

# Website Content Accessibility of 30,000 Cypriot Web Sites

Panayiotis Zaphiris<sup>1</sup> and Giorgos Zacharia<sup>2</sup>

<sup>1</sup>Institute of Gerontology and Dept. of Industrial & Manufacturing Engineering  
Wayne State University, Detroit, MI  
48202, USA

<sup>2</sup>Center of Biological and Computational Learning, Artificial Intelligence Lab  
Massachusetts Institute of Technology, Cambridge, MA  
02139, USA

**Abstract.** This paper extends previous studies [10, 12, 13] that investigated the accessibility of different web sites of specific content and context to an analysis of the whole web of a specific country (Cyprus). To our knowledge no previous study has analyzed such a big number of web sites for accessibility in a single study. More specifically this paper evaluates the compliance of 30,000 Cyprus related websites spidered by Arachne (<http://search.kypros.org>) search engine. The 30,000 Cyprus related websites where evaluated for accessibility using the Bobby (<http://www.cast.org/bobby/>) accessibility tool. Statistical analysis and comparison of the accessibility ratings for the different main domain categories (commercial, academic, governmental, and organizational) of the Cypriot web are also provided.

## 1 Introduction

Currently millions worldwide have physical, sensory or cognitive limitations that make interacting with traditional monitor, keyboard and mouse configurations difficult [5]. The number of people with disabilities is expected to increase significantly in the next decade as the world's population is rapidly growing older, and the number of World Wide Web (WWW) users of old age also increases exponentially [11, 2].

To make computer technology accessible to people with disabilities, companies provide specialized human computer interface devices (e.g. special mouse for people of age that have difficulty in motor movements, special magnification for monitors, special keyboards). However, although being able to interact with a computer is a necessary prerequisite to using the WWW, the web provides unique features (dynamic content, heavily graphical user interfaces, complicated navigation structures) that often make accessibility a more complicated challenge.

### 1.1 Definition of Web accessibility and Universal Design

Researchers have been advocating a universal design strategy when designing web interfaces. Universal design refers to the design of products and environments that are usable by all people, to the greatest extent possible, without the need for case-by-case accommodation. If you adopt universal design when developing WWW pages, your pages

will be more readily accessible to most people with disabilities who are already using computers [5].

Chuck Letoumeau [6] defines web accessibility to mean that “anyone using any kind of web browsing technology must be able to visit any site and get a full and complete understanding of the information as well as have the full and complete ability to interact with the site if that is necessary”

## 1.2 Accessibility Mandates, Guidelines and Tools

There are some encouraging signs that the accessibility of the Internet is taken into account by mainstream society [8]. Accessibility for information on the Web has been well regulated in the U.S. Some legal mandates regarding accessibility are Section 255 of the Telecommunications Act 1996 (<http://www.fcc.gov/cib/dro/section255.html>), which regulates the accessibility of Internet Telephony, and Section 508 of the Rehabilitation Act Amendments of 1998 (<http://www.ed.gov/offices/OSERS/RSA/RehabAct.html>), which requires that when Federal departments or agencies develop, procure, maintain, or use electronic and information technology, they shall ensure that the technology is accessible to people with disabilities, unless an undue burden would be imposed on the department or agency.

Various institutions also compiled accessibility guidelines for information on the Web. Those resources are well documented and available for public viewing on the Internet. Some examples of those guidelines are:

- W3C Web Content Accessibility Guidelines (WCAG) (<http://www.w3.org/TR/WAI-WEBCONTENT>)
- WAI Quick Tips Reference Card (<http://www.w3.org/WAI/References/QuickTips>)
- Penn State University's Center for Academic Computing Web Accessibility Check-List (<http://www.psu.edu/dept/cac/training/outlines/accessibility/check.html>)
- Public Service Commission of Canada: Designing Universal Web Pages (<http://www.psc-cfp.gc.ca/eepmp-pmpee/access/welcome1.htm>)
- Captioning and Audio Description on the Web - The National Center for Accessible Media (<http://www.wgbh.org/pages/ncam>).

Apart from the many social and economic motivations for addressing Web accessibility, regulatory compliance is becoming an important factor. More specifically [5]:

1. When a web site is used in a job or in schools or universities, accessibility becomes an issue that may be addressed by the Americans with Disabilities Act of 1990 (ADA).
2. If employees need to use an outside Web site for a critical job function, the employer or institution may be responsible for providing adequate access.
3. If web sites are designed so that current adaptive equipment cannot make the pages accessible, employers and educational institutions may have difficulty providing acceptable accommodation (e.g. heavily graphic oriented web pages).
4. A service provided to the public via a web site or page that is not accessible to users with disabilities may be subject to an ADA claim; and more important, the service

provider may lose market share because many potential customers are unable to access the service.

Others [7] advocate that inaccessible web pages are also in violation of Title III of ADA since the internet is a public space.

Similarly, the European Commission [4] through an action plan recognizes the importance of making the information highway accessible to people with disabilities by pointing out that “special attention should be given to disabled people and the fight against info-exclusion”. Furthermore the commission points out that:

“as government services and important public information become increasingly available on-line, ensuring access to government websites for all citizens becomes as important as ensuring access to public buildings. In the context of citizens with special needs, the challenge consists of ensuring the widest possible accessibility to information technologies in general as well as their compatibility with assistive technologies”.

The commission points out that public sector web sites and their content in member states and in the European Institutions must be designed to be accessible to ensure that citizens with disabilities can access information and take full advantage of the potential for e-government. More specifically, among other things, the eEurope action plan advocates that member states should share information in order to enforce policies to avoid info-exclusion (deadline - end of 2001), work for the publication of “Design for all” standards for accessibility of information technology products (deadline – end of 2002), adopt the Web Accessibility Initiative (WAI) guidelines for public websites (deadline – end of 2001).

Unfortunately the Cypriot legislature is not yet in line with the European action plan on the issue of web accessibility. To our knowledge, the only accessibility related Cypriot legislature available (which is very narrowly related to web accessibility) is the regulations relating to the accessibility of public buildings and highways [3].

These regulations:

1. Defines the term “disabled” as anyone who due to physical disability or limitation is faced with permanent or temporary difficulty in accessing buildings or roads.
2. Lists the categories of buildings (public buildings, shopping centers, apartment complexes and educational institutions) to which these regulations are applicable.
3. Provides a set of requirements that need to be satisfied (accessible entrance, corridor and pathway dimensions, safety requirements etc) before a building license can be issued.

Unfortunately, although this legislature provides the required legal framework for the protection of the right of access for the people with disabilities to the road highways of Cyprus, no similar legislature is available to protect their right of access to the information highway.

To demonstrate the importance of the topic of web accessibility let us for example consider the following hypothetical (but very likely) scenario:

We are at 2004, Cyprus is now a full member of the European Union. Andreas (hypothetical name) is a blind student of a Cypriot college/university. The tremendous

increase of academic information (conference/journal papers, data) becomes available (and often *only* available) on the web, Andreas is highly required to access the web for his research. His academic performance is highly influenced by how accessible the web is. Furthermore, lets assume that his department has recently shifted to a “paper-less” system where it requires its students to perform all registration and grade enquires online. This puts Andreas’ into an inferior position compared to his classmates. Andreas’ after complaining to his department about it, and his calls being ignored decides to ask legal help. Although there is still no Cypriot legislature to protect his legal rights to access to the information highway, he decides to use his right as a European citizen to ask help from the European bodies.

Apart from the ethical dimension of the scenario above, there is also an important legal/economic dimension that the primarily the Cyprus government and its educational institutions need to seriously consider. Similar scenarios for other domains beyond the educational can easily being presented.

### 1.3 Research motivation

Sullivan and Matson [10] compared 50 most popular web sites in terms of their usability and content accessibility and found a marginal correlation ( $\rho=0.23$ ) between manually analyzed content accessibility in conformance to the Priority 1 of the WCAG and overall automated usability testing result provided by LIFT (<http://www.usablenet.com/index.htm>). Other studies [12, 13] applied this methodology to other domains (educational and health related websites). Table 1 presents a summary of these studies.

Authors	Topic of websites evaluated	N	% Accessible
Sullivan and Matson [10]	Most popular web sites	50	18%
Zaphiris and Ellis [12]	Top USA universities	50	30%
Zaphiris and Kurniawan [13]	Health & Aging Websites	89	28%

**Table 1.** Previous Web accessibility research. (N = number of sites analyzed)

The present study tries to take the issue of accessibility evaluation a step further, by analyzing the accessibility of a whole country’s (Cyprus’) web. To our knowledge no previous study has analyzed such a big number of web sites for accessibility in a single study. The authors believe that analysis of the whole Cyprus domain is a better reflection of the nature of the whole world wide web than a thematic analysis of selective small number of websites.

More specifically this paper aims to answer two research questions:

1. To what extend is the Cyprus web accessible?
2. Are there significant differences between the accessibility rating of different categories (governmental, commercial, educational, organizational) of Cyprus websites?

The automatic evaluation tool used in this study is Bobby (<http://www.cast.org/bobby>). Bobby is the most widely used automatic accessibility evaluation tool.

To become Bobby approved, a Web site must:

1. Provide text equivalents for all images and multimedia such as animations, audio, and video.
2. Ensure that all information conveyed with color is also available without color.
3. Identify headers for data tables and make line-by-line reading sensible for layout tables.
4. Provide summaries of graphs and charts
5. Identify document language and any changes of the language
6. Organize content logically and clearly, such as with headings, list elements, meaningful links, and navigation bars.
7. Provide alternative content for features (e.g., applets or plug-ins) that may not be supported

Bobby also analyzes Web pages for compatibility with various browsers and automatically checks sites for compatibility with HTML 4.0. (<http://www.cast.org/bobby/>)

Bobby recommends effective Web page authoring for special Web browsers (e.g. the one which reads text out loud using a speech synthesizer for blind users). Bobby divides the accessibility errors into 4 sections to be tested:

1. *Priority 1 Errors* are problems that seriously affect the page's usability by people with disabilities, in accordance with Priority 1 of WCAG. A Bobby Approved rating can only be granted to a site with no Priority 1 errors. Bobby Approved status is equivalent to Conformance Level A for the WCAG.
2. *Priority 2 Errors* are secondary access problems. If all items in this section including relevant User Checks passed the test, it meets Conformance Level AA for the WCAG.
3. *Priority 3 Errors* are third-tier access problems. If all items in this section including relevant User Checks passed the test, it meets Conformance Level AAA for the WCAG.

*The Browser Compatibility Errors* are HTML elements and element attributes that are used on the page which are not valid for particular browsers. These elements do not necessarily cause accessibility problems, but users should be aware that the page may not be rendered as expected which may impact usability and accessibility.

As a general rating, Bobby gives the rating with the picture of "Bobby-hats". Hats with wheelchairs indicate Priority 1 accessibility errors that are automatically detectable. A question mark identifies a possible Priority 1 error that cannot be fully automatically checked, indicating that the user will need to address that question manually.

## **2 Methodology**

### **2.1 Data Collection Method**

In order to collect as many URLs on Cyprus as possible, we deployed a recursive multithreaded spider, which we bootstrapped by collecting as many Cypriot URLs. We collected the URLs through a combination of heuristics:

1. We collected all the registered .cy domains, as of Spring 2000, by listing all the database of the primary Domain Name Servers (DNS) of Cyprus.
2. We also collected several hundreds of Top Level Domain (TLD) URLs (.com, .net, .org as opposed to .com.cy, net.cy and .org.cy) that were hosted by the four major ISPs of Cyprus. We collected those domain names by listing the primary DNS hosts of the 4 major Internet Service Providers (ISP) of Cyprus (Cytanet, Spidernet, Logosnet and Cylink).
3. Finally, in order to include as many Cypriot websites hosted outside Cyprus, we spidered major Cypriot indexers, like Eureka and Yiasou and collected all the URLs listed on those indexes.

We merged the several lists we collected, eliminated the duplicate entries and fed them to a spidering product we had developed in order to create Arachne, a search engine that indexes Cypriot sites (<http://search.kypros.org>).

We ran Arachne's spider with 256 concurrent threads, half of which searched for new URL's in a Breadth First Search manner, and the other half in a Depth First Search manner. The spider filtered out all URLs that were not sub-WebPages of the initial bootstrapping set, or did not include stemmed names of Cypriot geography.

The spider collected 96,000 URLs of which only 30,000 represented html files. The 30,000 html files included almost 12,000 placeholder, under construction or dead pages. After we eliminated the pages without content, we were left with 18,096 URLs to analyze for accessibility.

These 18,096 were then analyzed for accessibility using Bobby (Figure 1) automatic accessibility tool.

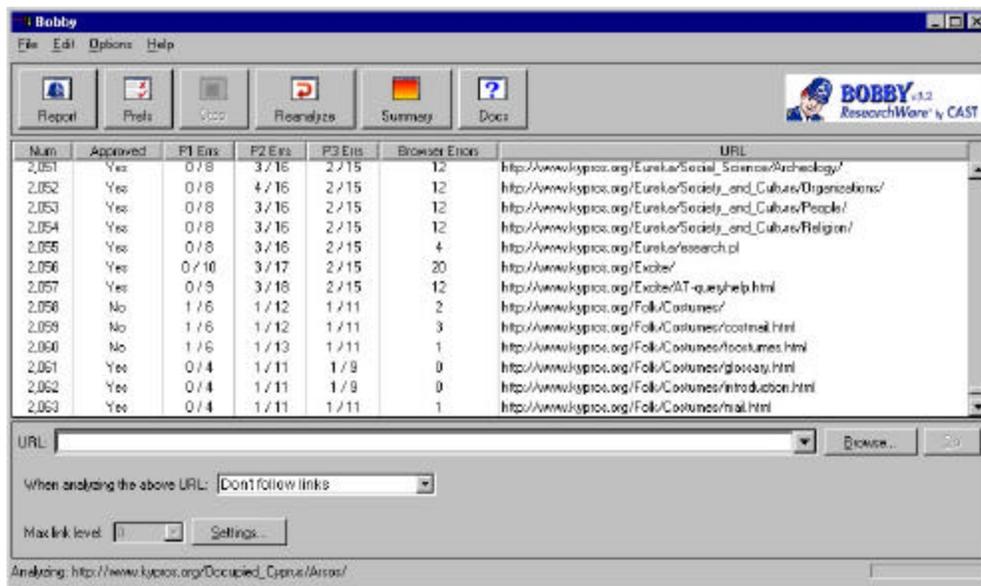
## 2.2 Analysis

To answer the aforementioned two research questions, several statistical analysis techniques are employed. For the first research question, the means and standard deviations of the accessibility of the whole Cyprus domain is calculated. To investigate whether there are significant differences between the accessibility rating of different categories (governmental, commercial, educational, organizational) of Cyprus websites separate analysis for each domain extension (.gov.cy, .ac.cy, .org and .org.cy, .com and .com.cy) were performed and finally an analysis of variance was carried out to notice any significant differences.

## 3 Results and Discussions

Table 2 lists the mean and standard deviation of the accessibility ratings for the whole Cyprus related websites analyzed in this study. Bobby's approval rating is converted into a binary variable with '0' representing 'Not Approved' and '1' representing 'Approved' status.

From Table 2 it is apparent that the Cyprus web sites analyzed are ranked very low in terms of accessibility (only 20% of them are bobby approved). Table 2 also shows high browser compatibility errors (average=6.5, maximum = 50) for these websites. One possible reason for this might be that web site designers tend to rely on web design tools that are compatible with only one particular type of browser.



**Fig. 1.** Screenshot of Bobby Interface

	N	Minimum	Maximum	Mean	Std. Deviation
APPROVAL	18096	0	1	.20	.40
Priority 1	18096	.00	4.00	.9907	.6296
Priority 2	18096	.00	7.00	2.2371	1.0619
Priority 3	18096	.00	4.00	1.7512	.4490
Browser Incom.	18096	.00	50.00	6.5115	5.1789
Valid N (listwise)	18096				

**Table 2.** Bobby approval results for the complete set of pages analyzed.

To answer the second research question, the 18,096 pages analyzed were divided into four groups:

1. Commercial (8,566 pages with a .com and .com.cy domain extension)
2. Academic (2,360 pages with a .ac.cy domain extension)
3. Governmental (1,242 under the gov.gov.cy domain)
4. Organizational (5,933 with an .org and .org.cy domain extension)

Specific accessibility results for each of the four cases above are presented in tables 3 to 6.

	N	Minimum	Maximum	Mean	Std. Deviation
APPROVAL	8555	0	1	.18	.39
Priority 1	8555	.00	4.00	.9873	.6004
Priority 2	8555	.00	7.00	2.4866	1.1049
Priority 3	8555	.00	4.00	1.8428	.3813
Browser Incom.	8555	.00	50.00	7.6638	6.1132
Valid N (listwise)	8555				

**Table 3.** Bobby approval results for the Cyprus commercial web sites analyzed.

	N	Minimum	Maximum	Mean	Std. Deviation
APPROVAL	2360	0	1	.25	.43
Priority 1	2360	.00	2.00	.9123	.6322
Priority 2	2360	.00	5.00	1.7309	.9139
Priority 3	2360	.00	2.00	1.6013	.5216
Browser Incom.	2360	.00	20.00	4.9288	3.2879
Valid N (listwise)	2360				

**Table 4.** Bobby approval results for the Cyprus academic web sites analyzed.

	N	Minimum	Maximum	Mean	Std. Deviation
APPROVAL	1242	0	1	8.00E-03	8.94E-02
Priority 1	1242	.00	2.00	1.8776	.3516
Priority 2	1242	.00	4.00	2.2697	.4704
Priority 3	1242	1.00	2.00	1.9968	5.668E-02
Browser Incom.	1242	2.00	13.00	8.8953	1.1047
Valid N (listwise)	1242				

**Table 5.** Bobby approval results for the Cyprus governmental web sites analyzed.

	N	Minimum	Maximum	Mean	Std. Deviation
APPROVAL	5933	0	1	.25	.43
Priority 1	5933	.00	2.00	.8411	.5604
Priority 2	5933	.00	7.00	2.0720	1.0400
Priority 3	5933	.00	2.00	1.6270	.4974
Browser Incom.	5933	.00	36.00	4.9771	4.1112
Valid N (listwise)	5933				

**Table 6.** Bobby approval results for the Cyprus organizational web sites analyzed.

As a follow up analysis we conducted an analysis of variance (ANOVA) to see if there are any significant differences in terms of accessibility among the four different domain category groups. The ANOVA results show a significant main effect ( $F(3, 18086)=144.485$ ,  $p<0.05$ ). Since one of the four groups (governmental) is way below the other groups in terms of accessibility a pair-wise post-hoc analysis (bonferroni) was performed. The pair wise analysis shows a significant difference among all of the pairs (at  $p<0.05$ ) except for the organization and academic pair which is of course not significant since both groups have the same mean accessibility rating.

The above tables show a clear weakness in accessibility in all four categories. Even though academic and organization websites are ranked top among the four categories only one quarter (25%) of Cypriot academic and organizational websites are accessible. Furthermore from table 6 it has to be noticed that the governmental websites (in year 2000 for which data was used in this paper, Arachne contained only all the websites under the .pio.gov.cy) are basically in total inaccessible (a merely 1% of them is accessible).

## 4 Conclusions

This study aimed to answer two research questions:

3. To what extent is the Cyprus web accessible ?
4. Are there significant differences between the accessibility rating of different categories (governmental, commercial, educational, organizational) of Cyprus websites ?

The analysis revealed that the Cyprus websites analyzed are ranked very low in terms of accessibility (only 20% of them are Bobby approved). Even though academic and organization websites were found to be rated significantly better than the governmental and commercial websites still only 25% of them were accessible.

The legal dimension of making websites accessible to people with disabilities is clearly specified by bodies like the European council and thus especially the governmental but also the academic community should develop a policy that pays more careful attention in incorporating accessibility guidelines in the web site development of their websites.

Further research could be conducted in several directions. First, in this study, only simple descriptive statistics were employed. Advanced statistical analysis such as structural equation modeling would be fruitful to explore the underlying relationship between different measures of accessibility evaluation. Secondly, the authors plan to extend the present study into a longitudinal research project that will evaluate the accessibility of the Cyprus web domain on a yearly basis. Finally, this study can be extended in analyzing the web domain of other countries providing a geographic comparison of web accessibility.

In this study, an automatic evaluation tool (Bobby) was used. Although Bobby can be used as a first step in an accessibility evaluation, some limitations of using automatic evaluation tools need to be recognized:

1. There are important elements (such as the web navigation structure, the information's layout, the value of information, or various aesthetic aspects) which are not evaluated by the automatic tools.

2. The meaning/significance/appearance of graphics is not evaluated, only the inclusion of ALT tags are taken into consideration by Bobby.
3. Text-only web sites will get high ranking with both tools regardless of the quality of information or the readability of the fonts.

These limitations might imply that, although automatic evaluation tools provide a quick reference and a first step analysis of the web site's accessibility and usability, formal usability and accessibility evaluation involving user testing combined with a series of other non-empirical methods (such as cognitive walkthroughs or GOMS) still hold a major importance in the thoroughness of web site evaluation.

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