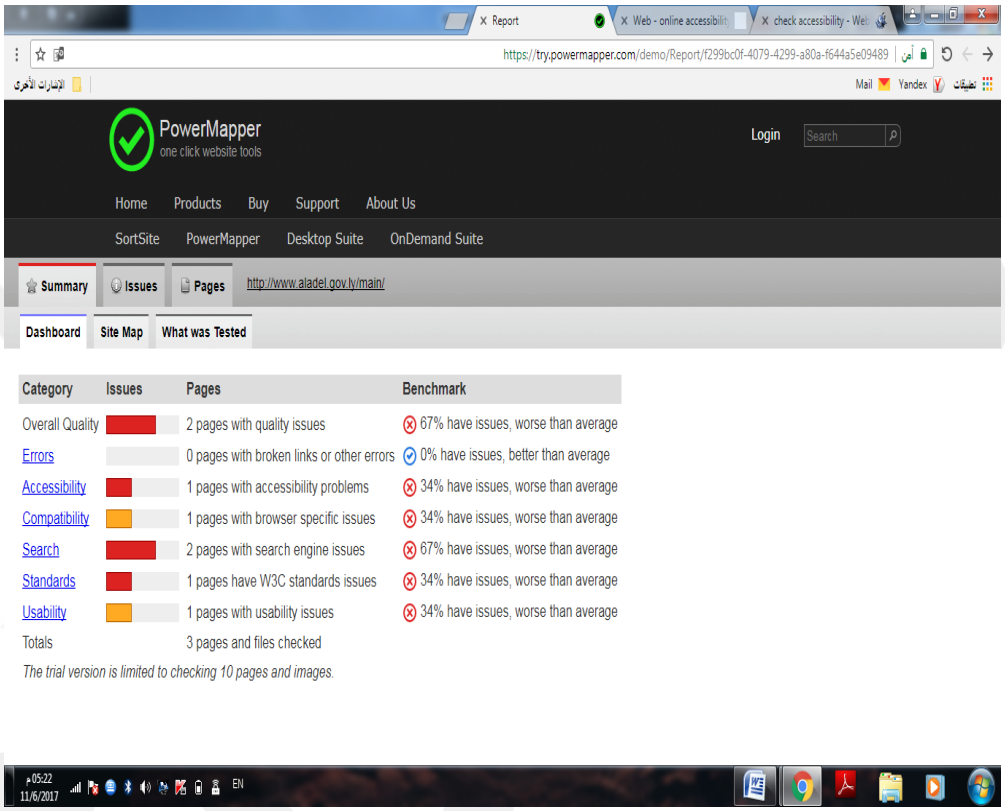

Figure 4.20: PowerMapper result for Ministry of Justice in Libya

Ministry of Interior:

Figure 4.21 shows the evaluation result of the web site of the Ministry of Interior in Libya obtained from the PowerMapper tool. In total, 10 pages are checked and 9 of them have accessibility problems.

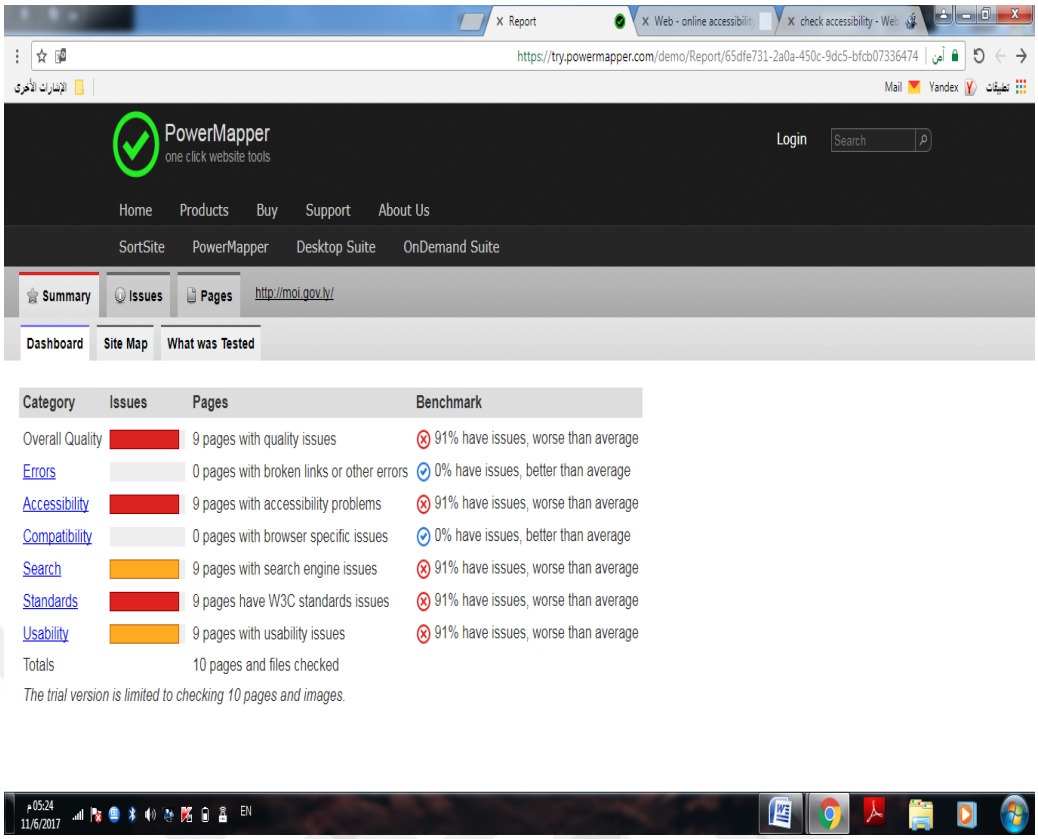

Figure 4.21: PowerMapper result for Ministry of Interior in Libya

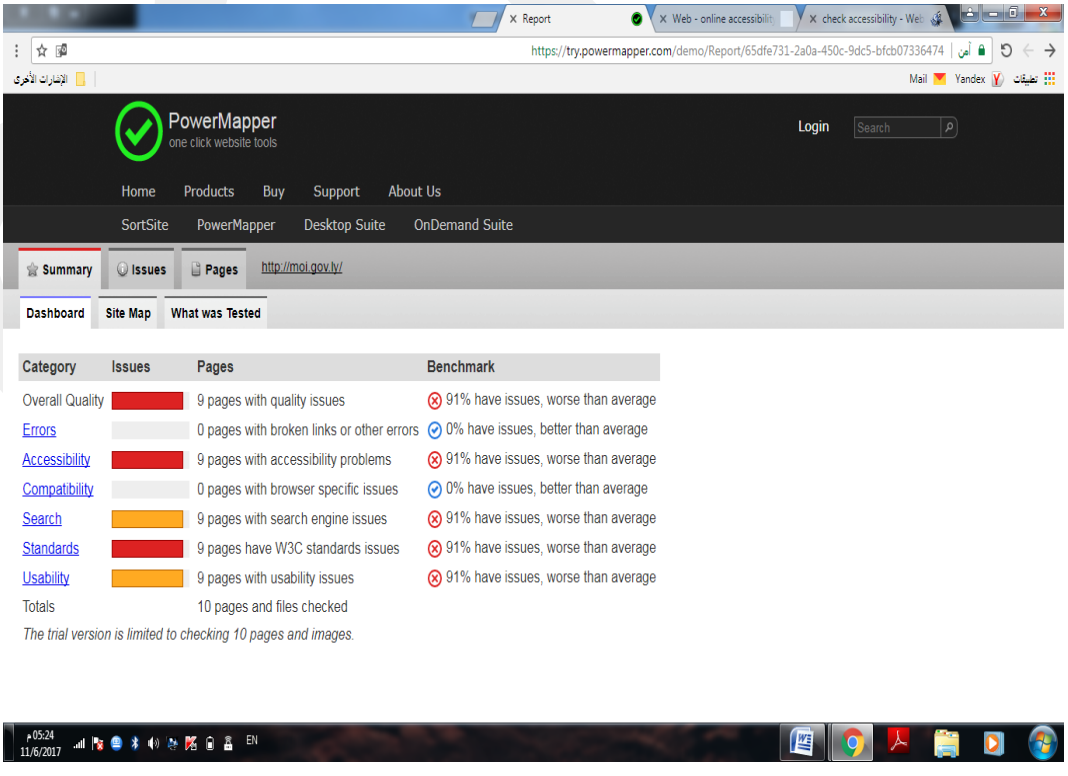

Figure 4.22: PowerMapper result for Ministry of Defense in Libya

Ministry of Defense:

Figure 4.22 shows the evaluation result of the web site of the Ministry of Defense in Libya obtained from the PowerMapper tool. In total, 10 pages are checked and 9 of them have accessibility problems.

Ministry of Finance:

Figure 4.23 shows the evaluation result of the web site of the Ministry of Finance in Libya obtained from the PowerMapper tool. In total, 10 pages are checked and 9 of them have accessibility problems.

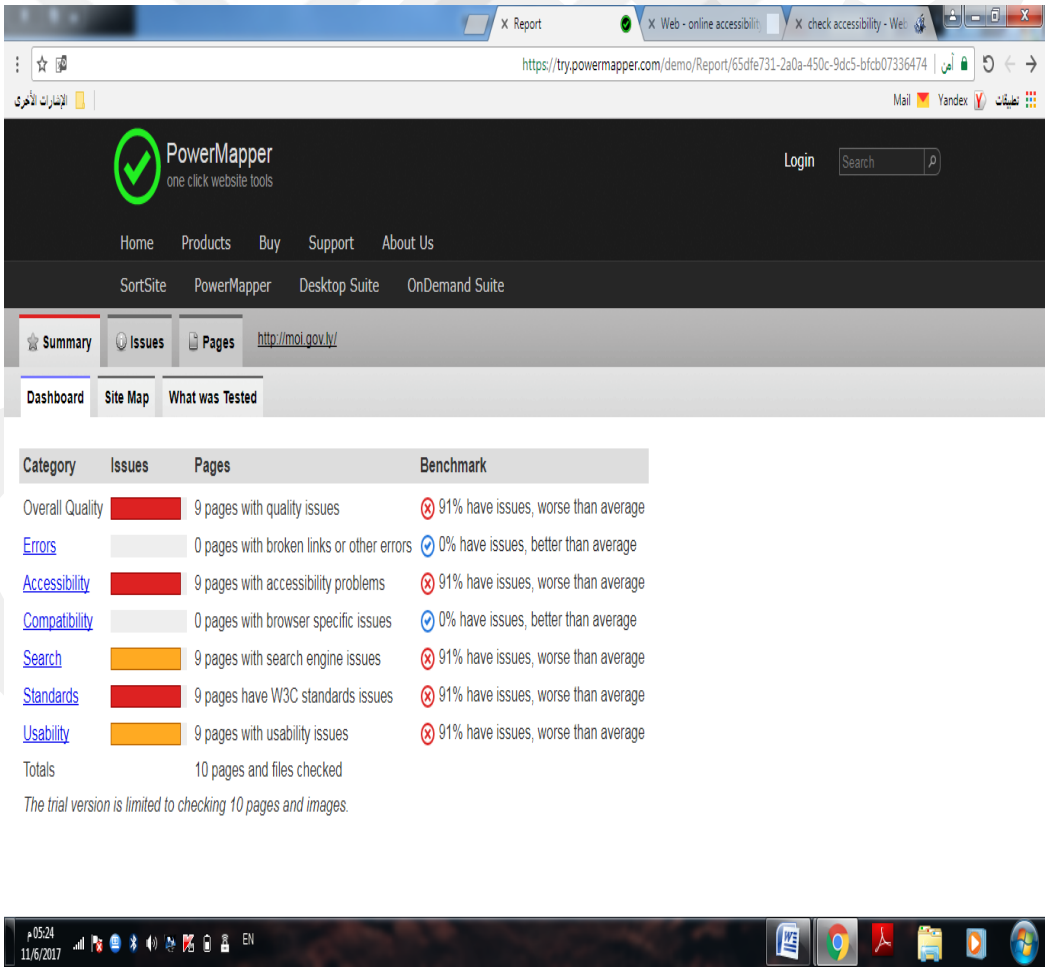

Figure 4.23: PowerMapper result for Ministry of Finance in Libya

Ministry of Civil Services:

Figure 4.24 shows the evaluation result of the web site of the Ministry The civil service in Libya obtained from the PowerMapper tool. In total, 10 pages are checked and 9 of them have accessibility problems.

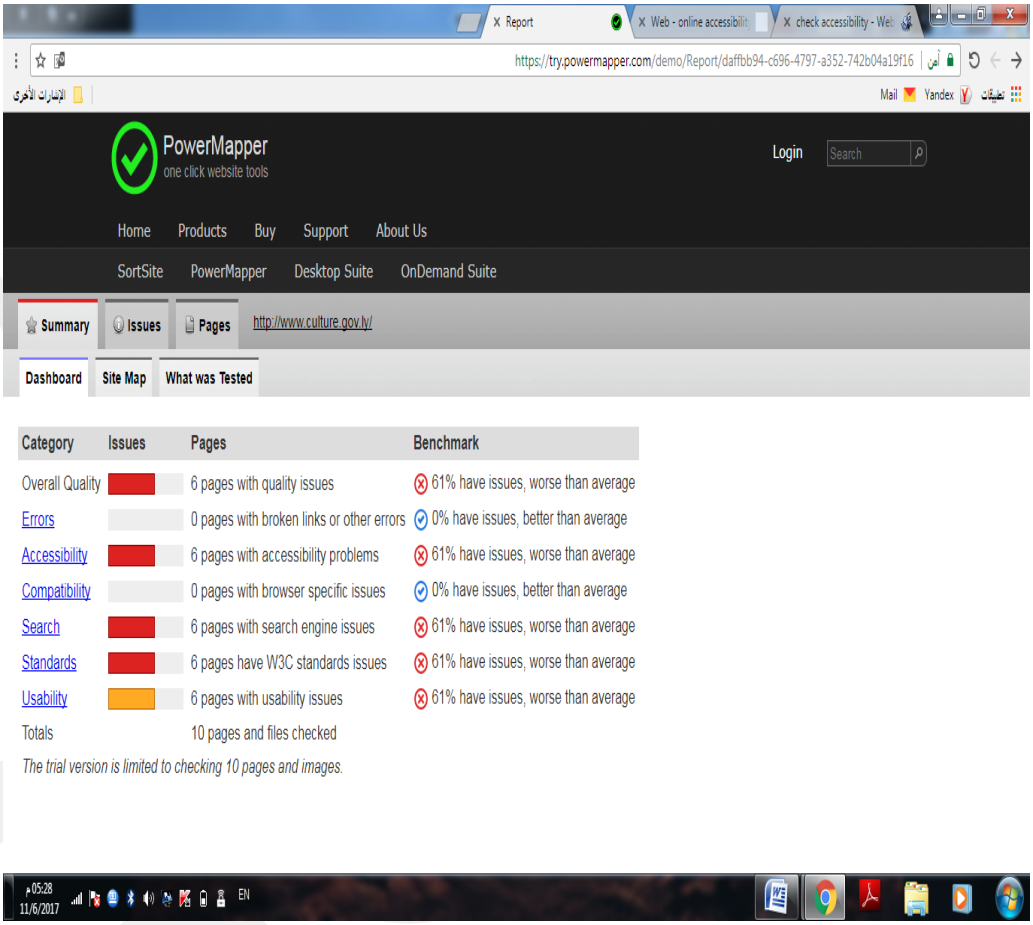

Figure 4.24: PowerMapper result for Ministry of Civil Services in Libya

Ministry of Social Affairs and Labors:

Figure 4.25 shows the evaluation result of the web site of the Ministry of Social Affairs and Labors in Libya obtained from the PowerMapper tool. In total, 10 pages are checked and all of them have accessibility problems.

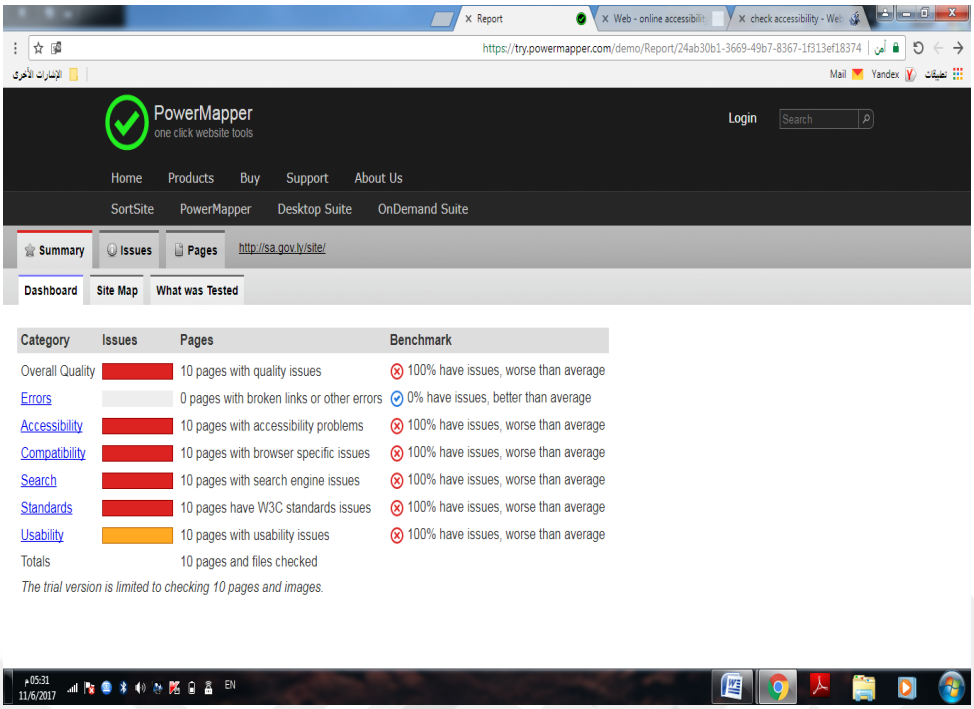

Figure 4.25: PowerMapper result for Ministry of Social Affairs and Labors in Libya

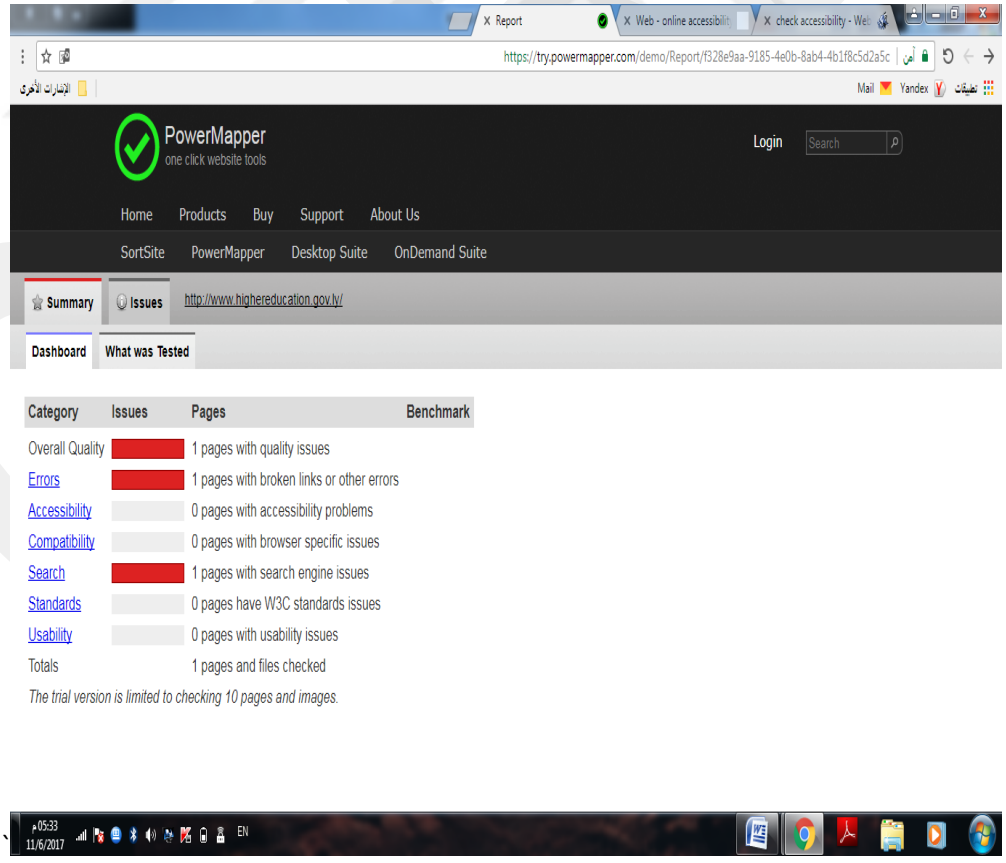

Figure 4.26: PowerMapper result for Ministry of Higher Education in Libya

Ministry of Higher Education:

Figure 4.26 shows the evaluation result of the web site of the Ministry of Higher Education in Libya obtained from the PowerMapper tool. In total, 1 page is checked and that page has quality problems.

Ministry of Education:

Figure 4.27 shows the evaluation result of the web site of the Ministry of Education in Libya obtained from the PowerMapper tool. In total, 9 pages are checked and one of them has accessibility problems.

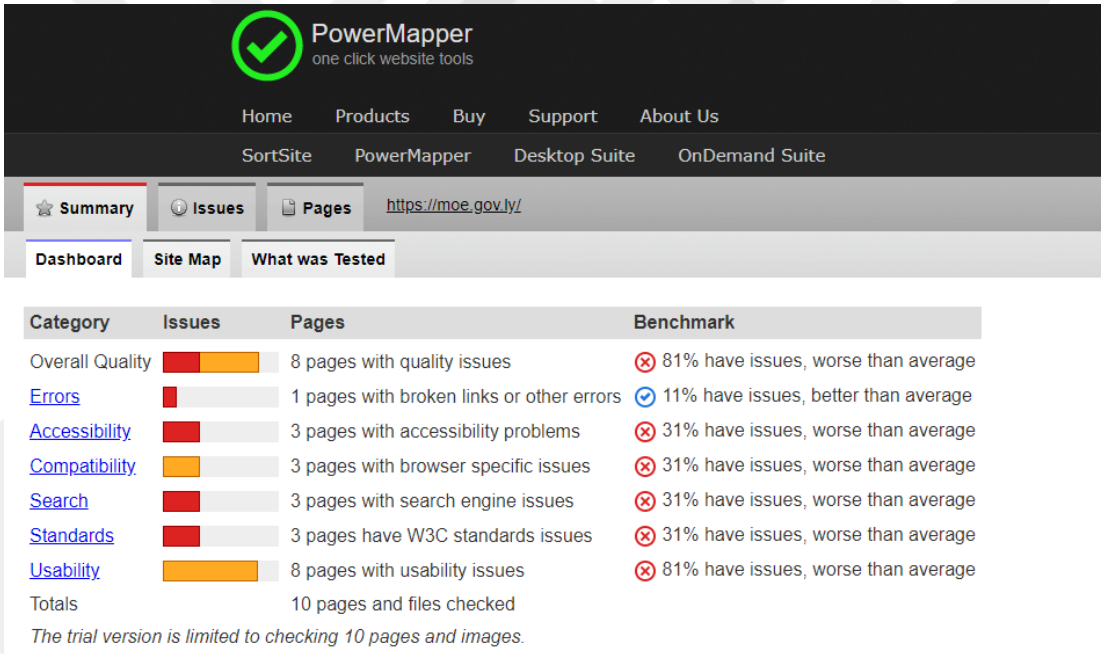

Figure 4.27: PowerMapper result for Ministry of Education in Libya

4.2 Evaluation Results of Tunisian E-Government Web Sites

In this study, we have also evaluated corresponding e-government web sites of Tunisia to compare the quality of two countries e-government services. To evaluate e-government web sites in terms of accessibility, three programs are used as explained in the previous chapter. Evaluation results are given in this section. Evaluated Tunisian e-government web sites and their web addresses are given in Table 4.2.

Table 4.2: Tunisia E-Government websites and their addresses

	Organization	**Web Address**
1	Ministry of Health	www.santetunisie.ms.tn/ar
2	Ministry of Justice	www.e-justice.tn/index
3	Ministry of Interior	www.interieur.gov.tn/
4	Ministry of Defense	www.defense.tn/index.php/ar
5	Ministry of Finance	www.finances.gov.tn/index.
6	Ministry of Civil Services	www.culture.gov.tn
7	Ministry of Social Affairs and Labors	www.social.gov.tn/
8	Ministry of Higher Education	www.mes.tn
9	Ministry of Education	www.education.gov.tn/

4.2.1 Results Obtained from Web Accessibility Evaluation Tool (WAVE)

Ministry of Health:

Figure 4.28 shows the evaluation result of the web site of the Ministry of Health in Tunisia obtained from the WAVE tool. Although 12 accessibility features are used, there are 8 errors, 11 alerts and other issues on the page.

Figure 4.28: WAVE result for Ministry of Health in Tunisia

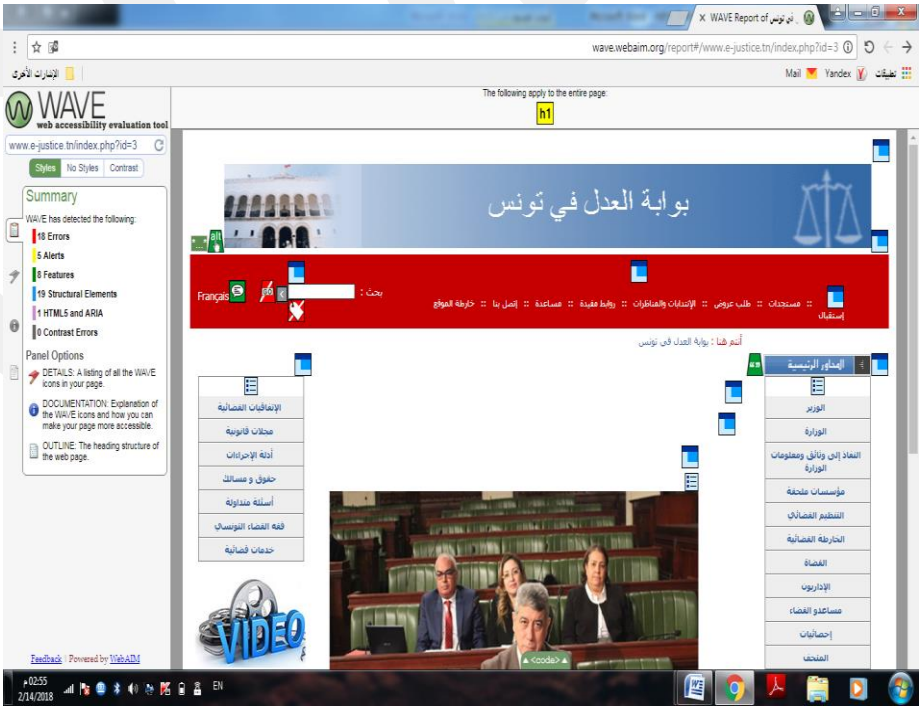

Figure 4.29: WAVE result for Ministry of Justice in Tunisia

Ministry of Justice:

Figure 4.29 shows the evaluation result of the web site of the Ministry of Justice in Tunisia obtained from the WAVE tool. There are 18 errors, 5 alerts and other issues on the page.

Ministry of Interior:

Figure 4.30 shows the evaluation result of the web site of the Ministry of Interior in Tunisia obtained from the WAVE tool. There is no accessibility feature used on the site. There are 37 errors, 103 alerts and other issues on the page.

Figure 4.30: WAVE result for Ministry of Interior in Tunisia

Ministry of Defense:

Figure 4.31 shows the evaluation result of the web site of the Ministry of Defense in Tunisia obtained from the WAVE tool. Although 20 accessibility features are used, there are many errors, alerts and other issues on the page.

Figure 4.31: WAVE result for Ministry of Defense in Tunisia

Ministry of Finance:

Figure 4.32 shows the evaluation result of the web site of the Ministry of Finance in Tunisia obtained from the WAVE tool. Although 63 accessibility features are used, there are many errors, alerts and other issues on the page.

Figure 4.32: WAVE result for Ministry of Finance in Tunisia

Ministry of Civil Services:

Figure 4.33 shows the evaluation result of the web site of the Ministry of Civil Service in Tunisia obtained from the WAVE tool. Although 33 accessibility features are used, there are many errors, alerts and other issues on the page.

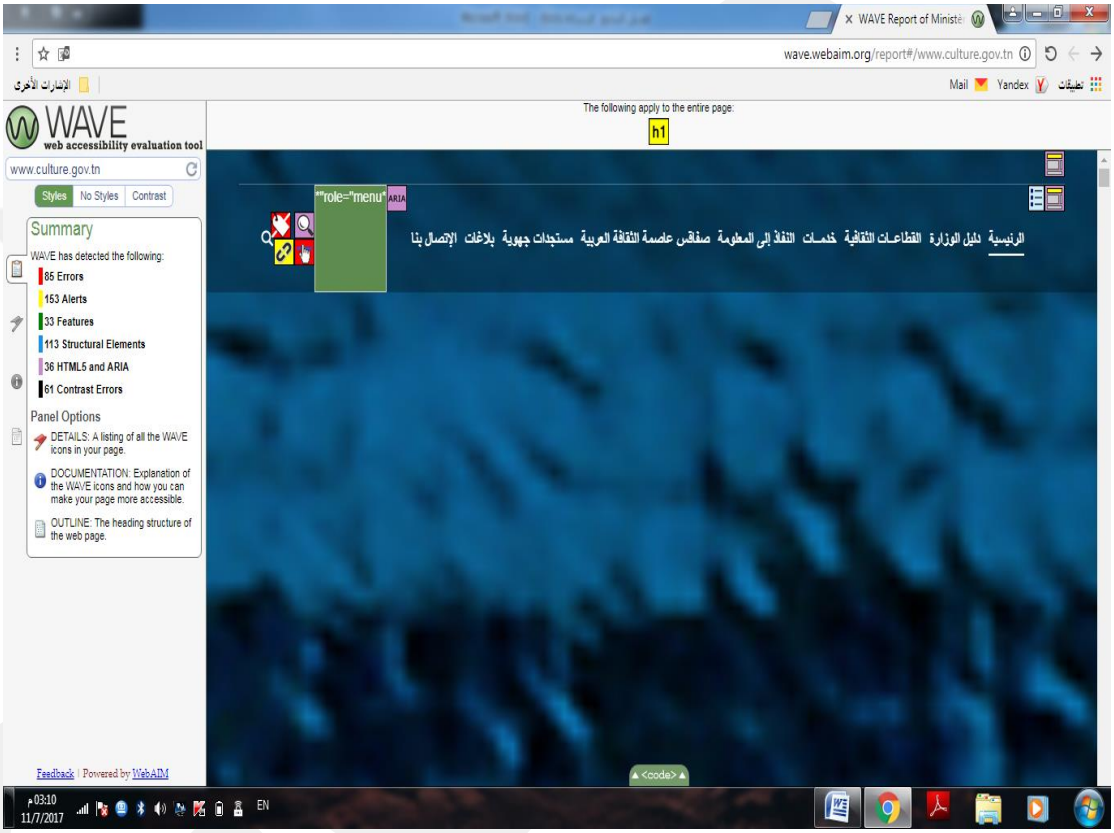

Figure 4.33: WAVE result for Ministry the civil service in Tunisia

Ministry of Social Affairs and Labors:

Figure 4.34 shows the evaluation result of the web site of Ministry of Social Affairs and Labors in Tunisia obtained from the WAVE tool. Although 15 accessibility features are used, there are 13 errors, 73 alerts and other issues on the page.

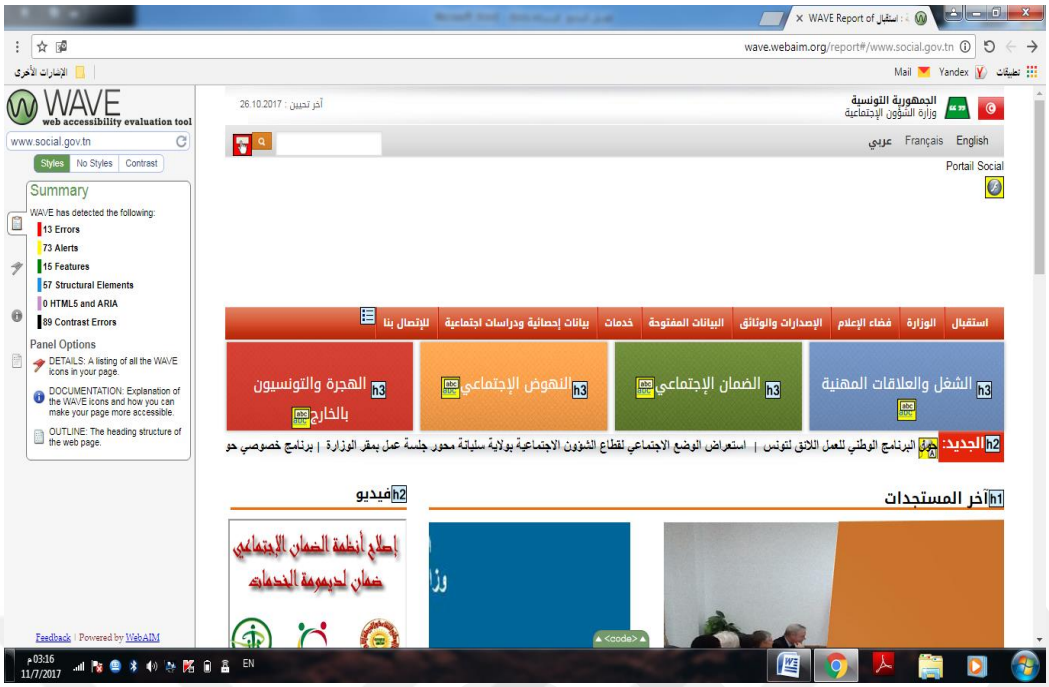

Figure 4.34: WAVE result for Ministry of Social Affairs and labors in Tunisia

Ministry of Higher Education:

Figure 4.35 shows the evaluation result of the web site of Ministry of Higher Education in Tunisia obtained from the WAVE tool. Although 63 accessibility features are used, there are many errors, alerts and other issues on the page.

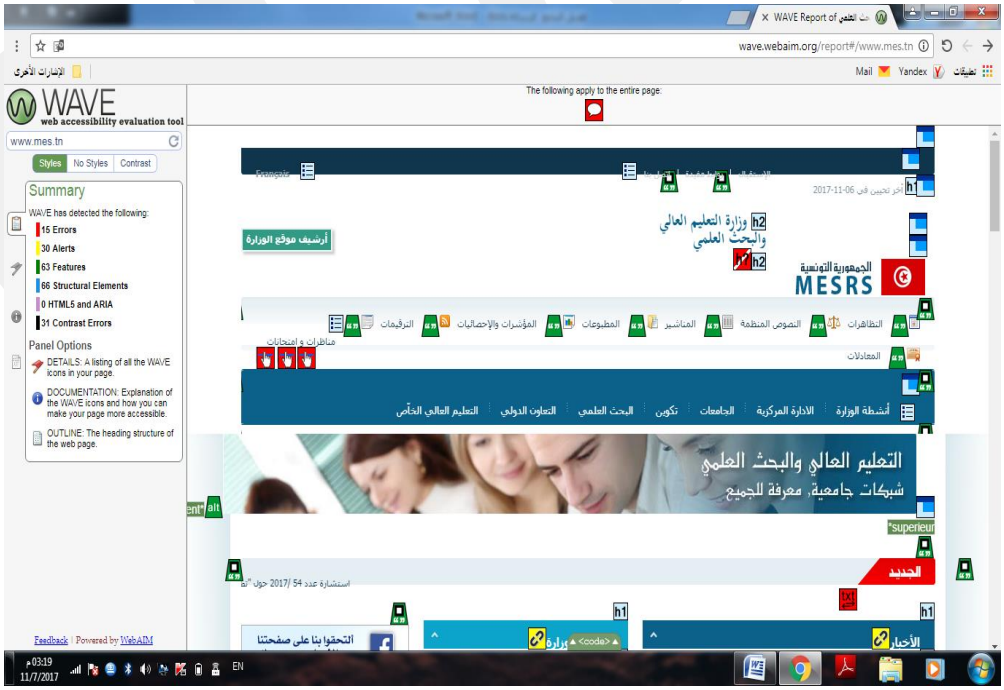

Figure 4.35: WAVE result for Ministry of Higher Education in Tunisia

Ministry of Education:

Figure 4.36 shows the evaluation result of the web site of Ministry of Education in Tunisia obtained from the WAVE tool. Although 125 accessibility features are used, there are many errors, alerts and other issues on the page.

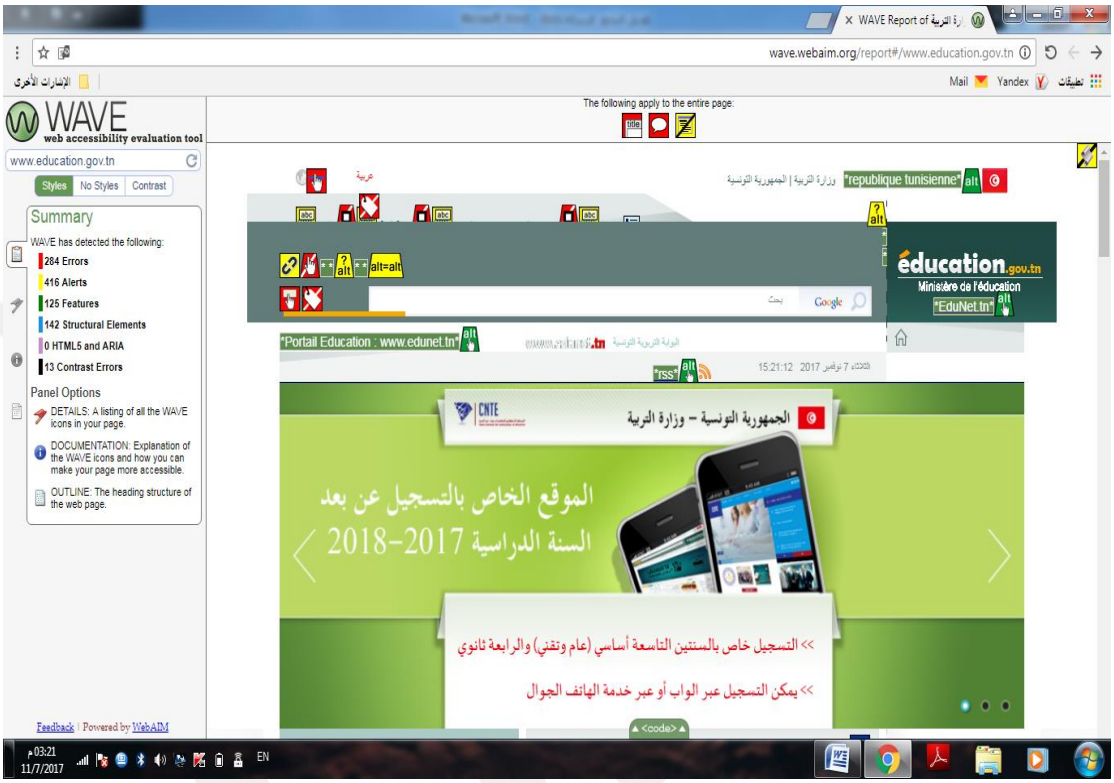

Figure 4.36: WAVE result for ministry of Education in Tunisia

4.2.2 Results Obtained from T.A.W.

Ministry of health:

Figure 4.37 shows the evaluation result of the web site of Ministry of health in Tunisia obtained from the T.A.W tool. There are 17 problems and 1557 warnings on the page.

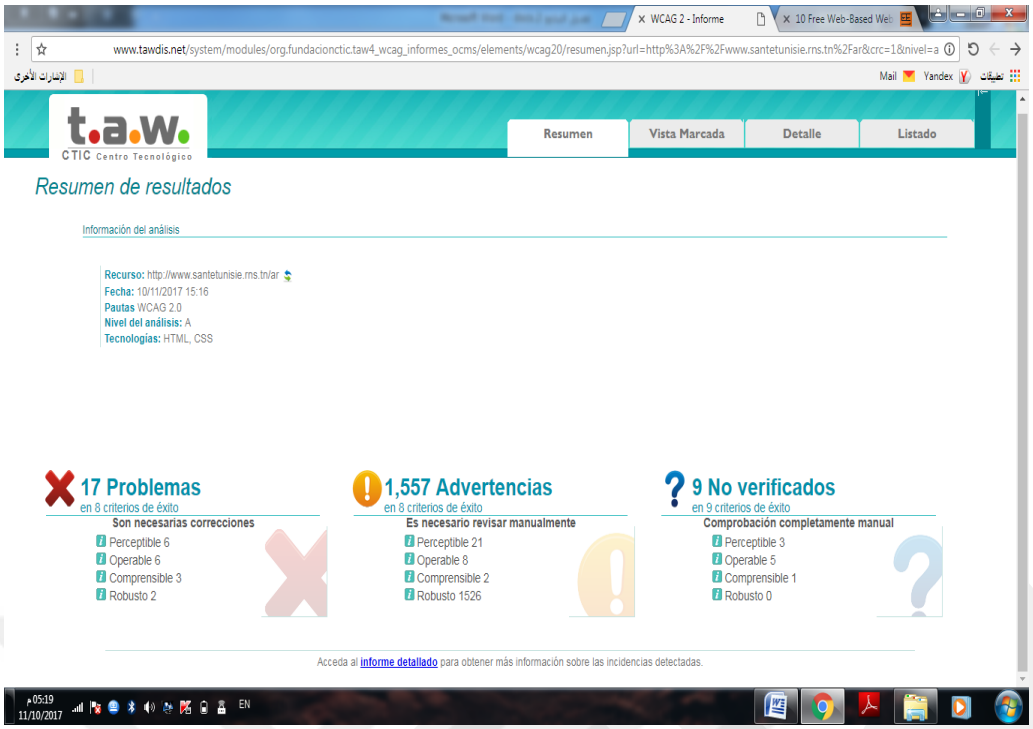

Figure 4.37: T.A.W. result for Ministry of Health in Tunisia

Ministry of Justice:

Figure 4.38 shows the evaluation result of the web site of Ministry of Justice in Tunisia obtained from the T.A.W. tool. The Web site cannot be evaluated. Therefore, obtained results do not show correct numbers.

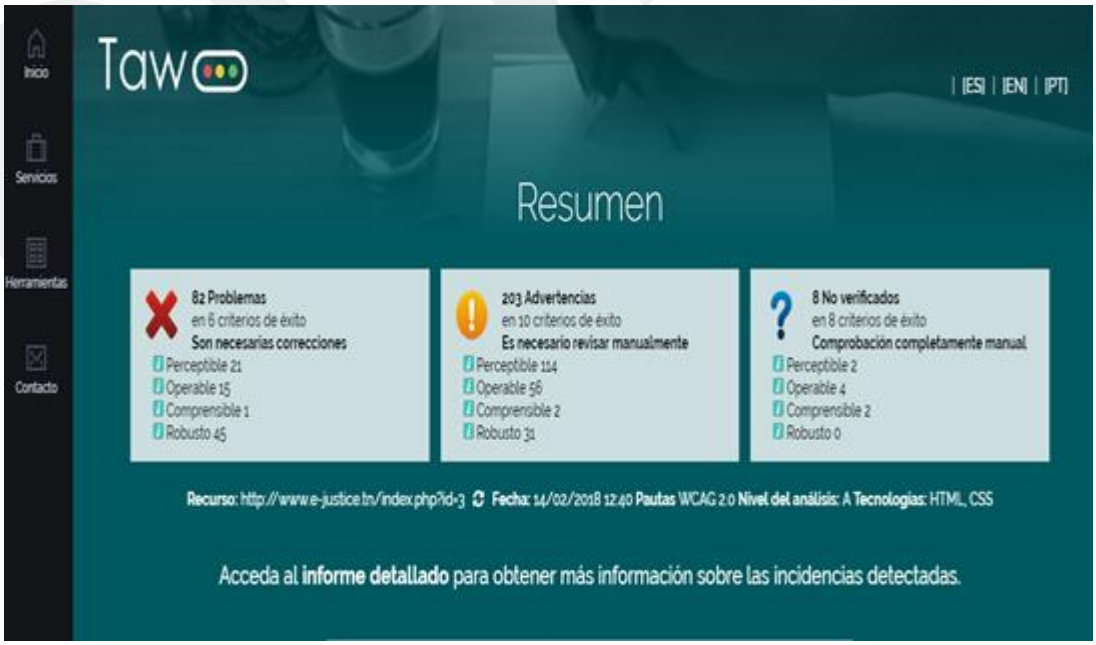

Figure 4.38: T.A.W. result for Ministry of Justice in Tunisia

Ministry of Interior:

Figure 4.39 shows the evaluation result of the web site of Ministry of Interior in Tunisia obtained from the T.A.W tool. There are 2 problems and 2 warnings on the page.

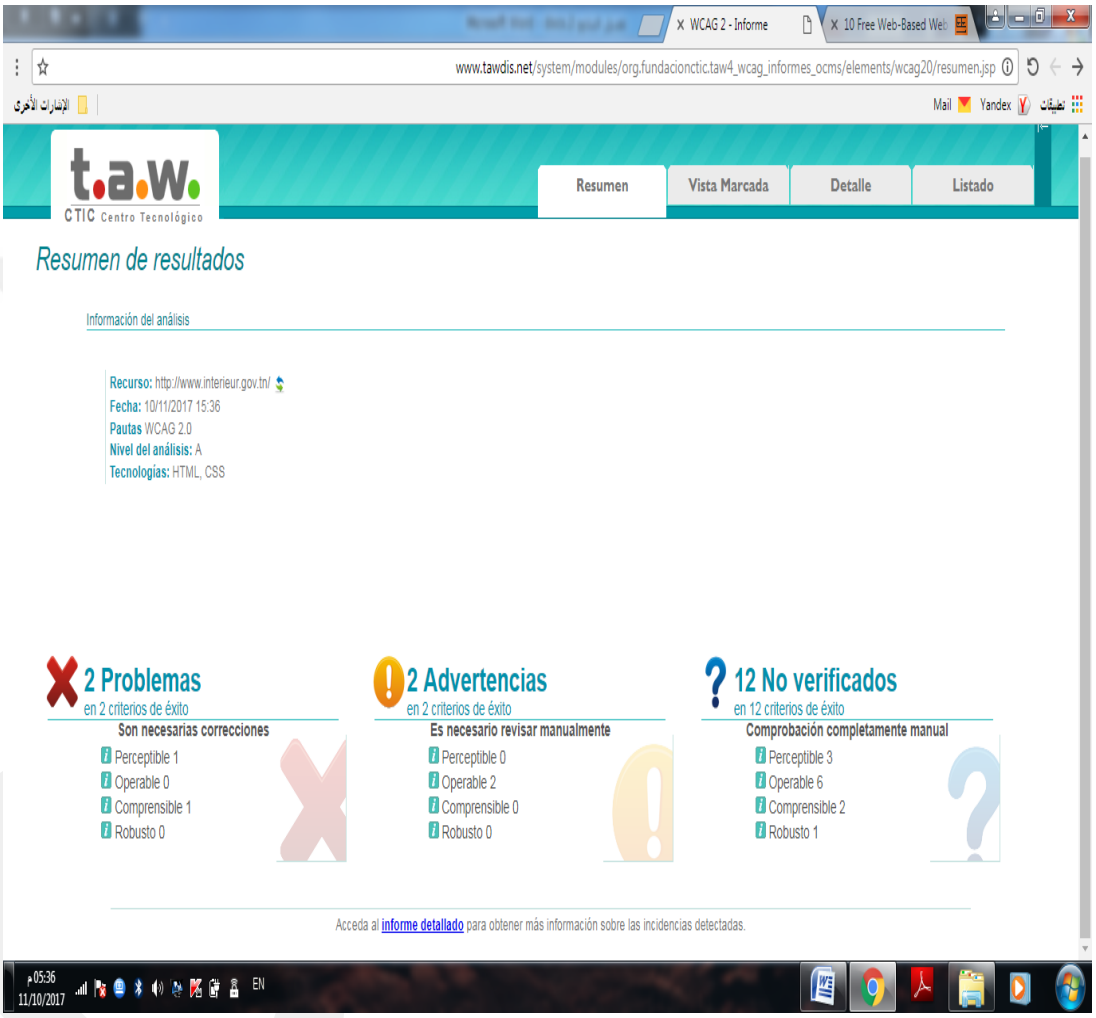

Figure 4.39: T.A.W. result for Ministry of Interior in Tunisia

Ministry of Defense:

Figure 4.40 shows the evaluation result of the web site of Ministry of Defense in Tunisia obtained from the T.A.W tool. There are many problems and warnings on the site.

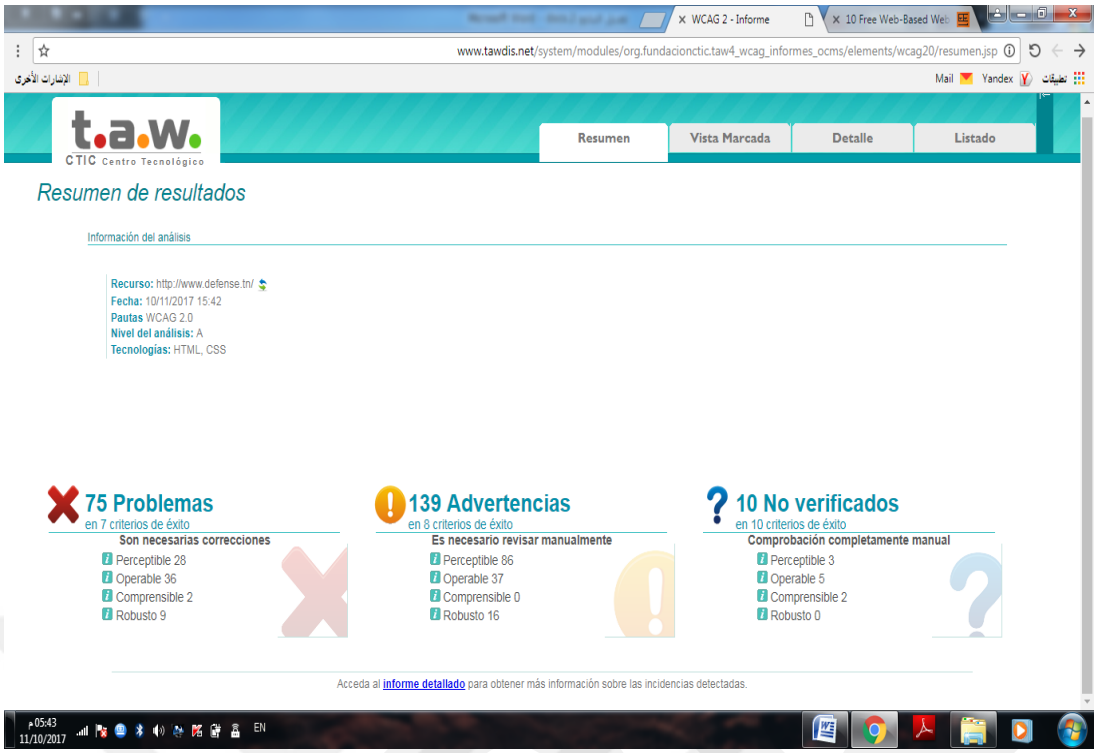

Figure 4.40: T.A.W. result for Ministry of Defense in Tunisia

Ministry of Finance:

Figure 4.41 shows the evaluation result of the web site of Ministry of Finance in Tunisia obtained from the T.A.W tool. The web site could not be tested.

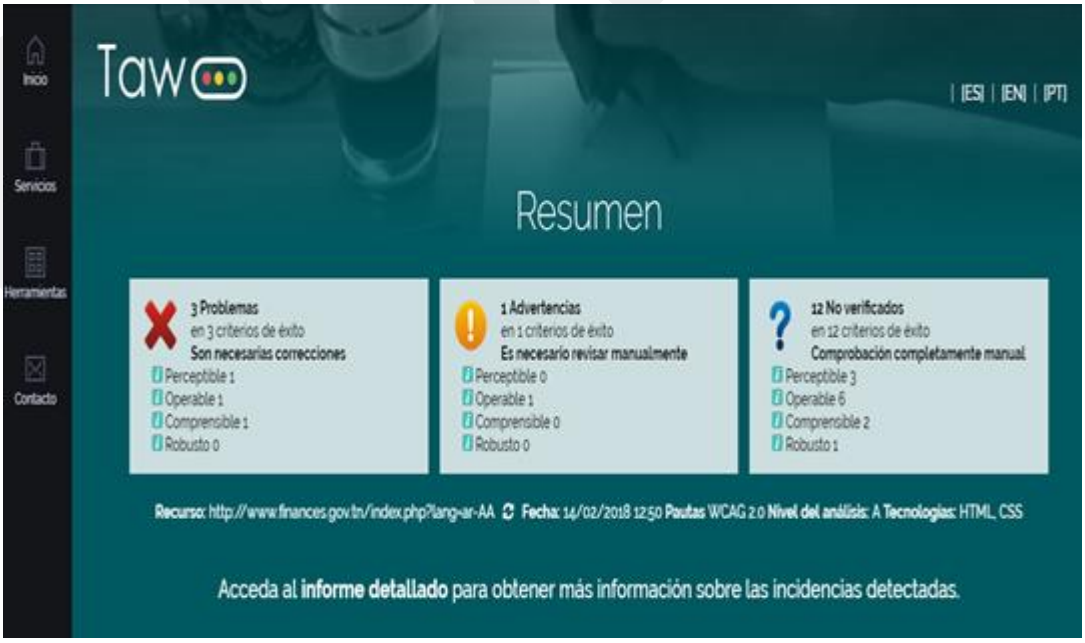

Figure 4.41: T.A.W. result for Ministry of Finance in Tunisia

Ministry of Civil Service:

Figure 4.42 shows the evaluation result of the web site of Ministry of Civil Services in Tunisia obtained from the T.A.W. tool. There are many errors and warnings on the page.

Figure 4.42: T.A.W. result for Ministry of Civil Services in Tunisia

Ministry of Social Affairs and Labors:

Figure 4.43 shows the evaluation result of the web site of Ministry of Social Affairs and Labors in Tunisia obtained from the T.A.W. tool. There are many problems and warnings on the page.

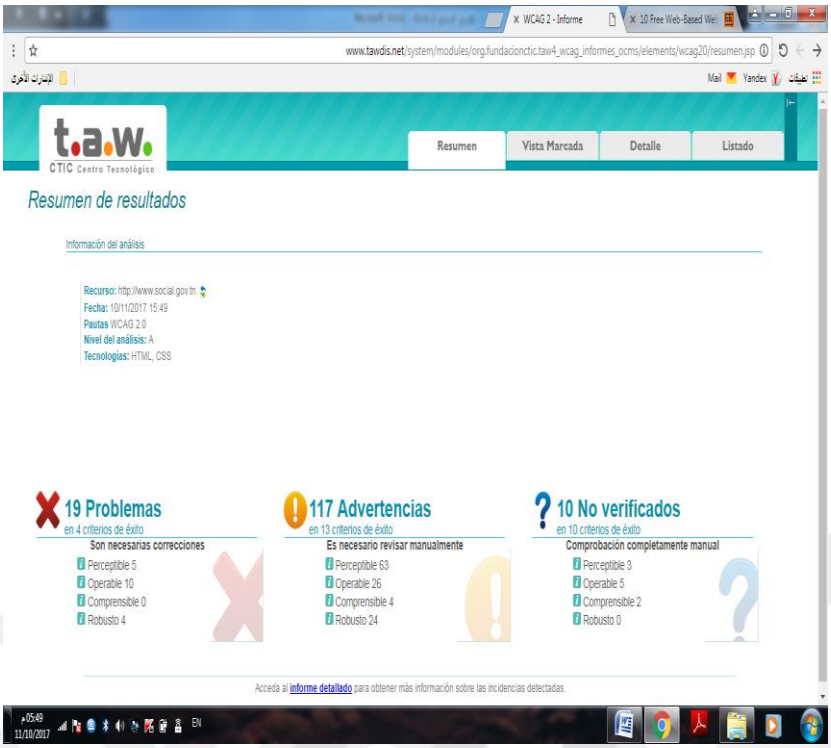

Figure 4.43: T.A.W. result for Ministry of Social Affairs and Labors in Tunisia

Ministry of Higher Education:

Figure 4.44 shows the evaluation result of the web site of Ministry of Higher Education in Tunisia obtained from the T.A.W tool. There are many errors and warnings on the page.

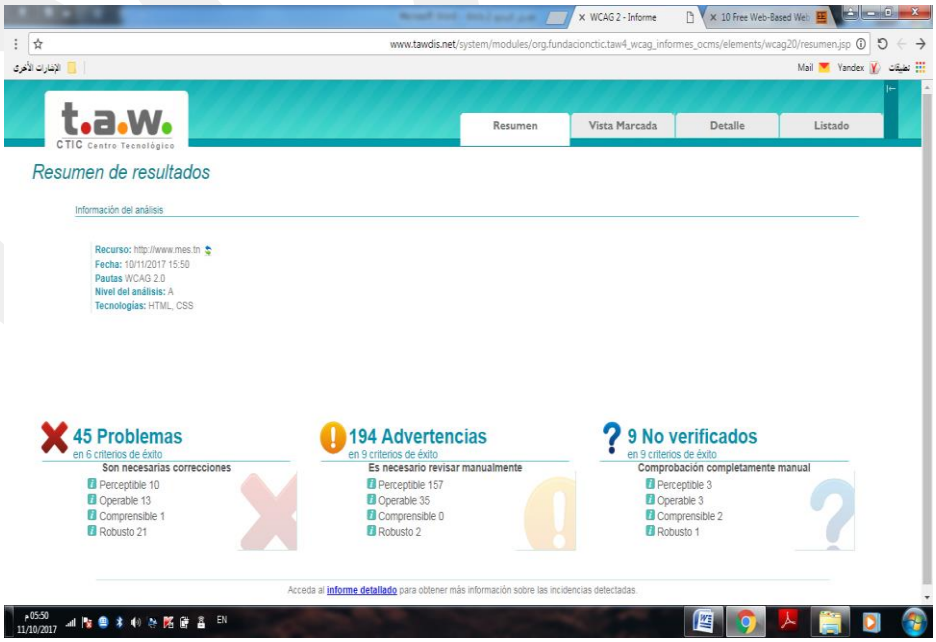

Figure 4.44: T.A.W. result for ministry of Higher Education in Tunisia

Ministry of Education

Figure 4.45 shows the evaluation result of the web site of Ministry of Education in Tunisia obtained from the T.A.W tool. There are so many errors and warnings on the page.

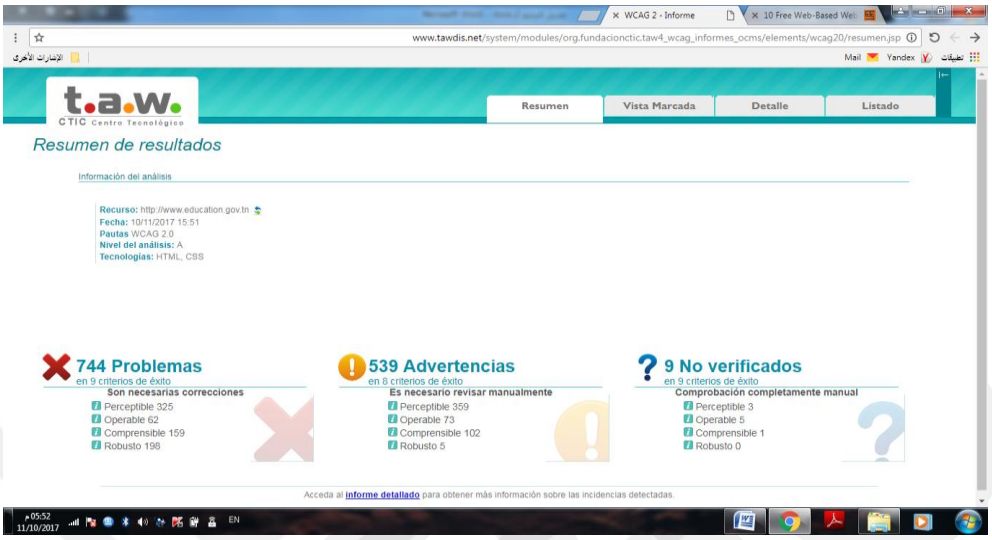

Figure 4.45: T.A.W. result for Ministry of Education in Tunisia

4.2.3 Results Obtained from PowerMapper

Ministry of Health:

Figure 4.46 shows the evaluation result of the web site of the Ministry of Health in Tunisia obtained from the PowerMapper tool. In total, 9 pages are checked and 2 of them have accessibility problems.

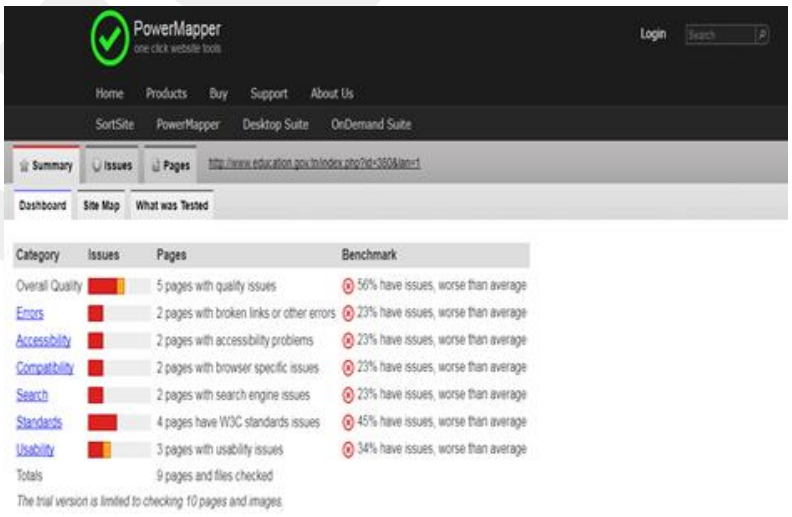

Figure 4.46: PowerMapper result for Ministry of Health in Tunisia

Ministry of Justice:

Figure 4.47 shows the evaluation result of the web site of the Ministry of Justice in Tunisia obtained from the POWERMAPPER tool. The web site could not be tested as seen on the figure.

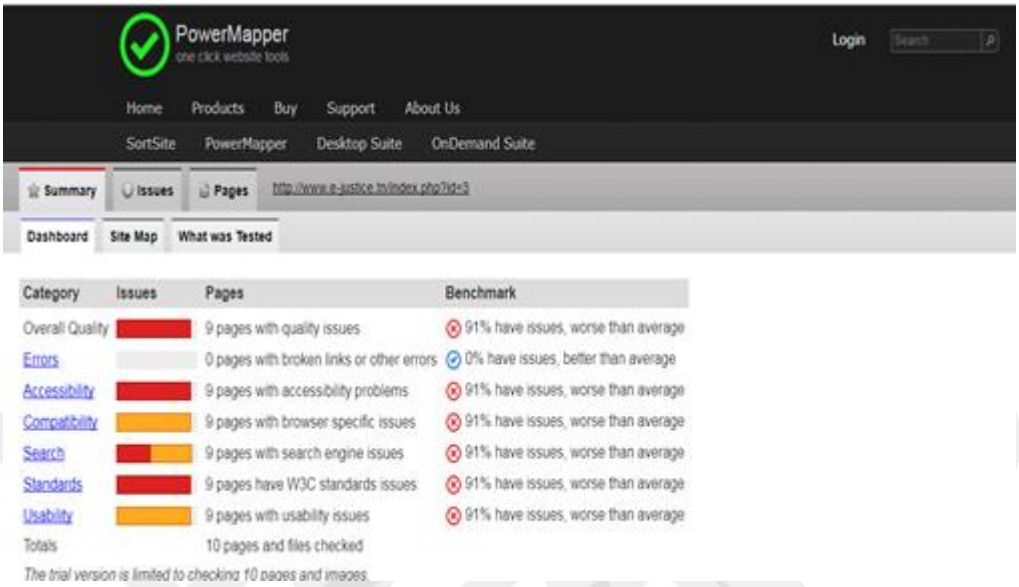

Figure 4.47: PowerMapper result for Ministry of Justice in Tunisia

Ministry of Interior:

Figure 4.48 shows the evaluation result of the web site of the Ministry of Interior in Tunisia obtained from the POWERMAPPER tool. In total, 10 pages are checked and 2 of them have accessibility problems.

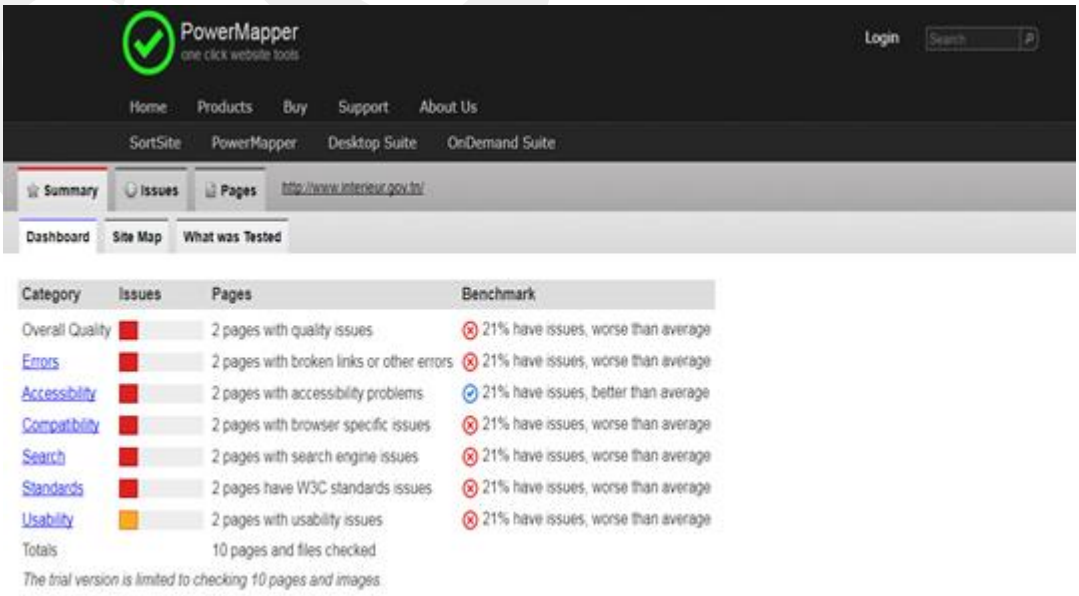

Figure 4.48: PowerMapper result for Ministry of Interior in Tunisia

Ministry of Defense:

Figure 4.49 shows the evaluation result of the web site of the Ministry of Defense in Tunisia obtained from the PowerMapper tool. In total, 10 pages are checked and 8 of them have accessibility problems.

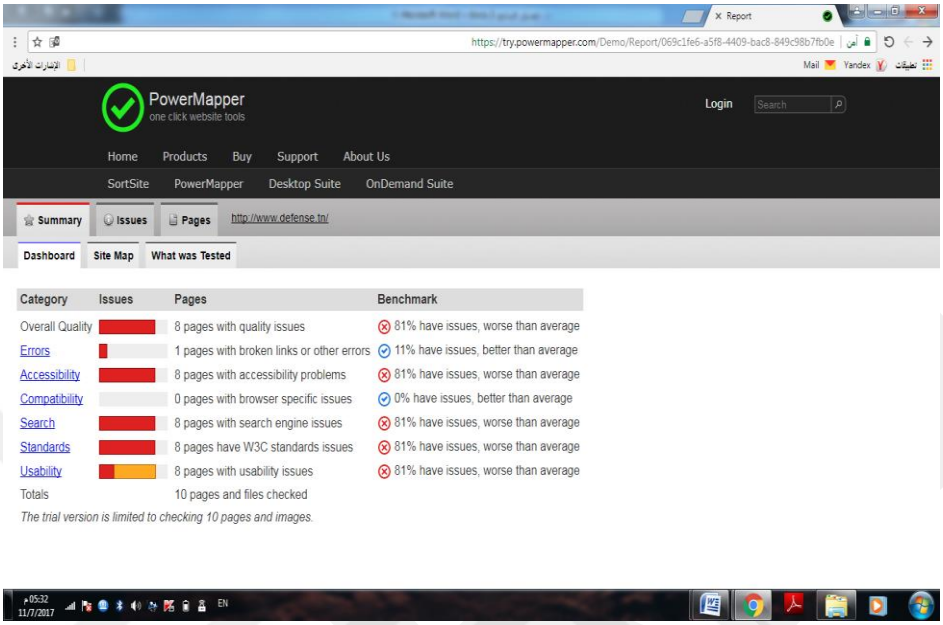

Figure 4.49: PowerMapper result for Ministry of Defense in Tunisia

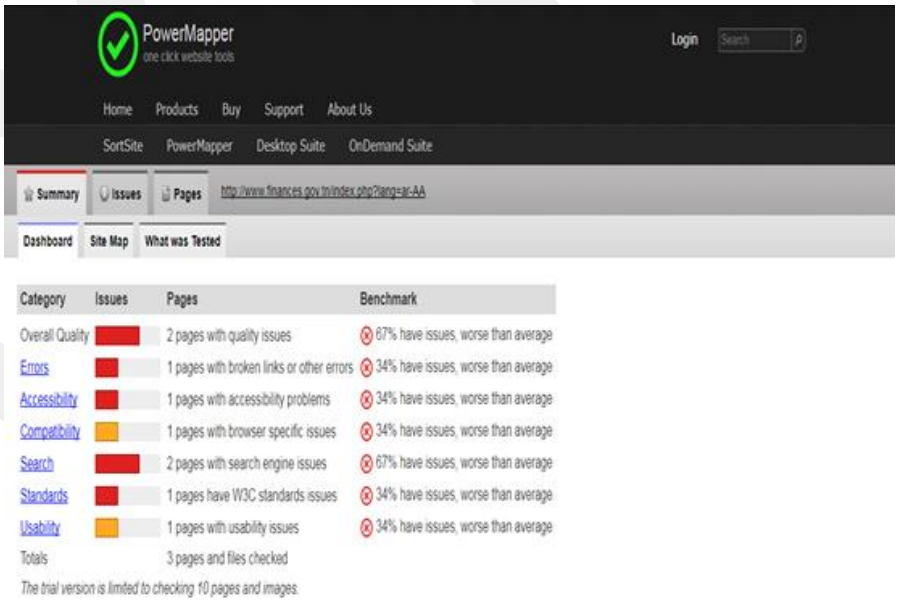

Figure 4.50: PowerMapper result for Ministry of Finance

Ministry of Finances:

Figure 4.50 shows the evaluation result of the web site of the Ministry of Finance in Tunisia obtained from the PowerMapper tool. In total, 3 pages are checked and one of them has accessibility problems.

Ministry of Civil Services:

Figure 4.51 shows the evaluation result of the web site of the Ministry of Civil Services in Tunisia obtained from the PowerMapper tool. In total, 10 pages are checked and all of them have accessibility problems.

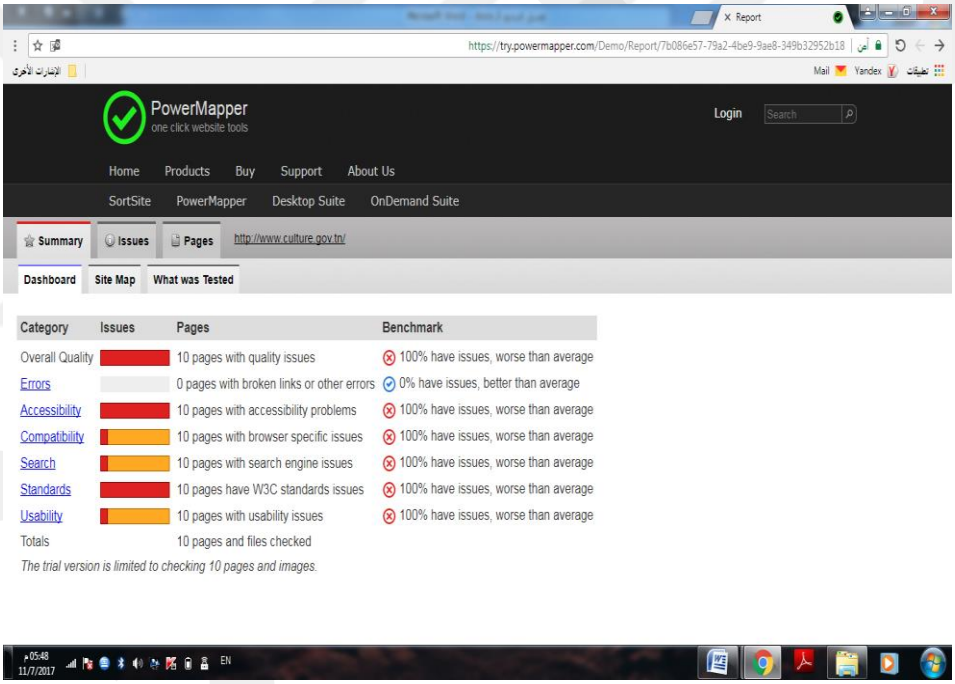

Figure 4.51: PowerMapper result for Ministry of Civil Service in Tunisia

Ministry of Social Affairs and Labors:

Figure 4.52 shows the evaluation result of the web site of the Ministry of Social Affairs and Labors in Tunisia obtained from the PowerMapper tool. In total, 10 pages are checked and 8 of them have accessibility problems.

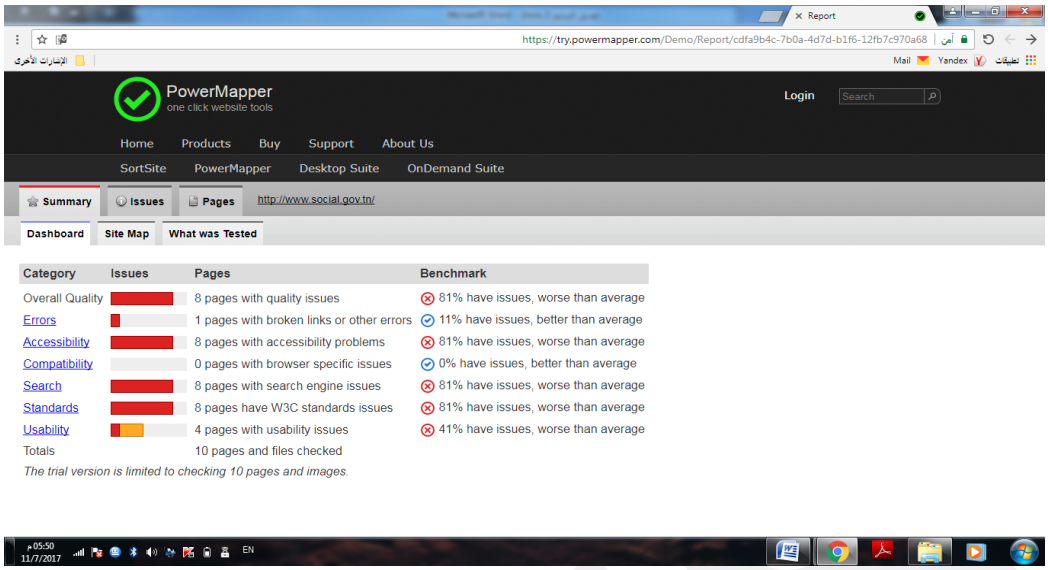

Figure 4.52: PowerMapper result for Ministry of Social Affairs and Labors in Tunisia

Ministry of Higher Education:

Figure 4.53 shows the evaluation result of the web site of the Ministry of Higher Education in Tunisia obtained from the PowerMapper tool. In total, 10 pages are checked and 8 of them have accessibility problems.

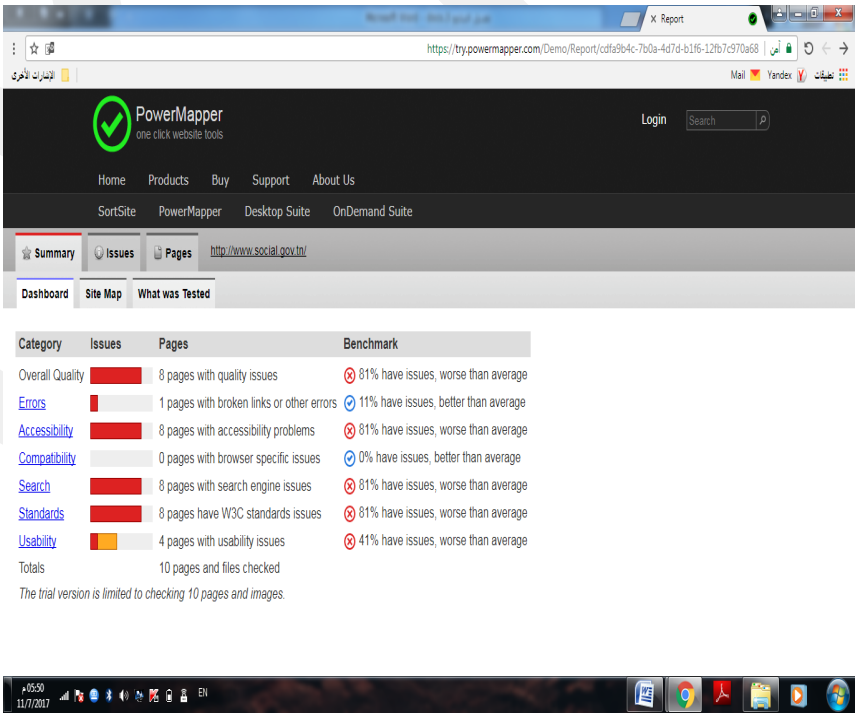

Figure 4.53: PowerMapper result for Ministry of Higher Education in Tunisia

Ministry of Education:

Figure 4.54 shows the evaluation result of the web site of the Ministry of Education in Tunisia obtained from the PowerMapper tool. In total, 9 pages are checked and 2 of them have accessibility problems.

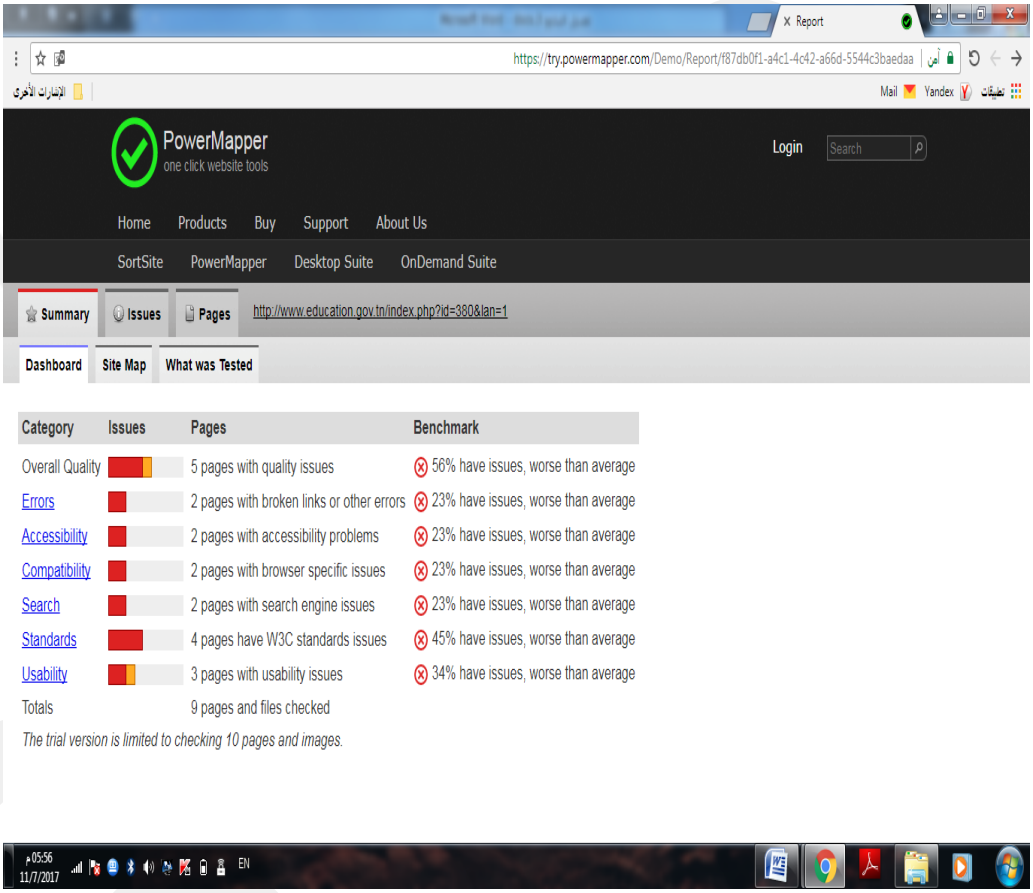

Figure 4.54: PowerMapper result for Ministry of Education in Tunisia

4.3 Comparison of Libyan and Tunisian Websites

Selected nine corresponding E-Government websites of two counries are evaluated using three testing tools which are WAVE, T.A.W. and PowerMapper. Now, we want to summarize the obtained results, compare obtained results of two counries and discuss the obtained results.

The results collected for 9 E-Government websites in Libya are summarized in Table 4.3. As seen in the table, there is no sites without errors/problems. Although some accessibility features are used, many requirements of W3C standards are ignored. Since we see so many problems, we can say that developers did not give enough importance to accessibility.

Table 4.3: Results of three tools for Libyan Web Sites

	WAVE			T.A.W.		PowerMapper	
	Errors	Alerts	Features	Problems	Warning	# of page with accessibility problem	Total Pages checked
1. Ministry of Health	15	45	31	4	1	0	2
2. Ministry of Justice	**3**	**1**	0	4	1	1	3
3. Ministry of Interior	20	34	17	58	419	9	10
4. Ministry of Defense	41	80	26	84	235	9	10
5. Ministry of Finance	17	36	1	55	224	9	10
6. Ministry of Civil Services	9	116	13	22	199	6	10
7. Ministry of Social Affairs and Labors	2	14	13	22	199	10	10
8. Ministry of Higher Education	-	-	-	-	-	-	-
9. Ministry of Education	**23**	66	31	11	111	3	10

For example, if we consider the PowerMapper tool results, mostly 10 pages are checked because of restriction of the trial version. Here, the important point is that 10 of 10 pages have accessibility problems for Ministry of Social Affairs and Labors. The web site of Ministry of Civil Services seems a little bit better, because 6 out of

10 pages have accessibility problems. The best one is the Web site of Ministry of Education.

We have compared the results obtained for the e-government Web sites of Libya and Tunisia. WAVE, TAW and PowerMapper results are compared in tables 4.4, 4.5 and 4.6, respectively.

Table 4.4: WAVE result comparison for Libyan and Tunisian websites

	Libya			Tunisia		
	Errors	Alerts	Features	Errors	Alerts	Features
1. Ministry of Health	15	45	31	8	11	12
2. Ministry of Justice	3	1	0	18	5	8
3. Ministry of Interior	20	34	17	37	108	0
4. Ministry of Defense	41	80	26	51	30	20
5. Ministry of Finance	17	36	1	42	96	63
6. Ministry of Civil Services	9	116	13	85	153	33
7. Ministry of Social Affairs and Labors	2	14	13	13	73	15
8. Ministry of Higher Education	-	-	-	15	30	63
9. Ministry of Education	23	66	31	284	416	125

Table 4.5: T.A.W. result comparison for Libyan and Tunisian websites

	Libya		Tunisia	
	Problems	Warnings	Problems	Warnings
1. Ministry of Health	4	1	17	20
2. Ministry of Justice	4	1	82	203
3. Ministry of Interior	58	419	2	2
4. Ministry of Defense	84	235	75	139
5. Ministry of Finance	55	224	3	1
6. Ministry of Civil Services	22	199	176	166
7. Ministry of Social Affairs and Labors	22	199	19	177
8. Ministry of Higher Education	-	-	45	194
9. Ministry of Education	11	111	744	539

Table 4.6: PowerMapper result comparison for Libyan and Tunisian websites

	Libya		Tunisia	
	# of page with accessibility problem	Total page	# of page with accessibility problem	Total page
1. Ministry of Health	0	2	2	9
2. Ministry of Justice	1	3	9	10
3. Ministry of Interior	9	10	2	10
4. Ministry of Defense	9	10	8	10
5. Ministry of Finance	9	10	1	3
6. Ministry of Civil Services	6	10	10	10
7. Ministry of Social Affairs and Labors	10	10	8	10
8. Ministry of Higher Education	-	-	8	10
9. Ministry of Education	3	10	2	9
Total	47	65	50	81

When we analyze the WAVE and TAW results, they have similar characteristics. That is, e-government web sites in both countries have many problems related to accessibility. It is very difficult to distinguish which country is better that the other. The results obtained from the PowerMapper tool are easier to analyze to see differences. In total, 65 pages are evaluated in Libya and 81 pages are evaluated in Tunisia. 47 of 65 pages of Libya have accessibility problems and this is about 72% of total tested pages. On the other hand, 50 of 81 pages of Tunisia have accessibility problem and this is 62% of the total tested pages. Considering this result, we can conclude that Tunisian e-government web sites are a little bit better than Libyan e-government web sites.

CHAPTER 5

CONCLUSIONS

This thesis investigated conformance of e-government web sites in Libya to W3C accessibility standards. To achieve this, we have tested nine e-government sites in Libya using three programs which can test conformity of web sites to W3C accessibility standards automatically. Obtained results show that there are no government sites in Libya which meet the W3C accessibility standards fully. However, for example, the web site of the Ministry of Education gives the best conformance result. There are only a few problems on this web site. Used three programs give similar results.

Accessibility is important for e-government web sites, because governments have to give equal chance to their citizens to reach government services. E-Government is a good way to provide services to citizens using web technologies. Therefore, Libyan government can benefit from this technology. However, the result of this study shows that many e-government web sites need improvements in terms of accessibility.

We have compared tested 9 e-Government websites in Libya with the corresponding web sites in Tunisia. Although we observe many accessibility problems in both countries, we conclude that Tunisian e-Government web sites are a little bit better than Libyan e-Government web sites.

Some suggestions for Libyan government to improve their web sites are as follows:

- Develop e-Government websites in Libya including more contents for citizens;
- Do not ignore accessibility features during web site development;
- Emphasize the importance of accessibility in training programs related to e-government; and
- Add specifications related to accessibility to specification documents used for e-government web sites development biddings/contracts.

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