Accessibility for Independence

Introducing Accessibility for Language Independence, Literacy Independence

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CERTIFICATE

This is to certify that **Mr. Nikhil Maheshwari (06/IS/09)** has carried out the major project titled **"Accessibility for Independence"** as a partial requirement for the award of Master of Technology degree in Information Systems by Delhi Technological University.

The major project is a bonafide piece of work carried out and completed under my supervision and guidance during the academic session **2009-2011**.

The matter contained in this report has not been submitted elsewhere for the award of any other degree.

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ABSTRACT

Web is the first source of information today but it has been seen that versatility and equality is still not achieved in web environment. All the works, from submission of bill to product purchase, is possible on internet (E-Commerce) but the persons with disabilities like Visual, Hearing, Motor and Cognitive are still facing lot of challenges in surfing the web due to WEB's limited accessibility.

Disabled persons have to be educated and trained in the web accessibility; otherwise it is still a puzzle for them. Hence an extensive research is going on in this area so that these persons also can access the web as any other person, who doesn't have disability of any kind.

Web Content Accessibility Guidelines (WCAG) is introduced to make Web accessibility more popular. In spite of these guidelines, web developers are still not able to use develop well structured WEB's, as these guidelines are complex in nature. Many Web developers are still not aware of WCAG 2.0 and their benefits.

A number of NGO's and other organizations like WebAim are working in the direction of making web equally available for everyone including those who has disability of some kind. Hence interest has been created in understanding the guidelines and their benefits which has been presented in this research work.

The objectives of this research are to develop:

- ***Website Development Life Cycle based on Web Content Accessibility Guidelines (WCAG) 2.0**, so that better accessible websites can be developed.*

- ***Accessibility for Independence (AFI)**, a framework to implement Language Independence, literacy independence in web applications, web sites and other Information Systems.*

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CHAPTER 1: INTRODUCTION

Web Access is an unavoidable habit of our daily life. It not only helps us in carrying out our daily work but also very useful source of latest information, entertainment, and social welfare with very low cost as compared to other sources. But imagine the life of those people who are partially or fully disabled without Web.

This research is an effort in the direction of making web more accessible to persons with disability (PWD) and explains the meaning of terminology used in this research:

1.1. World Wide Web

The World Wide Web [1] provides a user interface to the internet, which is made up of number of computers connected to each other with a network. Each of these computers either knows how to communicate, (or knows another computer that knows how to communicate), in a language called TCP/IP [2].

Thousands of computers are connected to World Wide Web and sharing the information with each other.

1.1.1. A brief history of the WWW

The idea of Web was conceptualized at CERN (European Organization for Nuclear Research) [3] in 1991 by Tim-Berners Lee, the creator of the hyperlink, who is today considered the father of the Web.

The principal of Web is based on the navigation between documents (Web Pages) by clicking hyperlinks using a program called browser. A Web page is written in simple text file by using tags of markup language (HTML) to decide the layout and formatting of page.

The documents and websites on the internet are identified by a unique address known as URL. These documents are connected to each other using HTTP protocol and hosted on distant computers called web servers.

1.1.2. Acronyms and terms used in WEB environment

The following are some popular acronyms used in the context of Web:

- **WWW :**

  World Wide Web. Also known as W3, or W cubed, or just "The Web".

- **HTML :**

  HyperText Markup Language [4]. It is what web pages are written in.

- **URL :**

  Uniform Resource Locator [5]. It is a standard for specifying an object on the Internet, such as a file or image. It's the thing in the "Location box" on your web browser. Examples include:

  http://www.dce.edu/

  gopher://it.dce.edu/

  news:dce

  mailto:nikhil@dce.edu

- **HTTP / HTTPD / HTTPS :**

  HyperText Transfer Protocol / Daemon / Secure Server HTTP

- **A link, red link, blue link :**

  A link is something which takes you to the page which address is associated with that link. An un-clicked link is represented in blue and a clicked link is represented in red.

- **Surfing the web :**

  The process of accessing web is known as surfing the web.

1.1.3. Website

Website is a collection of pages written in HTML to display the information about anything. These web pages are stored on a machine known as web server which is permanently connected to internet.

A website contains a central page known as "Home Page". Homepage contain links of pages which are hosted on same or different servers.

A URL looks something like this:

http://www.it.dce.edu/students/nikhil/index.html

Let's take a closer look at this address:

- **http://** It is the default protocol for browsing the web.
- **www.it.dce.edu** It is the web address. dce.edu is domain name and it.dce.edu is sub domain name.
- **/students/Nikhil/index.html** It is where the document is stored on server. Index.html is stored in students/Nikhil directory on web server.

1.1.4. Web browser

A "Browser" is a tool which help user visiting the websites. It provide user friendly graphical user interface (GUI), which includes navigation buttons, address bar, and status bar.
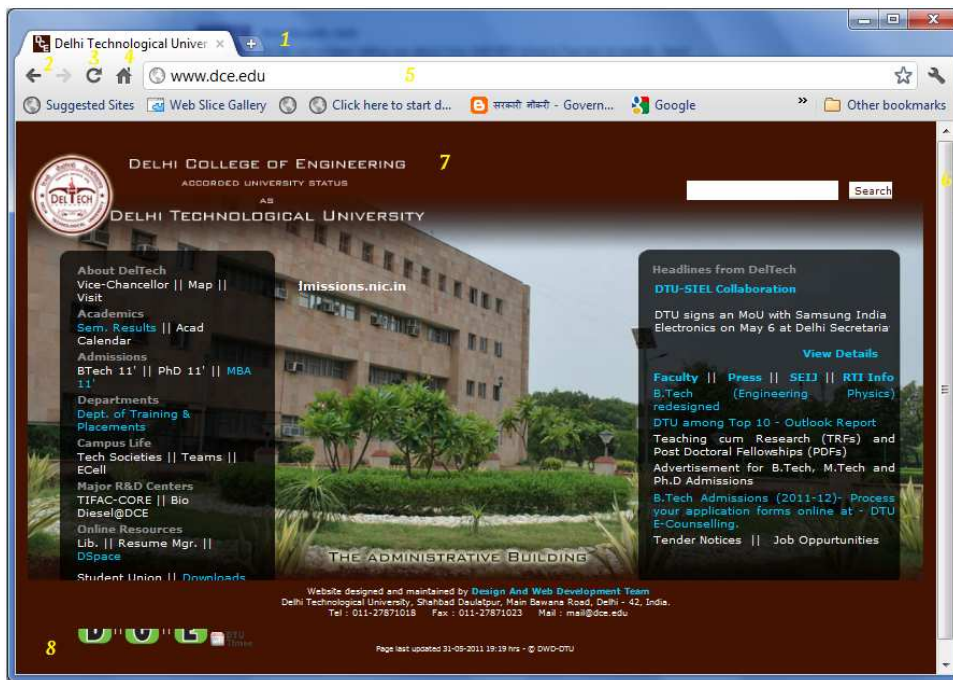
Figure 1.1: Screenshot of Web Browser (Firefox) with its different components

The basic elements of a Web Browser are specified in the figure 1.1. These elements are present in almost every Web Browser available today.

1.2. Dis (ability):

"Disability" [6] implies that a person is not able to do some things or anything (Baldwin, 2000) [7].

Like above, Most of the definitions of disability focus on only one aspect of disability and not upon the criteria which made a person disable. The basic criterion for successful interaction between user and system is the matching of their capabilities. If this matching is not there then user would not be able to access the system.

Most of the studies say that a significant number (20%) of our population has disability of some kind. These people are not capable of using internet unless any additional support is provided to them. Businesses are unknowingly excluding this 20 % population which can be their potential customers. Similar is the case with University, Schools and Government entities who are unaware that their websites are not accessible and they are breaking laws.

The major categories of disability are [8]:

- **Visual :** Low vision, Colour-Blindness and Blindness
- **Hearing :** Deafness (partial or complete)
- **Motor :** Unable to use a mouse, Poor response time, Limited fine motor control
- **Cognitive :** Distractibility, Learning Disability, Inability to remember or focus on large amounts of information

Many people consider that disability leads to failure but it is inappropriate since they neglect the abilities the person may possess.

Each of these disabilities requires different adaptation in order to make web content accessible to these. These adaptations are beneficial to disabled and non-disabled both.

1.2.1. Disability Laws

Different countries have some laws to enhance Accessibility in different environments. Few important laws related to Accessibility [9] are explained in this section:

- **India**: The Persons With Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995, commonly known as The PWD Act
- **United States**: The Americans with Disabilities Act (ADA) 1990 Section 508 of the Rehabilitation Act 1973 Individuals with Disabilities Education Act (IDEA)
- **United Kingdom**: The Disability Discrimination Act (DDA) 1995 Special Educational Needs and Disability Act (SENDA) 2001
- **Australia**: The Disability Discrimination Act (DDA) 1992

The definitions of disability are mainly given based on two factors, individual and society which are further divided in four models (Rioux, 1997) [10].

Table 1.1 : Categories of Definition of "Disabilities" (Rioux, 1997)

Category I: Individual as a unit of analysis		Category II: Society as a unit of analysis	
Biological or Medical Model	**Functional or Rehabilitation Model**	**Environmental Model**	**Human rights Model**
Emphasis on attributes in the individual	Emphasis on promoting or restoring fuller functioning in the individual.	Attention directed to ecological barriers: social, economic, political, institutional and legal, which can result in disabilities.	Focus is on the rights to which all people, including people with disabilities, are entitled.

The different categorization of definitions of Disability is shown in Table 1.1, which is adopted from Rioux, 1997 [10].

1.3. Web Accessibility

Web accessibility [11] means everyone can use the Web including the people with disabilities. The purpose of Web accessibility is to provide environment so that everyone can perceive, understand, navigate, interact and contribute to the Web. Web Accessibility has now become a major area for research.

The more details about the origin of Web Accessibility are given in next section.

1.4. The W3C's Web Accessibility Initiative

The World Wide Web Consortium (W3C), an international community, ensures the long-term growth of the Web by developing various web standards [13]. W3C is working to develop an accessible web environment for people having variations in education, culture, ability, resources and physical limitations. The prime goal of W3C is to develop web specifications (also known as recommendations), regarding communication protocols and basic building blocks of web.

Since web is not owned by anyone, W3C also works as a member organization such as IBM, Microsoft, Apple, Adobe, Sun Microsystems etc.

W3C keeps its work updated with many other standard organizations such as the Internet Engineering Task Force, the Wireless Application Protocols (WAP) Forum and the Unicode Consortium.

W3C has taken initiative in the direction of Web Accessibility, known as Web Accessibility Initiative (WAI) [12], to develop standards and guidelines for web browsers, authoring tools, web content etc. Guidelines for Web Accessibility are known as Web Content Accessibility Guidelines (WCAG) [14], which are explained in next section.

1.4.1. WCAG 1.0

Web Content Accessibility Guidelines 1.0 (WCAG 1.0) was published in May 1999. It was the major step taken in the direction of improving web accessibility. It was divided in 14 guidelines and numerous checkpoints, which were used to check the accessibility of a web page. There were 3 priorities or level of conformance to check whether the web page is following the guidelines or not.

- **Priority 1 or Level A conformance :** basic requirement
- **Priority 2 or Level AA conformance :** better accessibility and removal of significant barriers
- **Priority 3 or Level AAA conformance :** improvements to web content accessibility

WCAG 1.0 was very HTML specific in nature. Due to the limitations of WCAG 2.0, the development of WCAG 2.0 was considered.

1.4.2. WCAG 2.0

WCAG 2.0 was published on December 11, 2008 and it is applicable to advanced technologies. It is easily available, usable, understandable and testable with automated testing tools as well as human evaluation.

WCAG 2.0 has a four layered structure. The first layer consists of four design principles collectively known as POUR: Perceivable, Operable, Understandable, and Robust. The second layer is a set of twelve guidelines with basic goals of accessibility. Third layer is a set of success criteria similar to user requirements. The fourth layer consists of sufficient and advisory techniques required to meet the success criteria. These techniques can be developed inside as well as outside W3C.

- **Principles:** The foundation for Web accessibility is based on four principles: *perceivable, operable, understandable, and robust* known as POUR

- ➢ **Perceivable:** Web content and inefficient formation should be available to senses either through the browser or assistive technologies.
- ➢ **Operable:** Web content like controls and elements should be operable with keyboard, mouse, or an assistive device.
- ➢ **Understandable:** No ambiguity or confusion should exist in web content.
- ➢ **Robust:** Web content should be accessible through various available technologies.

- **Guidelines:** The author should follow twelve guidelines (Table 2: Guidelines from WCAG 2.0) in order to make web content more accessible to users. These guidelines are not testable directly but provide foundation for better understanding of success criteria and implementation.

- **Success Criteria:** Guidelines stated in WCAG 2.0 are testable through the success criteria provided. Success criteria should be performed during accessibility testing along with requirement and conformance testing. Based on the need of different organization, levels of conformance are defined in three parts: A (lowest), AA (medium), and AAA (highest).

- **Sufficient and Advisory Techniques:** Each guideline and success criteria can be achieved by some techniques documented by working group. The techniques fall into two categories: *sufficient and advisory*.

All the four layers work together to provide guidance on how to make web content more accessible.

The WCAG describes technique for making Web content accessible to everyone including disabled people. "Web content" generally means information contained in a Web page and or application, including text, images, graphics, sounds etc.

1.5. Website Development Life Cycle

The process of website development [15-16] can also be described as the traditional Software development life cycle (SDLC) [17]. By following these Life

Cycle steps, formation of team can be done effectively and maximum quality may be achieved using proper standards and procedures. These steps may vary from website to website but basic idea and goal remains same.
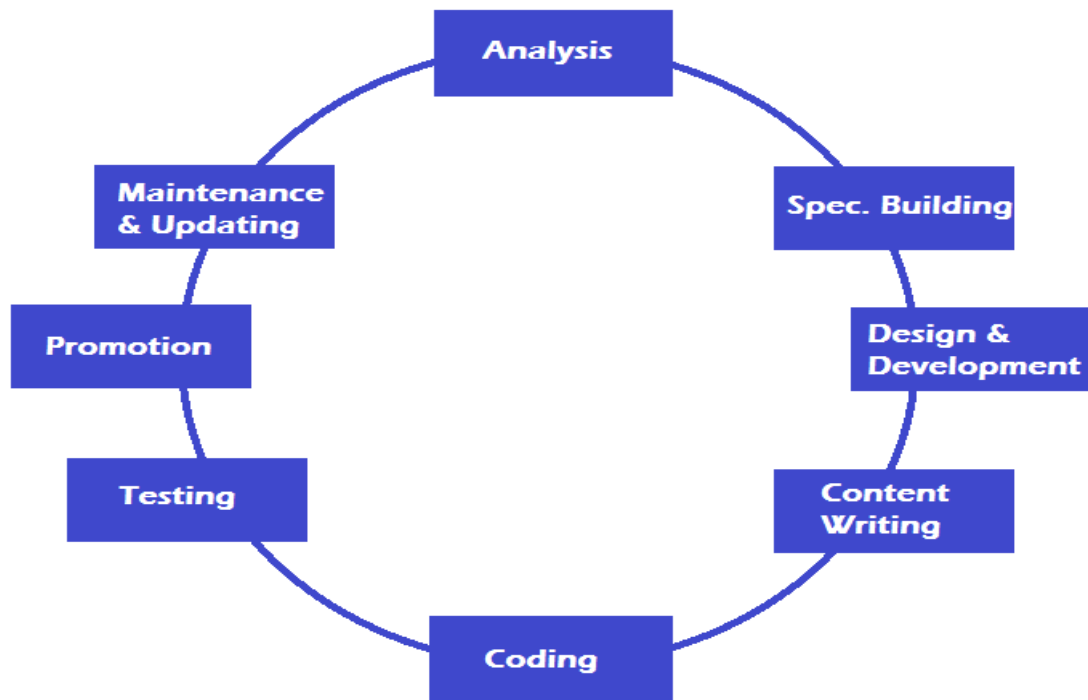
Figure 1.2: Different Life Cycle phases

The phases of WDLC can be described as [18]:

1. *Website Requirement and Analysis*
2. *Specification of Requirements*
3. *Design and Development*
4. *Content Writing*
5. *Coding*
6. *Testing*
7. *Promotion*
8. *Maintenance and Updating*

The details of different phases of WDLC are given in Chapter 3.

1.6. Thesis Organization

This Thesis is organized into the following chapters:

An Overview of prior work done in the field of Web Accessibility, related to our work, is described in **Chapter 2**.

Different phases of Website development life cycle (WDLC) based on Web Content Accessibility Guidelines (WCAG) are described in **Chapter 3**.

A multilingual approach to provide sound support to different websites for language independence and literacy independence is described in **Chapter 4**.

Details of Live project to make IBM University Relation Portal Accessible to persons with disability (PWD) are described in **Chapter 5**.

Conclusion and future scope for current research work is described in **Chapter 6.**

CHAPTER 2: LITERATURE REVIEW

2.1. An Overview

In 2002, Gloria A. Reece of University of Memphis Presented *"Text Legibility for Web Documents and Low Vision"[19]*. The ultimate goal of this study was to gain insight to aid designers in producing legible, effective electronic displays for a wide audience. The effects of three characteristics of low-vision readers, severity of vision loss, region of eye affected by the primary disorder, and the type of vision loss produced by the primary disorder were considered. Strong preferences for sans serif and Roman (i.e., no italics) typefaces were identified and were found to be similarly distributed among the various categories of participants.

In 2005, Yeliz Yesilada of University of Manchester presented *"Annotation and Transformation of Web Pages to Improve Mobility for Visually Impaired Users"[20]*. Investigation of principles and derived techniques to enhance the travel experience for visually impaired Web users was performed. The hypothesis was that travel support for visually impaired users could be improved if Web pages were analyzed to identify the objects that support travel and were then transformed in such a way that they can then fulfill their intended or implicit roles.

In 2006, Davis Sloan of University of Dundee presented *"The Effectiveness of the Web Accessibility Audit as a Motivational and Educational Tool in Inclusive Web Design"[21]*. The development and evaluation of a Web accessibility auditing methodology with the dual aims of accurately identifying accessibility barriers present in a Web site, and presenting the audit findings and recommended actions in a way that informs, educates and engenders an improved understanding of accessibility amongst the audience, was performed.

In 2006, Omar Kheir of University of York presented *"The Accessibility and Usability of Websites : Relationships between Measures from Users, Experts and Guidelines"[22]*. In this research, author tried to aware the web developers to follow accessibility guidelines by the accessibility study conducted on various web environments. *While going through this thesis, we got an idea to make the accessibility procedure easy so that developers can follow it.*

In 2006, Matt Huenerfauth of University of Pennsylvania presented *"Generating American Sign Language Classifier Predicates For English-To-ASL Machine Translation"[23]*. An English-to-ASL MT design capable of producing classifier predicates was created in this project. The classifier predicate generator inside this design had a planning-based architecture that uses a 3D "visualization" model of the arrangement of objects in a scene discussed by the English input text. This generator would be one pathway in a multi-path English-to-ASL MT design; a separate processing pathway would be used to generate classifier predicates, to generate other ASL sentences, and to generate animations of Signed English (if the system lacked lexical resources for some input). *During the study of this project we thought of developing a system accessible to everyone including the persons with disability irrespective of their language.*

In 2007, Scott Hollier of Curtin University of Technology presented *"The Disability Divide: A Study into the Impact of Computing and Internet-related Technologies on People who are Blind or Vision Impaired"[24]*. The purpose of this study was to find the reasons behind this digital divide for people with disabilities and provide solutions. The investigation into this 'disability divide' initially examined the historical significance of the social construction of disability, the developments of computing and Internet-related technologies and the evolution of associated government and corporate policies.

In 2009, Julie A. Smith of Capella University presented *"Developing Web Accessibility: Section 508 Compliance of Post-Secondary Educational Web Site Home Pages"[25]*. Web accessibility of education department home pages of institutions accredited by the National Council for Accreditation of Teacher

Education (NCATE) was studied. A multiple-methodological approach based on the literature and U.S. Section 508 and Web Content Accessibility Guidelines (WCAG) was used to further understand accessibility issues relating to higher education Web pages and visually-impaired Web users using screen readers.

In 2009, Jeffrey P. Bigham of University of Washington presented *"Intelligent Interfaces Enabling Blind Web Users to Build Accessibility Into the Web"[26].* This dissertation explored novel intelligent interfaces enabling blind people to independently improve web content. These tools are made possible by novel predictive models of web actions and careful consideration of the design constraints for creating software that can run anywhere. Solutions created by users of these tools can be shared so that blind users can collaboratively help one another make sense of the web. Disabled people should not only be seen as access consumers but also as effective partners in achieving better access for everyone.

In 2010, Lourdes Moreno of University of Madrid presented *"AWA, Methodological Framework in the Accessibility Domain for Web Application Development"[27]*. The methodological support AWA (Accessibility for Web Applications) is presented in this thesis. AWA provides a workspace in order to include the accessibility requirement in the organizations devoted to web application development. AWA provides guidance to engineering professionals to incorporate accessibility requirements from different perspectives: (a) in organizations and businesses, integrating accessibility and quality policies, (b) in the development process following a methodological approach that provides systemization in the integration of accessibility from the outset and, finally, (c) following a User-Centered Design (UCD) approach that places the user as a the main figure and makes him/she participate in the design process.

CHAPTER 3 : WEBSITE DEVELOPMENT LIFE CYCLE (WDLC) BASED ON WEB CONTENT ACCESSIBILITY GUIDELINES (WCAG) 2.0

The Software development process is completed following various frameworks, standards, methods and languages. Software development life cycle consists of various standards to help development team. Just like software, development of website is also the result of application of certain methods and guidelines. This chapter explains the details of different phases of WDLC specified in chapter 1.

3.1. Website Requirements and Analysis:

The well-organized websites with clear goals have more chances of success. Initially, customer and requirement team (analyst) undergo a discussion.

The purpose of this discussion is to analyze that:

a. How the website is beneficial for current system and business?
b. How the web site is going to join the existing system?
c. **Who are the targeted audience and what type of disabilities they have (if they have any) [8]?**
d. What are the present hardware, software, man power and data in the organization?

The analyst along with designers, developers and testers should collect sufficient information such as complete cost analysis and realistic project plan in limited time frame.

3.2. Specification of Requirements:

In specification of requirements, the requirements collected in above step are specified. General layout, site navigation and dynamic parts of the site should be included in the specification. Sometimes additional business and technical requirements are also collected for large projects. Finally, a written proposal is prepared with clearly mentioning scope, responsibilities, timelines and costs associated with the project.

Table 3.1 : Various Disabilities and their handling methods

Disability Type	Handling Methods
Visual : Low Vision, Colour-Blindness, Blindness	Sound Support for every Mouse Movement, Input & Output, Keyboard Accessibility.
Hearing : Deafness (Partial or Complete)	Captions for videos and complex content.
Motor : Unable to use a mouse, Poor response time, Limited fine motor control	Voice commands.
Cognitive: Distractibility, Learning disabilities, Inability to remember or focus on large amounts of information	Easy Structure of site and site map.

The Specification of handling Users with certain disabilities is also described as shown in Table 3.1.

3.3. Design and Development:

In the designing step, a signed proposal is prepared between customer and organization. Then some graphical content, layouts and navigation are designed as a full functional prototype. This prototype is then finalized by the customer before moving to the next step. Test Plan development for quality checking is done in this step. Parallel work towards

development of appropriate data structure and data tables is done by the database team. **The Principles of Accessible Design should be followed to adapt accessibility in Design Process [8].**

3.4. Content Writing:

The content writing step is mandatory for the websites. The content may be written by professional content writers with the consultation of customer. **The prospective user and their disabilities must be kept in mind while writing contents for website [8].** The grammatical and spelling check should also be performed in this step.

3.5. Coding:

Coding should be done keeping design unchanged and look and feel intact. A discussion session may be held between developer and designer to make content accessible to users irrespective of their disabilities. Necessary testing plans, User Manual, Final Documentation and Technical documentation (JavaDoc for java users) are prepared by coding team. These documents may not only help users but also to the developers in checking their coding flaws.

Table 3.2 : Guidelines from WCAG 2.0[14]

| Sr. No.	Guidelines	Description
1.1	Text Alternatives	Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language.
1.2	Time based Media	Provide alternatives for time-based media.
1.3	Adaptable	Create content that can be presented in different ways (for example simpler layout) without losing information or structure.
1.4	Distinguishable	Make it easier for users to see and hear content including separating foreground from background.
2.1	Keyboard Accessibility	Make all functionality available from a keyboard.
2.2	Enough Time	Provide users enough time to read and use content.
2.3	Seizures	Do not design content in a way that is known to cause seizures.
2.4	Navigable	Provide ways to help users navigate, find content, and determine where they are.
3.1	Readable	Make text content readable and understandable.
3.2	Predictable	Make Web pages appear and operate in predictable ways.
3.3	Input Assistance	Help users avoid and correct mistakes.
4.1	Compatible	Maximize compatibility with current and future user agents, including assistive technologies.

There are 12 Accessibility Guidelines in WCAG 2.0 [28] as specified in Table 3.2. These guidelines should be followed in coding phase to improve accessibility.

3.6. Testing:

The website is similar to a multiuser application or like a system which is carrying lot of load at any instance of time. So testing plays much crucial role in websites just like in traditional software.

Some of the applicable testing techniques are:

- Integration testing [29],
- Stress testing [30],
- Scalability testing [31],
- Load testing [32],
- Resolution testing [33],
- Cross-Browser compatibility testing [34],
- Accessibility Testing [35,36]
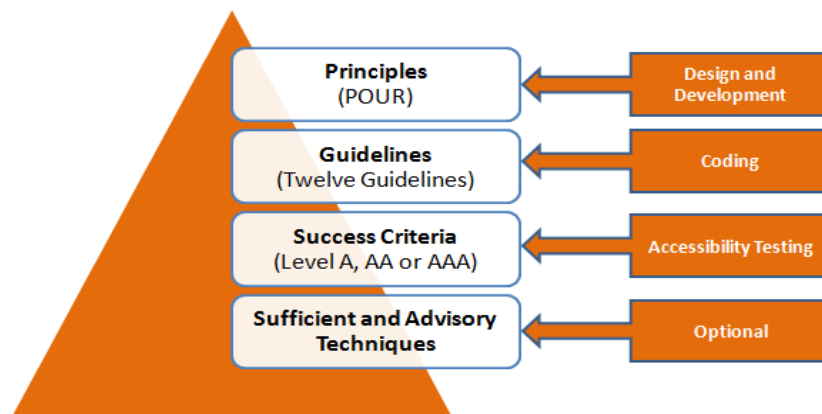
Figure 3.1: The structure of WCAG 2.0

Out of all, Accessibility Testing is more applicable and useful for testing Web Accessibility. The applicability of accessibility testing can be seen in Figure 3.1.

3.6.1. Accessibility Testing:

Accessibility Testing is performed with the intention of finding problems in web sites and products. In this step, responsibility of Development team is to make sure that product is partially accessibility compliant. Then during the functional testing, test team certifies that Website is accessibility compliant.

WCAG 2.0 success criteria should be used in accessibility testing to certify the accessibility compliance. These success criteria may have information for different accessibility related problems [37] such as:

- **What should be tested?**

- **How it should be tested?**

- **What is the current status of product?**

Table 3.3 : Success Criteria of WCAG 2.0 [38-39] (Courtesy of W3C)

Sr. No.	Guidelines	Success Criteria	Level of Conformance		
1.1	Text Alternatives	1.1.1 Nontext Content	A		
1.2	Time based Media	1.2.1 Prerecorded Audio only and Video-only	A		
		1.2.2 Captions (Prerecorded)	A		
		1.2.3 Audio Description or Media Alternative (Prerecorded)	A		
		1.2.4 Captions (Live)		AA	
		1.2.5 Audio Description (Prerecorded)		AA	
		1.2.6 Sign Language (Prerecorded)			AAA
		1.2.7 Extended Audio Description (Prerecorded)			AAA
		1.2.8 Media Alternative (Prerecorded)			AAA
		1.2.9 Audio-only (Live)			AAA
1.3	Adaptable	1.3.1 Info and Relationships	A		
		1.3.2 Meaningful Sequence	A		
		1.3.3 Sensory Characteristics	A		
1.4	Distinguishable	1.4.1 Use of Color	A		
		1.4.2 Audio Control	A		
		1.4.3 Contrast (Minimum)		AA	
		1.4.4 Resize text		AA	
		1.4.5 Images of Text		AA	
		1.4.6 Contrast (Enhanced)			AAA
		1.4.7 Low or No Background Audio			AAA
		1.4.8 Visual Presentation			AAA
		1.4.9 Images of Text (No Exception)			AAA
2.1	Keyboard Accessibility	2.1.1 Keyboard	A		
		2.1.2 No Keyboard Trap	A		
		2.1.3 Keyboard (No Exception)			AAA
2.2	Enough Time	2.2.1 Timing Adjustable	A		
		2.2.2 Pause, Stop, Hide	A		
		2.2.3 No Timing			AAA
		2.2.4 Interruptions			AAA
2.3	Seizures	2.3.1 Three Flashes or Below Threshold	A		
		2.3.2 Three Flashes			AAA
2.4	Navigable	2.4.1 Bypass Blocks	A		
		2.4.2 Page Titled	A		
		2.4.3 Focus Order	A		
		2.4.4 Link Purpose (In Context)	A		
		2.4.5 Multiple Ways		AA	
		2.4.6 Headings and Labels		AA	
		2.4.7 Focus Visible		AA	
		2.4.8 Location			AAA
		2.4.9 Link Purpose (Link Only)			AAA
		2.4.10 Section Headings			AAA
3.1	Readable	3.1.1 Language of Page	A		
		3.1.2 Language of Parts		AA	
		3.1.3 Unusual Words			AAA
		3.1.4 Abbreviations			AAA
		3.1.5 Reading Level			AAA
		3.1.6 Pronunciation			AAA
3.2	Predictable	3.2.1 On Focus	A		
		3.2.2 On Input	A		
		3.2.3 Consistent Navigation		AA	
		3.2.4 Consistent Identification		AA	

As stated above, Accessibility testing is very crucial so test team should prepare a separate cycle for its success.

3.7. Promotion:

Promotion phase is mandatory to the web sites. The prime goals of this phase are preparation of Meta tags, constant analysis and submitting the URL to the search engines. Based on strategies of various search engines, promotion is performed time to time by submitting the site URLs once in every 2 months. **The promotion phase is very helpful in increasing prospective users including disabled people. The proper promotion of web site and its accessible environment may encourage users (including disabled) to use it.**

3.8. Maintenance and Updating:

The maintenance and updating phase should be performed regularly or when required to increase usability and accessibility of website. For doing this analysis and all life cycle steps need to be repeated. Many bugs are fixed during maintenance phase. The regular activities of maintenance phase are technical maintenance, content management and updating, site activity report, staff training etc.   .

Figure 3.2: Overview of fusion.

The overview of the fusion performed in current research work can be seen in Figure 3.2.

CHAPTER 4 : ACCESSIBILITY FOR INDEPENDENCE

Accessibility for Independence (AFI) is an initiative towards making web accessible not only to disables but also to those who are illiterate and don't have disability of any kind.

4.1. Literacy Independence:

The Literacy has always been a major problem with developing nations like India. Even after the 62 years of independence, India is still fighting a war for literacy and no matter how hard it try to fight the problem, it simply seems to persist. The literacy independence can be achieved by web.

The Google provides translation API's to translate webpage in one language to be displayed after translation in other language. This seems to be the partial solution of the problem but what about those who are either blinds or with low vision and know only there regional languages.

A complete solution for literacy independence is required.

4.2. Language Independence:

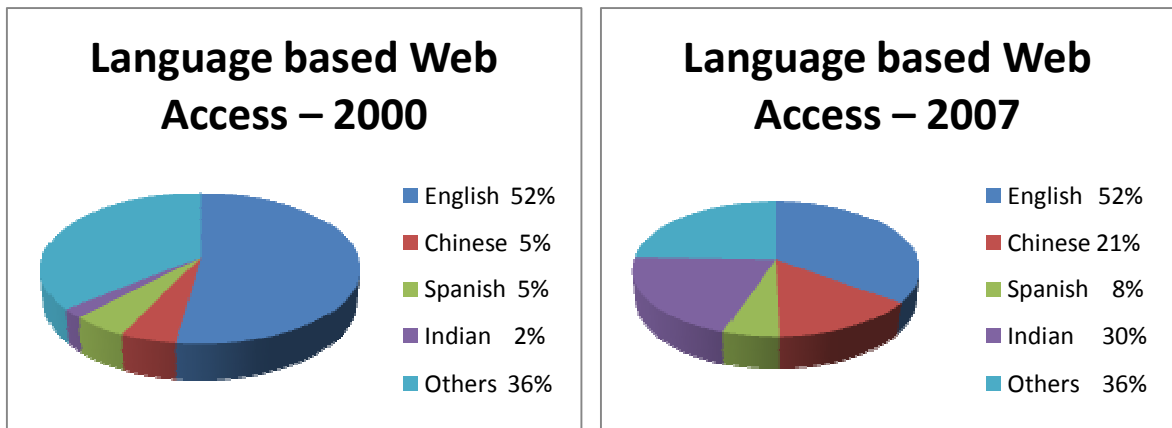In the current intellectual world, human being is mostly dependent on web for information access. The unlimited growth of web has brought information revolution. Since the advent of web, most of the web content is in English and it is still dominating the web. But developing nation and non English speaking country like India, has now become the IT centre of world and requirement of multilingual

support is felt. Since most of the content on web is in English, so a mechanism is needed to translate this content in regional languages to enhance the utilization web in non-English speaking countries.

The "Accessibility for Independence" (AFI) is an attempt in this direction.

Figure 4.1 : Language Based Web Access – 2000   Figure 4.2 : Language Based Web Access -2007

Requirement of multilingual support can be understand by the study of Language based Web Access in 2000 and 2007. Statistics are specified in Figure 4.1 and 4.2.

4.3. Google Language Application Programming Interface:

The researchers in Google are working on Language API's [40] for converting content in one language to other. Google also provide extension to convert whole website. This work is done using Google Language API's. The Google Language API Family consists of four powerful tools making it easier for you to communicate with users across the globe.

The Google provides Language API to the Users to perform four basic tasks:

- **Google Translate** : Google Translate[41] can dynamically translate text between thousands of language pairs.
- **Google Transliterate** : Google Transliterate[42] transforms a given written language into dozens of other scripts.
- **Google Virtual Keyboard** : Google Virtual Keyboard[40] can provide users with an on-screen keyboard layout native to one of dozens of available language scripts.
- **Google Diacritize** : Google Diacritize[40] helps non-native speakers learn how to pronounce these words

This research is based on Google Translation, which is very popular and dynamic approach of translation. Google has implemented instant translation by which results of translation can be achieved in fractions of second. This approach is used in this research to provide real time language support for websites. Currently, Google is offering support for over fifty languages.

4.4. Proposed System:

Web Accessibility has brought a revolution in Web Environment. The web industry is now aware of the consequences of avoiding the persons with disability. A significant part of our population has any disability and necessary actions have to be taken to support these people so that they can use the web efficiently. Much of the research work is going on to make web accessible but language support is still a challenge. A person who is blind can use the accessible website only if he knows certain languages (e.g. English) since language support is limited to these languages.

So idea is to introduce

i. Independence from language and literacy in the field of accessibility.

ii. Multilingual Approach

Language can be defined as a collection of symbols and rules and it is used by humans for communication. Every language has some unique features and there is a distinction in Native Language, English and other foreign languages. Human is always learning and information transfer occurs in learning. There are various sources of Information but Internet is fastest and reliable source of information today, which keeps information in various languages. With the increase in multilingual web access, various documents are translated and published on websites daily. Multilingual web support is working as a catalyst in business, Transaction processing, entertainment etc.

*Figure 4.3: The Simple Descriptive Diagram of Proposed System*

The proposed system "Accessibility for Independence" (AFI) uses translation API to convert one language to another in implementing independence in literacy and language. Currently, the system is providing support for Hindi Language but it can easily be extended for any language as shown in Figure 4.3.

4.4.1. AFI Functional Block Diagram

There are following three components of proposed system:

1. Text and Label Extractor

2. Translation API

3. Sound Producer
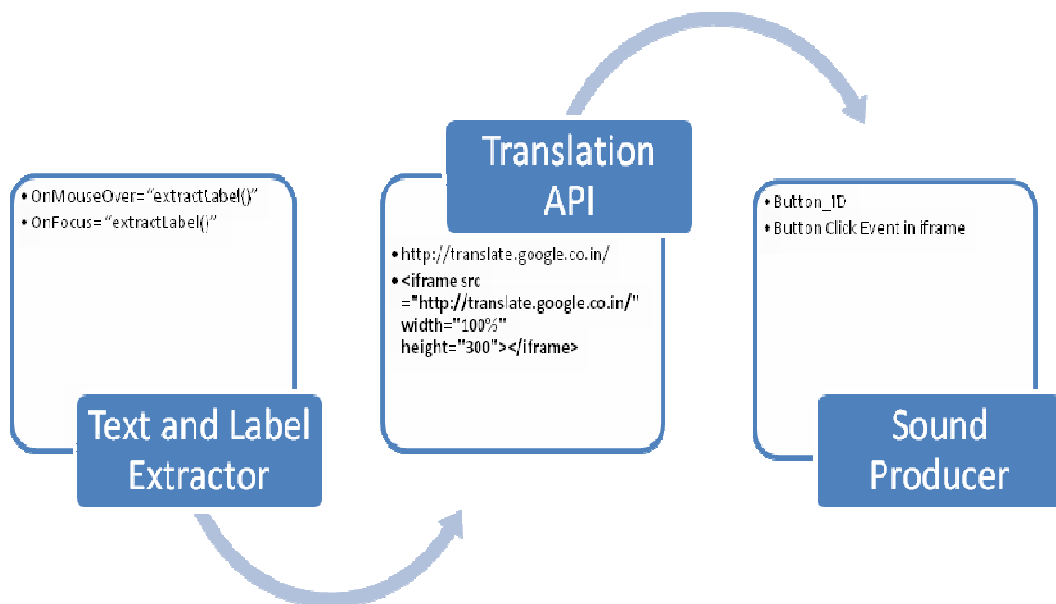
Figure 4.4 : AFI Functional Block Diagram

4.4.1.1. Text and Label Extractor

The necessary requirement for a accessible site is to have text label for each button and content. The proposed system utilizes this feature and fetches the text labels from the page. There are some html tags which will call a JavaScript function to extract the text label.

OnMouseOver= "extractLabel()"

OnFocus= "extractLabel()"

Figure 4.5 : Screenshot of DTUMTechIS Home Page

The alt text provided to the button is shown in Figure 4.5.

4.4.1.2. Translation API

Google is currently offering 99000 languages

These extracted labels is then send in another JavaScript function and send for translation to http://translate.google.co.in/ , which is shown in Figure 4.6.
http://translate.google.co.in/translate_t?hl=&ie=UTF8&text=Click+here+for+home+page.&sl=en&tl=hi#

Figure 4.6 : Screenshot of Translation Page

To do this work in background translation API does this translation in an iframe. **<iframe src ="http://translate.google.co.in/" width="100%" height="300"></iframe>**

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4.4.1.3. Sound Producer

The translation will produce a sound which will be stored in cache of the browser. The job of Sound producer is to perform a button click event for that hidden page in iframe. The Sound Producer will apply the button click event using Button_ID of that Listen Button.
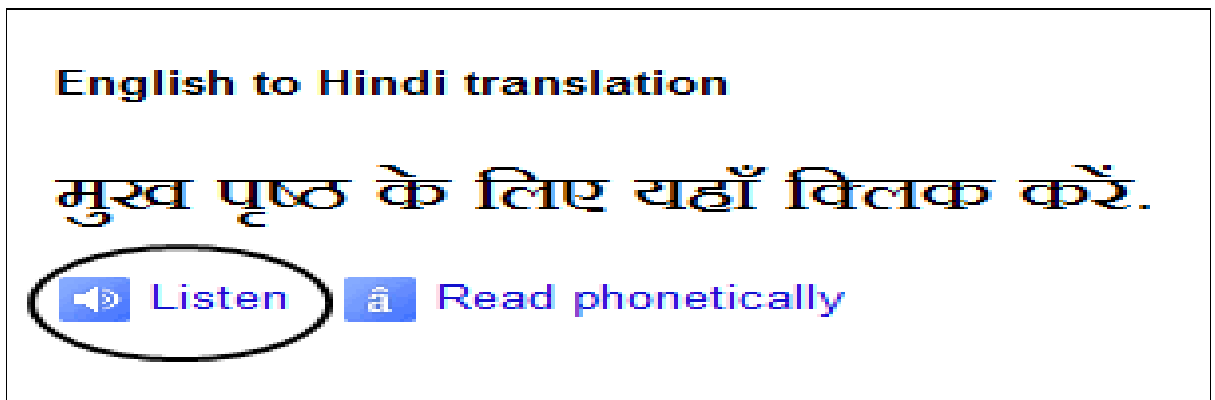
Figure 4.7 : Hidden Button in iframe
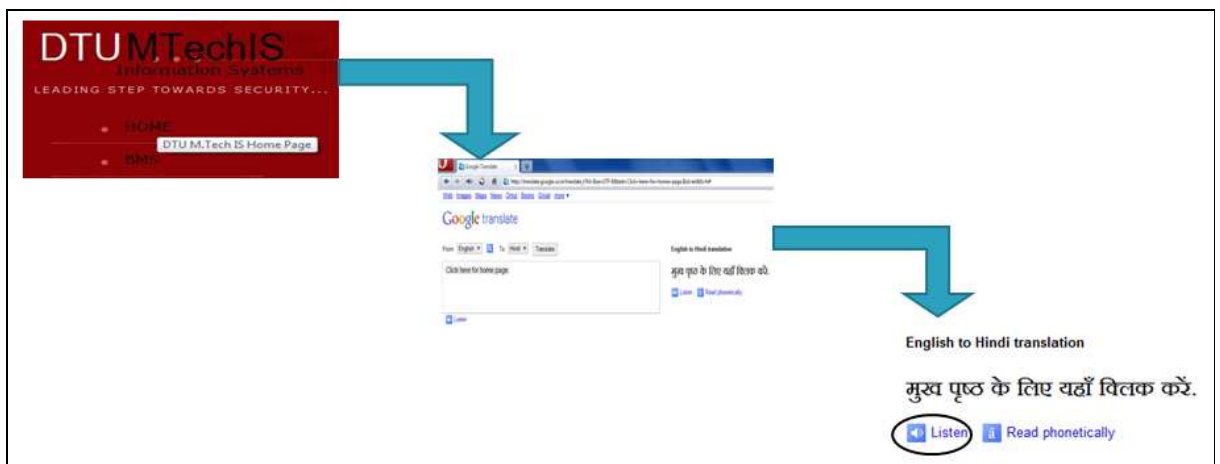
Figure 4.8 : Overall System Functionality

The button to be clicked is shown in Figure 4.7 and overall system functionality can be seen in Figure 4.8

4.4.1.4. *Analysis of AFI*

The Accessibility for Independence is a very useful technique for visually handicaps and for persons who don't know English. It is implemented on Windows based Web Browsers but can easily be extended to any platform. It can easily be applied on new as well as existing websites and no additional cost is required. End-User just has to visit the website as usual and he will experience an easily accessible environment with his regional language support.

CHAPTER 5: IBM UNIVERSITY RELATIONS COLLABORATION PORTAL – A REMOTE MENTORING PROJECT

5.1. IBM University Relations Collaboration Portal: Connecting Industry and Academia at one platform

IBM University Relations [43] in India drives various programs and offerings for select universities and colleges in India with the help of a virtual, cross business unit team, based out of different locations in IBM India. The intent of most of these programs is to strengthen - the relations with these institutes, improve the IBM brand image to be able to attract talent and impart industry relevant skills to the students graduating from these schools. Based on the feedback received during the AP University Relations Summit in November 2008, which was attended by over 250 faculty from colleges across India and several IBMers, it was realized that having a collaboration space for the two entities to interact was necessary, thereby allowing for the relations to be taken to the next level.

5.2. Web Accessibility Group of Delhi Technological University (WAGDTU)[44] :

Web Accessibility Group of Delhi Technological University is an initiative taken by Nikhil Maheshwari under the guidance of Prof. N S Raghava to improve web accessibility practices in India especially in education sectors. The prime goal of WAGDTU is to aware web developers and other people who are responsible to enhance the usability of Web about Web Accessibility. The contribution of WAGDTU is Accessibility for Independence (AFI), which is a framework to implement Language Independence and Literacy Independence in World Wide Web (WWW) and other Information Systems and Website Development Life cycle (WDLC) Based on Web Content Accessibility Guidelines (WCAG 2.0) to introduce an easy way to make accessible Websites.

5.3. Developing Accessibility Framework using IBM Technologies in collaboration with WAGDTU :

The objective of this project is to develop an Accessible framework by the merger of IBM Technologies with accessibility research performed by Web Accessibility Group of Delhi Technological University (WAGDTU) for making accessible web applications and websites for target audience including persons with disability (PWD).

During the project, proposal is to make IBM university relations collaboration portal [45] accessible using above stated framework and perform testing and implementations on the portal.

CHAPTER 6 : CONCLUSION AND FUTURE DIRECTIONS

WDLC based on WCAG helps web developers and project managers, understand WCAG 2.0 and provide them a simple and working approach to follow. WDLC will make a difference towards making Web more accessible especially to people with disabilities. The Future scope of this project is to make every digital environment (e.g. Websites, Mobile Interfaces, and Information Systems etc) accessible to everyone using Website Development Life Cycle (WDLC) based on WCAG 2.0.

The AFI is first initiative to offer safe, free and accessible web environment for creating multilingual web environment. Web Developers can easily implement the system and no additional training is required. The future scope is to reduce the delay occurring during the translation procedure.

APPENDIX

Presented at "*International Conference on Web Technologies & Internet Applications*" (WebTech 2011) on March 14-15, 2011 in Penang, Malaysia

Accessibility for Independence

Introducing Accessibility for Language Independence, Literacy Independence

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Delhi Technological University
New Delhi

ABSTRACT - In the fast growing science and superfast growing IT, many efforts have already been done to make the web accessible. All the work, from submission of bill to product purchase, is possible on internet (E-Commerce) but the major issue preventing it is its lower accessibility. Accessibility of Educated and trained Disabled has taken into accounts and research is going on in that area but web is still a puzzle for uneducated persons, who don't have disability of any kind.
The idea is to introduce Accessibility for Independence (AFI), a framework to implement Language Independence, literacy independence in web applications, web sites and other Information Systems.

Keywords - *Language Independence, Literacy Independence, Translation API, Multi-Lingual Web.*

I. INTRODUCTION

A. Accessibility:

Accessibility stands for convenient utilization of anything.

Web accessibility[1,2] means everyone can use the Web including the people with disabilities. The purpose of Web accessibility is to provide environment so that everyone can perceive, understand, navigate, interact and contribute to the Web.

The major categories of disability are [3]:

- **Visual :** Low vision, Color-Blindness and Blindness
- **Hearing :** Deafness (partial or complete)
- **Motor :** Unable to use a mouse, Poor response time, Limited fine motor control
- **Cognitive :** Distractibility, Learning Disability, Inability to remember or focus on large amounts of information
- **Illiterate:** Those who don't know English.

B. Literacy Independence:

The Literacy has always been a major problem with developing nations like India. Even after the 62 years of independence, India is still fighting a war for literacy and no matter how hard it try to fight the problem, it simply seems to persist. The literacy independence can be achieved by web.

The Google provides translation API's to translate webpage in one language to be displayed after translation in other language. This seems to be the partial solution of the problem but what about those who are either blinds or with low vision and know only there regional languages.

A complete solution for literacy independence is required.

C. Language Independence:

In the current intellectual world, human being is mostly dependent on web for information access. The unlimited growth of web has brought information revolution. Since the advent of web, most of the web content is in English and it is still dominating the web. But developing nation and non English speaking country like India, has now become the IT centre of world and requirement of multilingual support is felt. Since most of the content on web is in English, so a mechanism is needed to translate this content in regional languages to enhance the utilization web in non-English speaking countries.

The "Accessibility for Independence" (AFI) is an attempt in this direction.

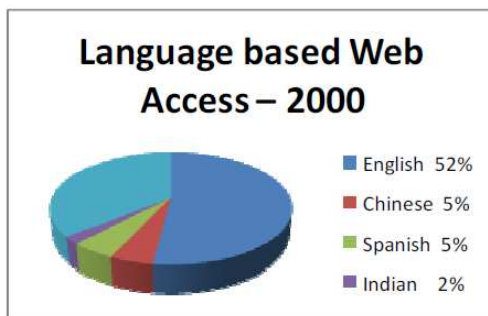Requirement of multilingual support can be understand by the statistics below:
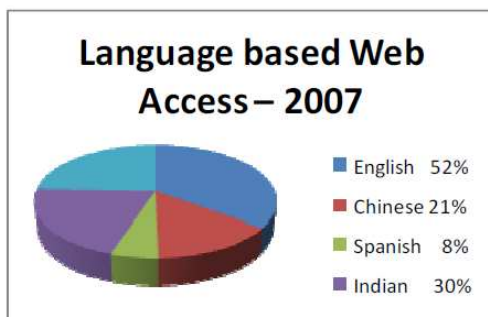
Figure 1 : Language Based Web Access – 2000

Figure 2 : Language Based Web Access – 2007

D. Google Language API's[4]:

The Google Language API Family consists of four powerful tools making it easier for you to communicate with users across the globe:

The Google provides Language API to the Users to perform four basic tasks:

- **Google Translate[5]:** It can dynamically translate text between thousands of language pairs.
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- **Google Virtual Keyboard[4] :** It can provide users with an on-screen keyboard layout native to one of dozens of available language scripts.
- **Google Diacritize[4] :** It helps non-native speakers learn how to pronounce these words.

II. Proposed System

Web Accessibility[1] has brought a revolution in Web Environment. The web industry is now aware of the consequences of avoiding the persons with disability. A significant part of our population has any disability[7] and necessary actions have to be taken to support these people so that they can use the web efficiently. Much of the research work is going on to make web accessible but language support is still a challenge. A person who is blind can use the accessible website only if he knows certain languages (e.g. English) since language support is limited to these languages.

So idea is to introduce

   i.   independence from language and literacy in the field of accessibility.
   ii. Multilingual Approach

Language can be defined as a collection of symbols and rules and it is used by humans for communication. Every language has some unique features and there is a distinction in Native Language, English and other foreign languages. Human is always learning and information transfer occurs in learning. There are various sources of Information but Internet is fastest and reliable source of information today, which keeps information in various languages. With the increase in multilingual web access, various documents are translated and published on websites daily. Multilingual web support is working as a catalyst in business, Transaction processing, entertainment etc.

The proposed system "Accessibility for Independence" (AFI) uses translation API to convert one language to another in implementing independence in literacy and language. Currently, the system is providing support for Hindi Language but it can easily be extended for any language.

Figure 3: The Simple Descriptive Diagram of Proposed System

A. AFI Functional Block Diagram

There are following three components of proposed system:

1. Text and Label Extractor
2. Translation API

3. Sound Producer

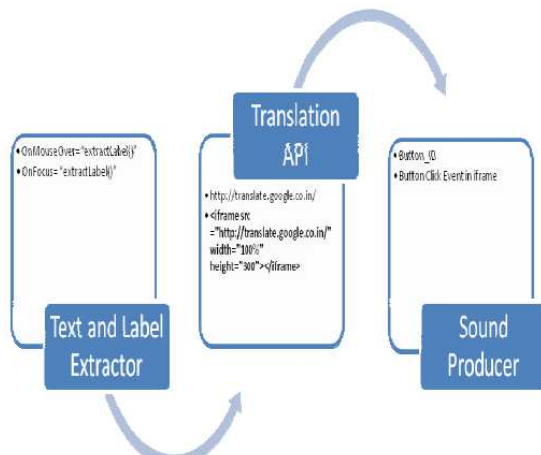Figure 4 : AFI Functional Block Diagram

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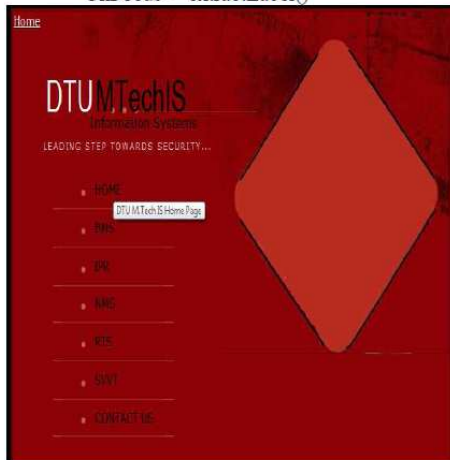OnMouseOver= "extractLabel()"
OnFocus= "extractLabel()"

Figure 5 : Screenshot of DTUMTechIS Home Page

2. Translation API

Googl is currently offering 99000 languages
These extracted labels is then send in another JavaScript function and send for translation to http://translate.google.co.in/
http://translate.google.co.in/translate_t?hl=&ie=UTF8&text=Click+here+for+home+page.&sl=en&tl=hi#

To do this work in background translation API does this translation in an iframe.
<iframe src ="http://translate.google.co.in/" width="100%" height="300"></iframe>

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3. Sound Producer

The translation will produce a sound which will be stored in cache of the browser. The job of Sound producer is to perform a button click event for that hidden page in iframe. The Sound Producer will apply the button click event using Button_ID of that Listen Button.

Figure 7 : Hidden Button in iframe

Figure 8 : Overall System Functionality

III. Analysis of AFI

The Accessibility for Independence is a very useful technique for visually handicaps and for persons who don't know English. It is implemented on Windows based Web Browsers but can easily be extended to any platform. It can easily be applied on new as well as existing websites and no additional

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cost is required. End-User just has to visit the website as usual and he will experience an easily accessible environment with his regional language support.

IV. Conclusion and Future Scope

There are few systems of such kind which are claiming to offer similar features as AFI but these are associated with some cost. The AFI is first initiative to offer safe, free and accessible web environment. Web Developers can easily implement the system and no additional training is required. We are working to reduce the processing time of AFI and to aware web developers to follow this practical approach.

V. REFERENCES

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[2] T. Berners-Lee. (2000, Oct. 10) Web accessibility initiative. World Wide Web Consortium web site. [Online]. Available: http://www.w3.org/WAI/

[3] Web Accessibility in Mind web site. [Online]. Available: http://www.webaim.org/intro/

[4] Google Language API Family. [Online]. Available: http://code.google.com/apis/language/

[5] Google's free online language translation service instantly translates text and web pages: http://translate.google.com/

[6] http://www.google.com/transliterate/

[7] Kirchner, "Benchmark for testing the evaluation tools for Web pages accessibility", in Fifth IEEE International Workshop on Web Site Evolution, 2003.

An Alternative Approach of Accessibility for Independence

Introducing Accessibility for Language Independence, Literacy Independence

Nikhil Maheshwari, N.S. Raghava, Vishal Bhargava, Aman Jain
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Department of Information Technology
Delhi Technological University
New Delhi

ABSTRACT – Web is the first source of information today but it has been seen that universality and equality is still not achieved in web environment. Many people, who have partial or full disability, are fighting for their rights to make the web available for them. A number of NGO's and other organizations like WebAim are working in the direction of making web equally available for everyone including those who have disability of some kind. Web Accessibility Group of Delhi Technological University (WAGDTU) is also working to establish *Accessibility for Language Independence, Literacy Independence* in World Wide Web (www) and other Information Systems. Recently, a research work was presented in Annual International Conference on Web Technologies & Internet Applications (WebTech 2011) in Penang, Malaysia. This paper presents the technical details of various functions used along with an alternative approach to the prior work.

Keywords - *Language Independence, Literacy Independence, Translation API, Multi-Lingual Web.*

I. INTRODUCTION

A. Accessibility:

Accessibility stands for convenient utilization of anything. Web accessibility [1,2] means everyone can use the Web including the people with disabilities. The purpose of Web accessibility is to provide environment so that everyone can perceive, understand, navigate, interact and contribute to the Web.

The major categories of disability (in web environment) are [3]:

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The Literacy has always been a major problem with developing nations like India. Even after the 62 years of independence, India is still fighting a war for literacy and no matter how hard it try to fight the problem, it simply seems to persist. The literacy independence can be achieved by web.

The Google provides translation API's to translate webpage in one language to be displayed after translation in other language. This seems to be the partial solution of the problem but what about those who are either blinds or with low vision and know only there regional languages.

A complete solution for literacy independence is required.

C. Language Independence:

In the current intellectual world, human being is mostly dependent on web for information access. The unlimited growth of web has brought information revolution. Since the advent of web, most of the web content is in English and it is still dominating the web. But developing nation and non English speaking country like India, has now become the IT centre of world and requirement of multilingual support is felt. Since most of the content on web is in English, so a mechanism is needed to translate this content in regional languages to enhance the utilization web in non-English speaking countries.

The "Accessibility for Independence" (AFI) is an attempt in this direction.

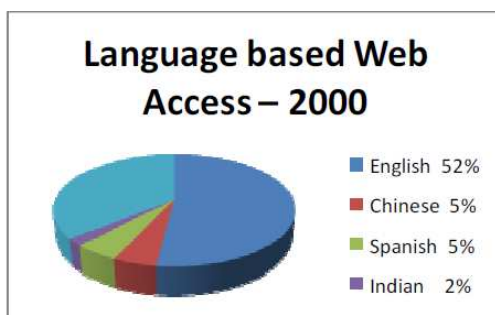Requirement of multilingual support can be understand by the statistics below:
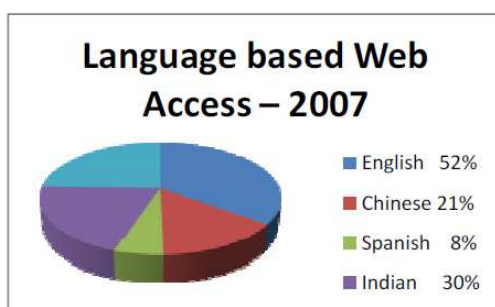
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This paper is based on Google Translation, which is very popular and dynamic approach of translation. Google has implemented instant translation by which results of translation can be achieved in fractions of second. This approach is used in this paper to provide real time language support for websites. Currently, Google is offering support for over fifty languages.

E. Google Compression of Sound Files:

Google, not only provides translation of one language to other but also the pronunciation of original as well as translated text can be heard. Since Google provides instant translation, the sound files produced in this process are highly compressed and light weighted. These files are stored temporarily in cache of the Web Browser used for the translation.

F. Web Accessibility Group of Delhi Technological University (WAGDTU)[7]:

Web Accessibility Group of Delhi Technological University[8] is an initiative taken by Nikhil Maheshwari under the guidance of Prof. N S Raghava to improve web accessibility practices in India especially in education sectors. The prime goal of WAGDTU is to aware web developers and other people who are responsible to enhance the usability of Web about Web Accessibility. The contribution of WAGDTU is *Accessibility for Independence* (AFI)[9], which is a framework to implement Language Independence and Literacy Independence in World Wide Web (WWW) and other Information Systems. Currently WAGDTU is working on *Website Development Life cycle (WDLC) Based on Web Content Accessibility Guidelines (WCAG 2.0)* to introduce an easy way to make accessible Websites.

II. Proposed System

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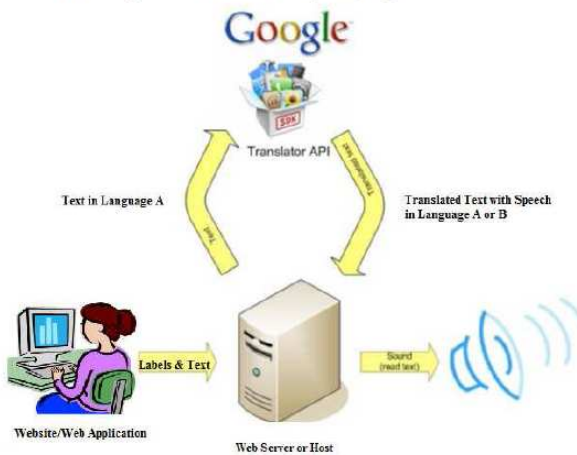

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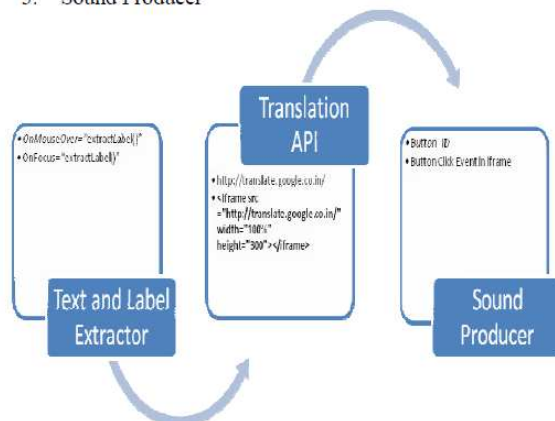1. Text and Label Extractor
2. Translation API
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Figure 4 : AFI Functional Block Diagram

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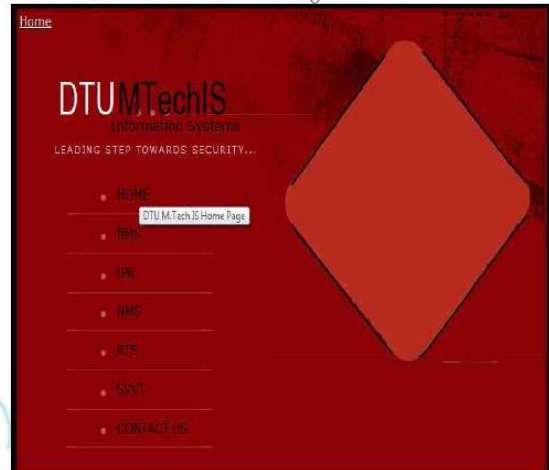OnMouseOver= "extractLabel()"
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Figure 5 : Screenshot of DTUMTechIS Home Page

2. Translation API

These extracted labels is then send in another JavaScript function and send for translation to http://translate.google.co.in/
http://translate.google.co.in/translate_t?hl=&ie=UTF8&text=Click+here+for+home+page.&sl=en&tl=hi#
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Figure 6 : Screenshot of Translation Page

3. Sound Producer

The translation will produce a sound which will be stored in cache of the browser. The job of Sound producer is to perform a button click event for that hidden page in

iframe. The Sound Producer will apply the button click event using Button_ID of that Listen Button.

English to Hindi translation

मुख पृष्ठ के लिए यहाँ क्लिक करें.

🔊 Listen ā Read phonetically

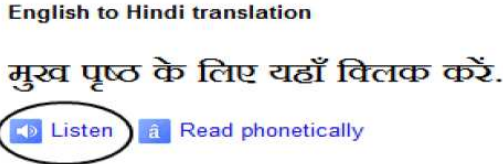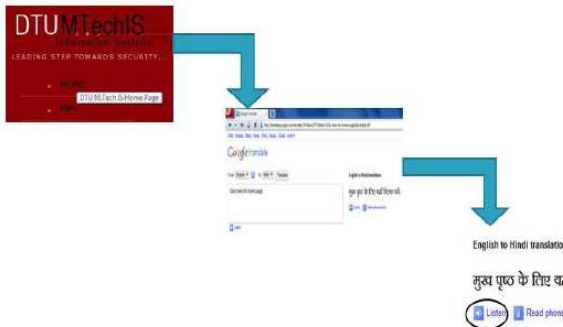Figure 7 : Hidden Button in iframe

Figure 8 : Overall System Functionality

III. Alternative approach using Google Sound Files

The above stated approach of development of AFI is applicable in real time environment but with few constraint like high speed internet connection. There is one alternative approach to this which is quite easy to implement and can be used even with a dial up connection. We call this *Alternative Approach for Accessibility for Independence* (AAFI).

The sound files produced during Google Translation are highly compressed and light weighted, which can be downloaded instantly. Once downloaded, these files can be used to produce sound at real time. Java script functions can be used to execute the sound files on OnFocus and OnMouseOver. But limitation of this approach is that developers have to store sound files for different languages manually.

B. AAFI Functional Block Diagram

There are following five steps to implement AAFI:

1. Text and Label Extraction
2. Translation of Text
3. Storing Sound File
4. Using Java Script Functions to call Sound Files

The Two steps are already covered in previous part.

3. Storing Sound Files:

The sound files produced during clicking of listen button are stored in Cache of web Browser. These files are then stored at Web server in a common folder. If more than one language
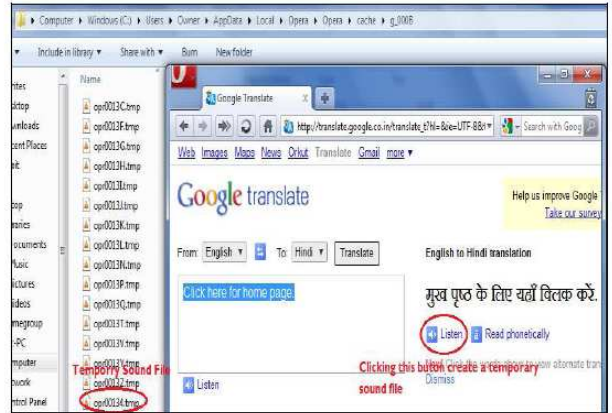
support is required than sub folder should be created within the sound folder.

Figure 9 : Screenshot of Browser showing files in cache

4. Using Java Script Functions to call Sound Files

The sound files are embedded as an element of web page for better availability and auto downloading. Then OnFocus and OnMouseOver properties are set to call the java script functions giving respective sound element as argument.

```
<embed name="ln0" src="sound\WM.wav" autostart="false" mastersound hidden="true" volume=100>


<liclass="style2"><atitle="BiometricSecurity"onmouseout="jsStop('ln2')"
onfocus="jsPlay('ln2')"onblur="jsStop('ln2')"onmouseover="jsPlay('ln2')"
href="bms.html">BMS</a></li>


<script language="JavaScript1.4" type="text/javascript">
<!--
function jsPlay(soundobj) {
 var thissound= eval("document."+soundobj);
 try {
    thissound.Play();
 }
 catch (e) {
    thissound.DoPlay();
 }
}
function jsStop(soundobj) {
 var thissound= eval("document."+soundobj);
 try {
    thissound.Stop();
 }
 catch (e) {
    thissound.DoStop();
 }
}
//-->
</script>
```

IV. Analysis of AFI

The Accessibility for Independence is a very useful technique for visually handicaps and for persons who don't know English. It is implemented on Windows based Web Browsers

but can easily be extended to any platform. It can easily be applied on new as well as existing websites and no additional cost is required. End-User just has to visit the website as usual and he will experience an easily accessible environment with his regional language support.

V. Conclusion and Future Scope

There are few systems of such kind which are claiming to offer similar features as AFI but these are associated with some cost. The AFI is first initiative to offer safe, free and accessible web environment. Web Developers can easily implement the system and no additional training is required. WAGDTU is working to reduce the processing time of AFI and to aware web developers to follow this practical approach. On the other hand WAGDTU has introduced an alternative approach, which can be used easily with simple modifications.

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