

# Promoting Web Accessibility for Users with Multiple Disabilities

Eddalís Batista Ortiz

Computer Engineering

Nelliud D. Torres, Ph.D.

Electric and Computer Engineering and Computer Science Department

Polytechnic University of Puerto Rico

**Abstract** — *The web is quickly evolving and allowing people access to all types of information from the comfort of home. Information is accessible through electronic devices like computers, phones and tablets, for example. There has been an increase in the number of people with different disabilities, including older people, which constitute approximately 10 percent of the world's population today. The categories of such disabilities include physical, cognitive, sensorial, emotional, developmental, mental, and/or a combination of them. Websites need to be modified to provide equal access and to ensure their access to information to the internet, as is their human basic right. This improvement to websites is known as Web Accessibility. Web accessibility allows users with disabilities to browse through a website using accessible components or assistive tools as needed. Every website should strive to address and provide accessibility for as many disabilities as possible.*

**Key Terms** — *Assistive Technologies, Disabilities, Web Accessibility, Web Browsing.*

## INTRODUCTION

Today, business transactions, news, publishing, general communications, information searches, entertainment, and college education can occur in an electronic form through different types of websites. Companies target specific audiences to sell their products and services. Other organizations focus on general audiences and try to provide information in the form of written news, videos, forums, etc. People using the internet have the ability to search and download music and videos, get up to date on fashion tips, or simply find

the latest gossip on their favorite celebrities. People should have the ability to: browse, search, and find information, regardless of who they are or what disability could be affecting them.

“Currently around 10 per cent of the total world's population, or roughly 650 million people, live with a disability” [1]. The Disability Discrimination Act (DDA) and the Americans with Disabilities Act (ADA) define a disabled person as someone who “has a physical or mental impairment that has a substantial and long-term adverse effect on his or her ability to carry out normal day-to-day activities” and “has a physical or mental impairment that substantially limits one or more major life activities, has a record of such an impairment and is regarded as having such an impairment.” [2], respectively. In other words, a disability is an impairment that affects the ability of a person to function properly. This impairment can be physical, developmental, sensorial (specially visual and hearing), cognitive, mental, or emotional in nature. It could also be a combination of conditions within the same category or multiple categories. A person could be born with a disability or could develop such a disability at any point in his/her life. Areas that have been improved or are accessible to people with disabilities, mostly physical disabilities, are normally identified with the symbol in Figure 1.



**Figure 1**  
**International Symbol of Access**

In 2006, the United Nations adopted the Convention on the Rights of Persons with Disabilities and its Optional Protocol. The Convention “adopts a broad categorization of persons with disabilities and reaffirms that all persons with all types of disabilities must enjoy all human rights and fundamental freedoms. It clarifies and qualifies how all categories of rights apply to persons with disabilities and identifies areas where adaptations have to be made for persons with disabilities to effectively exercise their rights...” [3]. The Convention states that people with any kind of disabilities will have appropriate assistance and support to ensure access “to new information, communication technologies and systems, including the Internet” [4].

Following the Convention’s agreement, companies have been reviewing their websites to identify areas of improvement to ensure web accessibility.

## WEB ACCESSIBILITY

The Web provides an opportunity of access to people with disabilities by making available resources that may not be so easy to access in the physical world. However, when a website or one of its components is not carefully designed, it can prove to be a problem for a person with disabilities. For example, websites that do not provide multiple ways to reach the same information, that are too crowded with too many items on the same screen, or that have a video without caption, could not be properly used by people with visual and hearing disabilities. Depending on the importance of the content, this would cause a business to lose a potential customer or simply prevent a user from browsing that website.

People with disabilities can feel great frustrations when they cannot access the web. This frustration can be worse than the feeling on being incapable of doing any other task (Figure 2), since the web is supposed to be accessible all the time to all users.



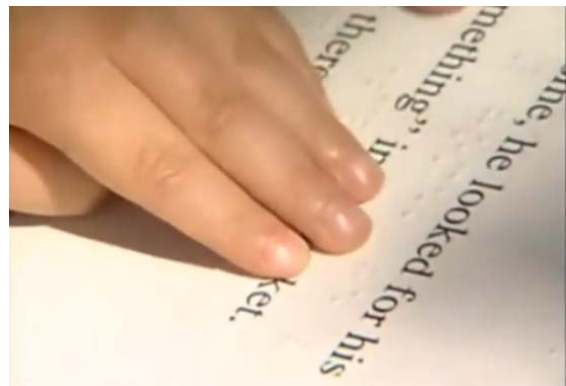
**Figure 2**  
**Learning Disability**

Web accessibility is the design through which people with different “disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging” [5].

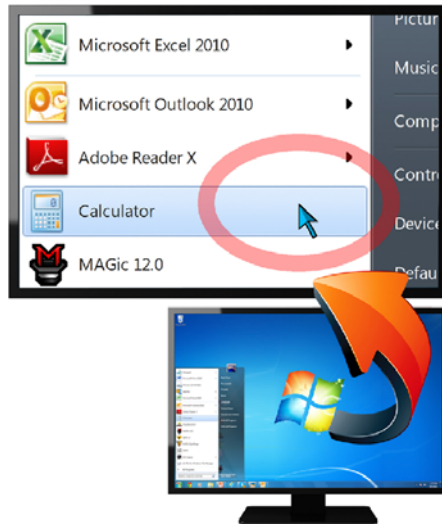
## Visual Disabilities

Officially diagnosed visual disabilities can include blindness, poor eyesight and color blindness, where the condition is permanent or has already lasted more than twelve (12) months [2].

Assistive tools for people with visual disabilities include: voice recognition tools, printing in Braille (Figure 3), magnification software (Figure 4), talking calculators, recorded books and others [6].



**Figure 3**  
**Reading Braille Print**



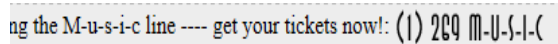
**Figure 4**  
**Magnification Software**

A good example of making text accessible in a website is giving the user the ability to select text size and/or color, as shown in Figure 5. This option allows a user with limited visibility to manipulate site content with minimum use of external assistive tools.

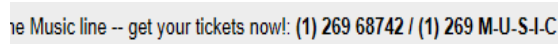


**Figure 5**  
**Manipulate Text Size and Color**

It is very important to avoid making a combination of letter types in the same area that can prevent an assistive reading tool from successfully recognizing and vocalizing the text in the screen. Figure 7 shows the correct form to display the text that was inaccessible as shown in Figure 6.



**Figure 6**  
**Mistake in Letter Type Combination**



**Figure 7**  
**Uniform Letter Type and Size Use**

Figure 7 not only shows a standardized use of letter type and size, but it shows how the phone number published is accessible for both the general public and for people with disabilities.

Figure 8 is a good example of how a table should be displayed on screen.

**Ticket prices for the Les Garçons and The Obelisks concerts**

Adult	Front Seats	Rear Seats	Dress Circle	Special Tables
Obelisks - Monkey, Monkey	\$20.90	\$20.90	\$20.90	\$20.90
Les Garçons de la Plage	\$20.90	\$27.90	\$30.90	\$33.90
<b>Concession</b>				
Obelisks - Monkey, Monkey	\$20.90	\$20.90	\$20.90	\$20.90
Les Garçons de la Plage	\$20.90	\$27.90	\$30.90	\$33.90
<b>Group (5 or more)</b>				
Obelisks - Monkey, Monkey	\$14.90	\$14.90	\$14.90	\$14.90
Les Garçons de la Plage	\$14.90	\$20.90	\$22.90	\$23.90

**Figure 8**  
**Accessible Table on Screen**

If the user is browsing a website and is going through a process where progress is being tracked, especially with a linked progress bar, the bar should be more visually intuitive. For example, Figure 9 shows a progress bar composed of tabs with the same color, where one tab acquires a darker shade when it's active. This bar would not be accessible for a person with low vision or who is color blind.



**Figure 9**  
**Inaccessible Progress Bar for Users with Visual Disabilities**

Figure 10 shows an accessible progress bar where each tab has a dark background and an indentation that identifies the active tab. Completed steps are identified with a checkmark in front of the name of the tab.



**Figure 10**  
**Accessible Progress Bar for Users with Visual Disabilities**

## Hearing Disabilities

Hearing disabilities include deafness and hearing impairments where sometimes a hearing aid might not provide enough assistance.

People with hearing disabilities may not experience problems browsing through a website, searching for information, reading and performing other actions. However, when it comes to watching videos, listening to music, listening to recordings or any other component that involves sound; they may experience great difficulties, if the necessary assistance is not provided.

Websites and web components can be modified within reason to meet the following conditions:

- Videos should have sufficient volume to allow a speaker system to increase sound enough for a person using a hearing aid (Figure 11).
- Videos should include captions that show the wording for the entire content. A transcript of the video could also be provided.
- Videos with important messages could include a sign interpreter to translate for the user.
- If possible, validate with a captioning tool that the video being added can be captioned successfully.



**Figure 11**  
Speaker System for People with Hearing Disabilities

## Learning Disabilities

A learning disability causes difficulty to acquire or properly develop skills like “reading, writing, math, listening, speaking, and reasoning” [7]. For example, a person with specific learning problems or dyscalculia would need a calculator to solve simple mathematical problems that any other person would solve easily. A person with learning disabilities can be unable to gain meaning from standard print materials and tends to struggle with problem-solving, memory, attention, and comprehension. Examples of learning disabilities include autism, intellectual disability, emotional disability, cerebral palsy, retardation, attention deficit disorder, dyslexia, hydrocephaly, traumatic brain injury, etc.

Providing web accessible websites for people with learning disabilities should include allowing users with ADD to turn off advertisements in order to focus their attention on important content. Avoid using unnecessary sounds and only use them to help the user to focus on the desired content. If the person is required to write comments or complete a form, a spell-checker function should be provided.

The use of high quality illustrations, video and audio can provide a healthy stimulus to support written content, since it has been proven to help users to retain more information. Content that is simple, structured and organized is easier to process and understand by people with learning disabilities.

## Physical Disabilities

A physical disability can constitute body and/or brain injuries, epilepsy, muscle tightness or spasm, involuntary movement, paralysis, muscular dystrophy, arthritis, Parkinson’s disease, and other motor conditions [8]. People with physical or motor disabilities can have difficulty reading or using standard print materials. Many of these conditions prevent people from properly holding and using a mouse to browse through a website. Also, in the case of an epileptic person, certain components may even trigger an epileptic episode [9].

Web accessibility solutions for people with physical disabilities include ensuring all the components and functions in the website can be accessed from the keyboard, and being able to skip certain areas when content is too long [8]. A website and web components should be constructed in an organized and structured manner that would allow the person to use eye tracking technology to move throughout the content. It should also, provide accessibility for voice recognition technology, where the person can speak into a microphone and be able to type into a specific field in the website without the use of a keyboard.

### **APPLYING WEB ACCESSIBILITY EXAMPLE**

The following list is an example of multiple techniques to be applied in a website and its components in order to make it accessible to people with multiple disabilities:

- Include captioning in all visual media or provide the option for captioning software to be used with the video. Include a text transcript of the video for the user to read.
- Include illustrations, videos, audio formats and other media in the highest quality possible.
- Ensure website components and functions are accessible through the keyboard.
- Avoid moving links or distracting content.
- Avoid including text within the content that doesn't make sense.
- Ensure uniform use of text font size and styles.
- Ensure structured and organized text, tables and additional content.
  - Clear headings, sized and spaced letters
  - Bulleted lists
  - Static illustrations
- Provide multiple ways to reach the same information within the website.
- The website should allow the user to change text size and color to facilitate reading.
- Allow the user to disable certain functions within the website.

- Avoid causing the screen to flicker and if it does, allow the users to control its flickering.
- Avoid causing the screen to blink and if it does, allow the users to control its blinking
- Minimize or avoid movement in pages and allow the users to stop movement or freeze the content.
- Links related to illustrations, news or other media should use correct text in terms of specifying the title or providing a specific reference to the content it's pointing to.
- Underline and color links.
- Resize links and buttons to facilitate precision in users with motor disabilities.
- Include instructional diagrams when possible.

Many other basic techniques can be identified and used according to the type of website and web components being used.

### **Polytechnic University of Puerto Rico Website**

The website for the Polytechnic University of Puerto Rico (PUPR) [10] has already been updated with web accessible techniques. Some of those techniques are:

- Most components in the website are accessible with the keyboard, providing an alternative to users with motor skills disabilities.
- The font type is relatively uniform throughout the majority of the content in the screens, facilitating the use of assistive technology.
- Links can be seen as underlined and colored as the mouse passes over them.
- The main page includes an announcement banner which changes slowly. No other components have blinking or flickering functions that may affect someone with epilepsy, for example.

However, there are still other techniques that could be included to greatly improve the website. Those techniques are:

- Provide the option to resize text and change text colors in all the screens.

- This will allow students to manipulate screen text and be able to see the content in the website from any computer in the university without the need for additional assistive technology.
- Example: Figure 12 shows the screen from the *Graduate School* homepage, that includes the *Message from the Dean*. The content in this screen is too long and even though the font type is easy to read, unless the user can modify the desktop's resolution or use the mouse to increase the size of the screen, it will not be an accessible component in the website for someone with restricted mobility or restricted permissions in the computer.
- Improve the table design used in the screens.
  - Example: The *Tuition & Fees* table is not visually attractive or that easy to read, as can be seen on Figure 13.
  - Figure 14 shows the suggested table format that could be used to make the content in the table more accessible, organized and structured. The font type in the screen title was also modified.

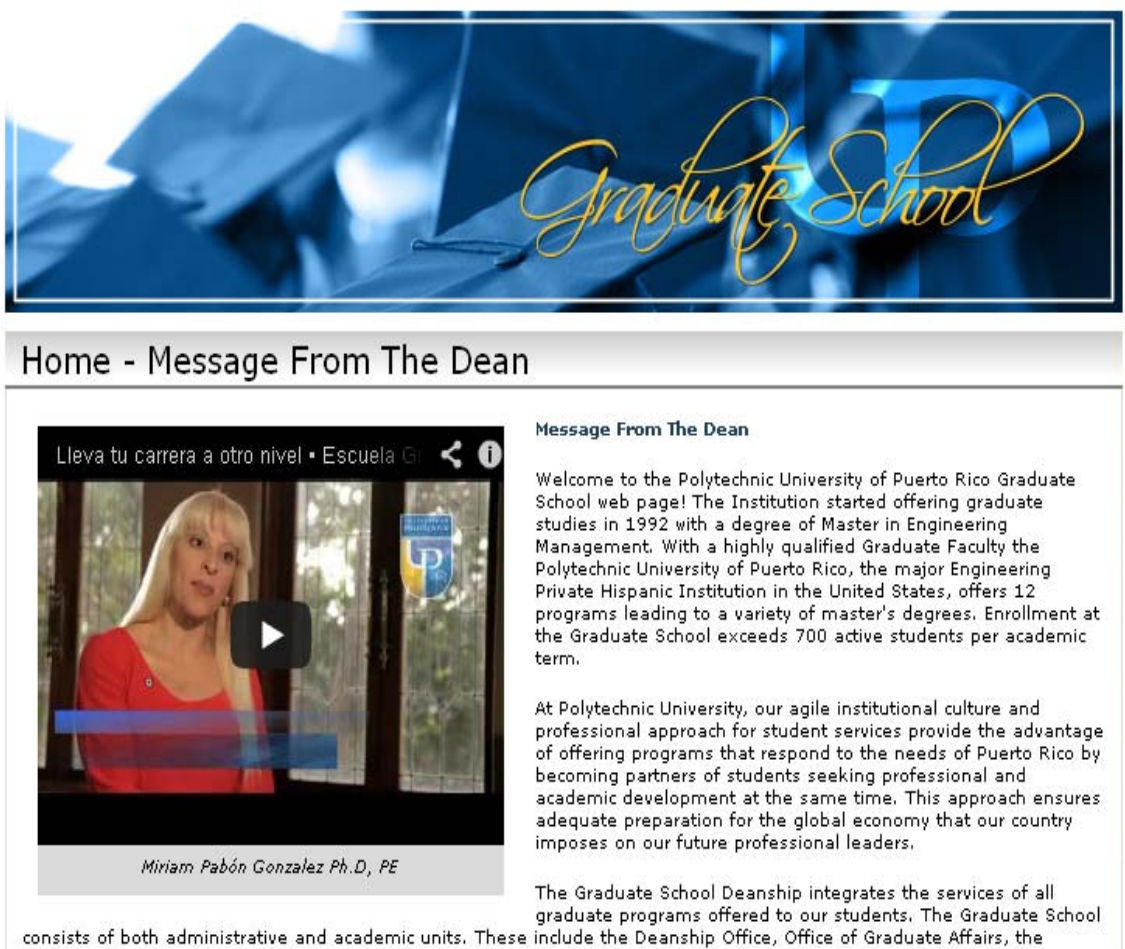


Figure 12

PUPR Website Example of Text Resize Option Needed

Financial Services Tuition & Fees *Services*

**Tuition And Fees Schedule For Undergraduate Programs**

The following schedule of tuition and fees applies to all undergraduate students of the Polytechnic University of Puerto Rico.. Academic Year consists of three consecutive academic periods called terms from August to July.

TUITION PER CREDIT - HOUR		
TOT CODES	DESCRIPTION	FISCAL YEAR 2011-2012
TEN	TUITION ENGINEERING	\$190.00
TBA	TUITION BUSINESS ADM.	\$175.00
TGN	TUITION GENERAL COURSE	\$175.00
TAR	TUITION ARCHITECTURE	\$200.00
GENERAL FEES (per trimester – 12 weeks)		
DESCRIPTION UNDERGRADUATE FEES	FISCAL YEAR 2011-2012	
ATHLETIC FEE	ATL	\$30.00
TECHNOLOGY FEE	CTI	\$80.00
LIBRARY	LIB	\$65.00
REGISTRATION	REG	\$35.00
STUDENT HEALTH SERVICES	SRM	\$20.00
STUDENT ACTIVITIES	STA-UG	\$30.00
OTHER FEES		
APPLICATION FOR ADMISSION	ADB	\$30.00
APPLICATION FOR ADMISSION INTERNATIONAL STUDENTS	ADF	\$50.00
READMISSION	REA	\$25.00
TRANSCRIPTS	TRA	\$6.00
CERTIFICATIONS	CER	\$4.00
COPY OF REGISTRATION REPORT	RRC	\$2.00

**Figure 13**  
Current Tuition & Fees Screen in the PUPR Website

Financial Services Tuition & Fees *Services*

**Tuition And Fees Schedule For Undergraduate Programs**

The following schedule of tuition and fees applies to all undergraduate students of the Polytechnic University of Puerto Rico.. Academic Year consists of three consecutive academic periods called terms from August to July.

**UNDERGRADUATE TUITION AND GENERAL FEES FOR FISCAL YEAR 2011-2012**

TUITION PER CREDIT - HOUR	TOT CODES	TOTAL FEE
TUITION ENGINEERING	TEN	\$190.00
TUITION BUSINESS ADM.	TBA	\$175.00
TUITION GENERAL COURSE	TGN	\$175.00
TUITION ARCHITECTURE	TAR	\$200.00
GENERAL FEES (per trimester – 12 weeks)		
ATHLETIC FEE	ATL	\$30.00
TECHNOLOGY FEE	CTI	\$80.00
LIBRARY	LIB	\$65.00
REGISTRATION	REG	\$35.00
STUDENT HEALTH SERVICES	SRM	\$20.00
STUDENT ACTIVITIES	STA-UG	\$30.00
OTHER FEES		
APPLICATION FOR ADMISSION	ADB	\$30.00
APPLICATION FOR ADMISSION INTERNATIONAL STUDENTS	ADF	\$50.00
READMISSION	REA	\$25.00
TRANSCRIPTS	TRA	\$6.00
CERTIFICATIONS	CER	\$4.00
COPY OF REGISTRATION REPORT	RRC	\$2.00

**Figure 14**  
Suggested Tuition & Fees Screen for the PUPR Website

- Provide illustrations and other media with the highest resolution possible.
  - Example: The *New Courses* tab within the *Continuing Education* (CE) section displays a table that is unreadable even for regular users (Figure 15). It is also a good example of how a person with low vision may perceive content in a website if the appropriate assistance is not provided.



**Figure 15**  
Unreadable Content in PUPR's CE New Courses Screen

- A partial solution to the possibly negative impression caused by the image in Figure 15 would be to include an explanatory text instructing the user to click over the image, in order to use the zoom function to properly view its content. A better and normal solution would be to present the small image with a good resolution providing the option to enlarge it.

Simple improvements may be incorporated in the website as each single addition is included in its particular section.

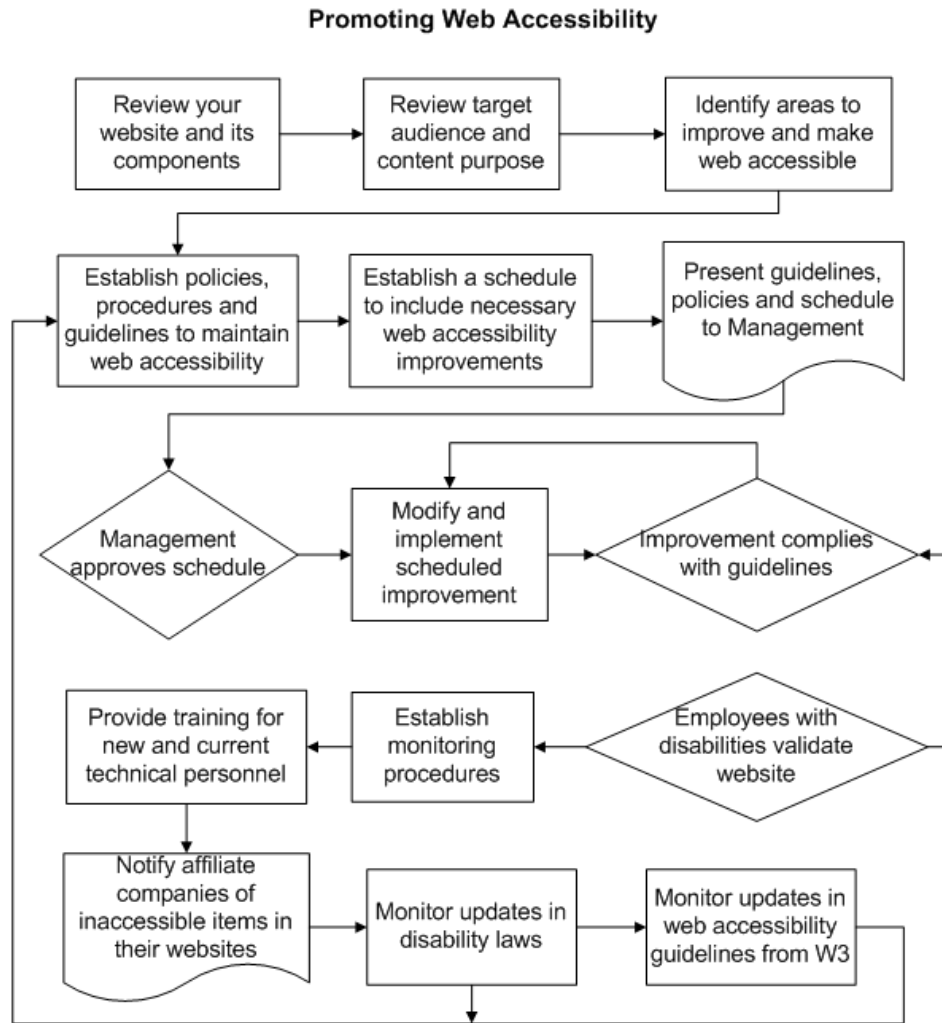
### PROMOTING WEB ACCESSIBILITY

There are multiple steps to be followed to ensure a website and its components are accessible to *all* users (Figure 16). Those steps are:

- Evaluate your website and web components.

- Evaluate the status of the content and products offered in your website.
- Identify your main audience and expand your scope to target people being excluded from using the website due to lack of sufficient accessibility.
- Identify areas that are not accessible to all users.
  - Use available evaluation tools to facilitate the identification of such items.
- Establish policies and procedures to maintain current products and use as guidelines for new ones.
- Establish a schedule in coordination with management to make releases of updated accessible components.
  - Define priorities according to the most important screens on the website.
- Modify your website to include the improvements in text, video, browsing, etc.
- Establish a monitoring procedure to ensure the website and the other components still comply with the required web accessibility policies.
- Train new technical resources to ensure correct maintenance of legacy content.
- Communicate inaccessible components of affiliate companies to help them update their websites in compliance with general web accessibility requirements.
- Monitor the Americans with Disabilities Act (ADA) [11], Individuals with Disabilities Education Act (IDEA) [12], and the Rehabilitation Act of 1973 (Section 504 [13] and 508 [14]) for any updates or revisions regarding accessibility.
- Monitor the Web Content Accessibility Guidelines, which provide a basis for most web accessibility law in the world. Go to <http://www.w3.org/> for additional guidelines and techniques [5].





**Figure 16**  
**Promoting Web Accessibility Flowchart**

## CONCLUSION

Web accessibility for people with hearing disabilities is still a work in process since captioning videos is practically a skipped step for website developers who are more focused on people with visual disabilities.

Accessible websites offer people with disabilities the opportunity to be independent and to have a feeling of normality that they would not have under regular circumstances.

It is important to remember that it is not expected that a website will be updated to be web accessible from one day to the next. However, part

of the business project plan and promotion to provide web accessibility facilities should follow the schedule to make partial releases where new sections are released according to the established guidelines. This process should continue until the website has reached the set goal to be web accessible to all people with multiple disabilities.

## REFERENCES

- [1] "World Facts and Statistics on Disabilities and Disability Issues", *Disabled World Towards Tomorrow*, Retrieved on 4/26/2013, <http://www.disabled-world.com/disability/statistics/>.

- [2] "Definitions of Disabilities", *Disabled World Towards Tomorrow*, Retrieved on 4/26/2013, <http://www.disabled-world.com/definitions/disability-definitions.php>.
- [3] "Convention on the Rights of Persons with Disabilities", *United Nations Enable*, Retrieved on 4/27/2013, <http://www.un.org/disabilities/default.asp?navid=14&pid=150>.
- [4] United Nations, "Accessibility", *Convention on the Rights of Persons with Disabilities and Optional Protocol*, 2006, 10.
- [5] Lawton Henry, Shawn, "Introduction to Web Accessibility", *Web Accessibility Initiative*, Retrieved on 5/03/2013, <http://www.w3.org/WAI/intro/accessibility.php>.
- [6] "Types of Assistive Technology Available Visually Impaired Students", *Bright Hub Education*, Retrieved on 5/08/2013, <http://www.brighthouseeducation.com/special-ed-visual-impairments/74539-assistive-technology-for-students-with-visual-impairments/>.
- [7] Grodzinsky, Gail; Horowitz, Sheldon; Urion, David, "What is a Learning Disability?", *PBS Parents*, Retrieved on 5/07/2013, <http://www.pbs.org/parents/education/learning-disabilities/basics/what-is-a-learning-disability/>.
- [8] "Motor Disabilities", *WebAIM*, Retrieved on 5/04/2013, <http://webaim.org/articles/motor/motordisabilities>.
- [9] "Web Design", *Epilepsy Action*, Retrieved on 5/03/2013, <http://www.epilepsy.org.uk/info/photosensitive-epilepsy/web-design>.
- [10] "Polytechnic University of Puerto Rico", *Universidad Politécnica de Puerto Rico*, Retrieved on 5/11/2013, <http://www.pupr.edu/>.
- [11] "Information and Technical Assistance on the Americans with Disabilities Act", *United States Department of Justice, Civil Right Division*, Retrieved on 4/29/2013, <http://www.ada.gov/index.html>.
- [12] "Building the Legacy: IDEA 2004", *United States Department of Education*, Retrieved on 4/29/2013, <http://idea.ed.gov/explore/home>.
- [13] "Rehabilitation Act, Section 504", *Federal Communications Commission*, Retrieved on 4/30/2013, [http://transition.fcc.gov/cgb/dro/504/disability\\_primer\\_1.html](http://transition.fcc.gov/cgb/dro/504/disability_primer_1.html).
- [14] "Section 508 of the Rehabilitation Act", *Federal Communications Commission*, Retrieved on 4/30/2013, <http://www.fcc.gov/encyclopedia/section-508-rehabilitation-act>.